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# ISTEC 2012

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Without the authors and participants ISTEC 2012 would of course have been impossible. We would like to sincerely thank all of you for coming, presenting and joining in the academic activities. We would also like to thank all of those who contributed to the reviewing process of the "ISTEC - 2012" conference papers.

We have lots of participants from 28 different countries. Some of these countries are Azerbaijan, Cyprus, Czech Republic, Hungary, India, Iran, Italy, Jordan, Latvia, Lebanon, Malaysia, Morocco, Pakistan, Serbia, Saudi Arabia, Slovakia, South Africa, United Arab Emirates, United Kingdom, Thailand, Republic of China and The United States.

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# A STEM WON'T GROW WITHOUT SUN SHINE! SHEDDING TRADITIONAL UNIVERSITY APPROACHES FOR NOVEL PRACTICES TO ADDRESS THE CHALLENGES OF STEM FOR *ALL*

Colleen Sexton

In FY10 the US Government invested \$3.4 Billion in Science, Technology, Engineering and Mathematics (STEM) education initiatives with the major portion of funds to support STEM careers and STEM Degrees. While those who earn STEM degrees are twice as likely to be employed as those with non-STEM degrees, most recent figures indicate that globally only 26% of college degrees are in STEM areas. Efforts to increase graduates in these fields include an increased emphasis on STEM education in grades K-12. Many nations have undertaken changing national science curricula to place a growing emphasis on conceptual understanding across the applied sciences. The revised standards are calling for an in-depth understanding of the practices of science and engineering and a call for increased connections among the theory and the practice. This paper maintains that the return on investment in STEM education requires universities to Shed their traditional University approach to student selection, degree offerings, and course sequencing to introducing more Novel practices grounded by the research on high impact practices for higher education to best address the challenges of STEM education for all K-12 students.

## Introduction:

Back in 1996, when the US National Research Council first presented a set of national science standards for K-12 students, I traveled across the state of Ohio with a colleague to provide workshops for K-12 School Administrators designed to examine the new standards and share strategies on how to implement them across the K-12 curriculum. Before any “lectures” were given we provided the administrators with 3 simple pieces of equipment, a wire, a “D” dry cell (some may call a D Battery), and a small flashlight sized light bulb, and challenged them to see how many ways they could make the bulb light. We asked them to draw the configuration of bulb, wire and battery they tried, prodding them to draw the ways in which the light lit and the ways in which it did not light, and to share those with the class. Using their drawings as “data” we developed the concept of a simple circuit. I remember the challenge this task presented to the school administrators, with some admitting they were embarrassed to put their drawings of attempts that did not work on the board. Yet, when asked how many in the room could provide a definition for a simple circuit if we had not completed that activity, it was not uncommon to find that more were comfortable in their attempt to provide a definition than to provide a deeper understanding of the concept.

In 1996 we used that simple activity as the basis for a conversation on effective application of the new science standards into teaching. Back then we spoke of the *dimensions of science* - those essential skills, habits, and dispositions necessary to bring about scientifically literate students. In my science education courses I use the example of using a table without legs, for what good is it without them? You might as well be eating off the floor. If you are teaching science as a body of knowledge in areas such as the life, physical and earth/space sciences without capturing the power of learning science through inquiry, understanding the history and nature of science, being able to apply the science concepts to personal and social perspectives, and understanding the interrelationships between the science and technology, then

science teaching, void of those four pillars, is akin to having a table without any legs. Basically it's useless.

The example we provided in our workshops was designed to provide the administrators with that “Aha!” moment – a quick example of the importance of integrating all dimensions of science into science teaching, teaching what we called *whole science*. On a parallel track with our call for teaching *whole science*, was the vast body of research on the importance of Science, Technology, Engineering and Mathematics (STEM) Education. STEM research could be tracked back to the 1945 study by Vannevar Bush – *Science, the Endless Frontier*, which called for growing scientific “capital” by training people in science based on their ability (Atkinson and Mayo, 2010). So with this increase in attention to all dimensions of science it was disappointing to find that between 1997 and 2009 the number of high school students taking Advanced Placement tests in STEM areas grew very little (Atkinson and Mayo, 2010, p.25) with the exception of AP Statistics exams, which had an average annual growth rate of 109% over the 12 years. There was little growth in other STEM subjects with Computer Science AP tests showing the least growth of barely 1% per year. In terms of bachelor degrees awarded in STEM related fields there was a fairly steady growth rate of about 2% per year, about the same as the growth rate of non-STEM careers (36% STEM vs. 30% non-STEM), yet the difference in Masters degrees and Doctoral degrees was dismal with only 29% growth for the STEM Master degrees compared to non-STEM of 71% growth and 35% compared to 51% growth at the doctoral level for STEM vs. non-STEM degrees (Atkinson and Mayo, 2010, pg. 26).

By 2007 this call for increased STEM Education was strengthened by the signing of the America Competes Act which provided funding to support several initiatives for STEM programs (Thomas and Williams, 2010), and with the re-authorization of that act in 2010 came increasing demands for evidence that all of these expenditures made a difference in science education (National Science and Technology Council, Dec 2011). The call for increased participation in STEM fields was tied to the national economy. According to the US Department of Commerce, “STEM workers drive our nation’s innovation and competitiveness by generating new ideas, new companies and new industries. However, US businesses frequently voice concerns over the supply and availability of STEM workers. Over the past 10 years growth in STEM jobs was three times as fast as growth in non-STEM jobs” (July 2011). As was noted by the *National Governors Association Center for Best Practices* “The average annual wage for all STEM occupations was \$77,880 in May 2009, significantly above the U.S. average of \$43,460 for non-STEM occupations” and “In 2010, the unemployment rate for STEM workers was 5.3 percent; for all other occupations, it was 10 percent” (NGA Center for Best Practices, Dec 2011, p.4).

It was inevitable that the 1996 science standards and the ever growing body of STEM funded initiatives would eventually come together to influence the *Next Generation Science Standards* which are currently in development. The Framework for K-12 Science Education, released in draft form in July 2011, brings STEM Education front and center. The four dimensions of science from the 1996 standards are now incorporated into three: *Disciplinary Core Ideas, Crosscutting Concepts, and Practices*. This paper briefly examines what is meant by each dimension, explores factors which effect implementation, and challenges universities to apply what I will refer to as **SUN** shine practices - creating a **S**hift from **U**sual to **N**ovel practices – to promote STEM growth.

### ***A Framework for Science Education***

### Disciplinary Core Ideas:

Traditionally the teaching of science includes a large volume of information, examined at a superficial level. As a student moves through the grades they encounter more of the same content, with each year piling on more information. In the 2012 Framework this traditional view of science content is replaced with **Disciplinary Core Ideas**. According to Achieve Inc. (2011):

Disciplinary Core Ideas have the power to focus K-12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four:

1. Have **broad importance** across multiple sciences or engineering disciplines or be a **key organizing concept** of a single discipline;
2. Provide a **key tool** for understanding or investigating more complex ideas and solving problems;
3. Relate to the **interests and life experiences of students** or be connected to **societal or personal concerns** that require scientific or technological knowledge;
4. Be **teachable** and **learnable** over multiple grades at increasing levels of depth and sophistication.

This new challenge for the creation of disciplinary core ideas has also changed what was considered the traditional smattering of science courses offerings at the K-12 level. While the typical life, earth/space and physical science offerings are still present a fourth domain of science is now introduced to capture engineering, technology and applications of science. As noted in *A Framework for Science Education: Practices, Crosscutting Concepts, and Core Ideas* (National Research Council (NRC), 2012) “Engineering and technology are featured alongside the natural sciences (physical sciences, life sciences, and earth and space sciences) for two critical reasons: 1) to reflect the importance of understanding the human-built world and 2) to recognize the value of better integrating the teaching and learning of science, engineering, and technology” (p.2).

#### *Practices which effect implementation – letting the SUN shine*

As I noted in the telling of my experiences in teaching about the 1996 standards, with the exception of adding engineering, technology and the applications of science as a key science domain, the application of the disciplinary core continues to call for teaching with greater depth which over time deepens the students’ understanding of each field’s disciplinary core ideas. Assumed in this practice is that greater depth and less breadth is needed by *all* learners. This reflects the traditional “pipeline” view of science education, by adding more students into the pipeline, you’re bound to increase the number of STEM participants at the college level. Atkinson and Mayo (2010) believe this idea of *Some STEM for All* did little to increase participation in STEM areas in the years since 1996 and see little return on a large investment of federal money on STEM education using this approach. They advocate an *All STEM for Some* approach to the application of these future science standards.

At this point in time the feedback period on the first public draft of the Next Generation Science Standards has closed, with a promise for publication of the next version in late fall 2012. Perhaps the suggestion of Atkinson and Mayo, to move from *Some STEM for All to All STEM for Some*, will be reflected in a second version of the standards. Whether a vision of more depth and less breadth is reflected in the standards for *Some or ALL* students, there are practices and strategies found in the

research which will require a shift from usual to novel practices to promote STEM growth to address the **Disciplinary Core Ideas**.

A call for greater depth of understanding merged with the idea of *All STEM for Some* can be seen in the America Competes Act from 2007 and in the re-authorization of that act in 2010. In both, funds have been allocated to establish and maintain schools designed to meet the needs of the academically talented student in STEM areas. Many residential secondary schools have been established to promote exploration of STEM concepts in greater depth. Some, such as the Illinois Mathematics and Science Academy, have created outreach programs to also impact the depth of experiences in these areas with professional development opportunities for teachers. Students who attend these schools rated their research skills very highly. In a study by Thomas and Williams (2010) they found that these same students tend to rate their high schools more favorably than their college experiences “in terms of instructors’ expertise in teaching and instructors’ attention to students” (p. 20). In a study by Subotnik, et.al. (2010) they found that students who attended specialized secondary schools where opportunities for conducting research in STEM areas in “top laboratories with enthusiastic mentors and teachers” were often disappointed in their undergraduate experiences where they encountered less than supportive climate for undergraduate research.

Why not shake-up the normal procedures and approach a STEM curriculum in a novel way? A suggested SUN shine practice would be to remove the concept of sequencing all courses through the use of the traditional “pipeline” practice of learning this bit of content first and then building on it with another bit of content and then another which does little other than to perpetuate the notion that each discipline has discrete bodies of knowledge to be learned and mastered before the entire discipline is revealed. If the move from discrete bodies of knowledge is to be replaced with **Disciplinary Core Ideas** then at the university level, we must rethink how we offer students opportunities to explore the concepts related to the STEM disciplines. We should provide opportunities for undergraduate students to engage in research that has real world consequences. Atkinson and Mayo (2010) go even as far as suggesting we create “new kinds of STEM colleges and programs” which move “undergraduate and graduate education towards a more interdisciplinary model which would attract more students to STEM” (p.12). They suggest that the National Science Foundation and the National Institute of Health should allocate grants up to \$20 M/year to create this institutional transformation.

Another area of research which may lend credence to the call for *All STEM for Some* was the study of gifted K-6 learners. In a study by Mann, et.al. (2011) at Purdue University, the researchers examined the traits essential to successful engineers as compared to traits of children identified as gifted. The similarities are striking as each list includes traits such as love of learning, strong analytical skills, creative or imaginative, and problem solvers. In examining the similar traits the researchers call for practices in STEM teaching which will challenge the gifted learner and encourage their opportunities to engage in the Engineering Design process. They point to the engineering practice of using models to explain phenomenon and provide opportunities to develop mathematical and design skills. While these practices can work for gifted K-6 children they can also work for students in engineering classes. Another SUN shine practice would be to use “Model-Eliciting Activities” in undergraduate engineering education which can be used to meet the Accreditation Board for Engineering and Technology’s (ABET) Criterion 3 Program Outcome which “stresses the need for engineering graduates to be able to function on multidisciplinary teams, understand professional and ethical responsibilities associated with the

discipline, and to assess the impact of engineering solutions in global, economic, environmental and societal contexts” (Mann, et.al, 2011, p.646). In another study completed by Tolley, et.al. (2012) they found another SUN shine practice to retain freshmen engineering students as they move through their first set of engineering courses was to make use of a web based software to refresh the mathematics skills of the students while in the course. While the technology did not change the mathematics performance of the students in the study over the non-users it was useful in “eliminating the gap in incoming academic preparation and was a valuable tool for refreshing basic mathematics skills and for enhancing mathematics self-confidence” (p. 82).

Another way of spreading SUN shine on university practices to impact the need for greater depth in teaching science concepts is for universities to continue in their participation of science curricula development for the K-12 schools. For instance, at the University of California, Berkeley, the Lawrence Hall of Science (2012) has consistently contributed to this effort through their creation of research based science curricula which reflect the best practices of science teaching. Curricula such as *GEMS – Great Explorations in Math and Science*, *FOSS- Full Option Science System*, provide teachers with complete units for teaching which capture the criteria established for the **Disciplinary Core Ideas** in the Science Framework.

Universities can also apply SUN shine practices designed to deepen the understanding of STEM content through their required content courses for students in teacher preparation programs. In a study which analyzed the challenges new science teachers face, Davis, Petish and Smithey (2006) found that “preservice teachers for the most part, lack adequate understandings of science content” and that while they may have an adequate number of science courses “negative experiences with science can alienate new teachers from science, but positive experiences in traditional science courses may lead them to naïve understandings of the nature of science” (p. 617). If STEM education is to be deepened at the K-12 level then I suggest the universities revisit the traditional offering of science courses for the preservice teacher. A typical university requirement of science coursework for elementary (grades K-8) teachers is to take one biology, one chemistry and one earth/space or physics course with only one of the four having a required lab experience. It’s time to **Shake-Up** these **Normal** practices of requiring a general survey course in each of the traditional science disciplines. Where will these future STEM teachers at the K-8 level learn to implement **Disciplinary Core Ideas** if they have never been exposed to them in their own science preparation coursework? How many College of Engineering would allow an elementary education major to take one of their courses – even if it were just a survey course in the field? Where are the opportunities to examine the role of Computer Sciences to better implement the **Disciplinary Core Ideas**?

As was suggested by Atkinson and Mayo (2010) in their proposal to move towards a more interdisciplinary model for STEM programs, perhaps a baby step for universities to take is in the creation of some interdisciplinary STEM courses for the student in teacher preparation programs. Expecting students to study selected sciences in isolated bits and attempting to put them back together with little or naïve understandings of the nature of science will, as the research has shown, only contribute to children’s misunderstandings and false application of science concepts. Universities must take on this responsibility if we are ever to bring about proper science concept formation through the establishment of **Disciplinary Core Ideas**.

At the University of Nebraska, for example, faculty from the College of Engineering and Technology collaborated with faculty from the College of Education and Human Services to “introduce teachers to the work of engineers and to support them in using this information and related resources in the development and implementation of lesson plans, providing a viable way to infuse engineering into the K-12 curriculum” (Nugent, et.al., 2010, p. 14). At Ohio University the College of Education and the College of Engineering collaborated to develop a summer experience which allowed teachers to learn and apply gaming design principles alongside their middle school students and to convert these games into challenging science units for use with all of their students when back in the classroom (Franklin, et.al. 2009). In research conducted by Levin and Richards, in which pre-service teachers were taught to focus on student thinking, they found that preservice teachers were capable of learning to listen to how their students develop an understanding of science concepts and how they can use this to use their use of questioning to allow students to examine their understanding of the science concept (2011). At California Polytechnic State University, San Luis Obispo, they developed the Science Teacher and Researcher (STAR) program to recruit preservice science teachers from the STEM majors and instill in them a sense of prestige in science teaching as a career. They paired the students with scientist mentors and had them engage in research alongside their mentor. This preparation is designed to “promote the understanding of the nature of scientific discovery and engineering design, personal experience doing research, and inquiry based instruction” (Baker and Keller, 2010, p. 24). Their practices have increased retention of “teacher-scientists” for K-12 students through an emphasis on the **Disciplinary Core Ideas**.

#### *Summary of SUN shine Practices for **Disciplinary Core Ideas***

In summary, the advancement of the dimension of **Disciplinary Core Ideas** as articulated in the Framework for K-12 Science Education, can be addressed by Universities if they engage in SUN shine practices which include: 1) examining the appropriateness of the call for deeper understanding of science concepts through a *Some STEM for ALL vs. an ALL STEM for Some* approach to science standards; 2) using the lessons learned from the specialized secondary schools for STEM education by providing opportunities for undergraduate research, changing the sequencing of courses and perhaps even changing from a series of courses within one program to a set of integrated learning experiences throughout the entire program; 3) engaging in “Model-Eliciting Activities” in undergraduate engineering education which can be used to meet the ABET’s Criterion 3 Program Outcome; 4) using technology when possible to use refresh basic skills needed for deeper understanding of course content; 5) continuing their participation of science curricula development for the K-12 schools; 6) making changes in their required content courses for students in teacher preparation programs – which includes allowing non-STEM majors to take STEM courses; 7) and creating interdisciplinary courses or professional development opportunities for pre- and in-service educators.

#### **Crosscutting Concepts:**

If the Disciplinary Core Ideas are to be examined with any depth then it makes sense to stick with a few key concepts within each discipline and come to know them through concepts which transcend each of the science domains. For example, the suggested core ideas for the physical sciences are matter and its interactions; motion and stability: forces and interactions; energy; and waves and their applications in technologies for information transfer (NRC, 2012). Through the application of **Crosscutting Concepts** the ability to provide increasing depth of understanding for each of those core ideas can be achieved. As

the Framework emphasizes “these concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world” (Achieve, Inc. 2011, website).

The seven crosscutting scientific and engineering concepts included in the *Framework for K-12 Science Education* “begin with two concepts that are fundamental to the nature of science” (NRC, 2012, p.84): patterns and cause and effect: mechanism and explanation. The next crosscutting concept takes into account the “mathematical relationships among disparate elements” (NRC, 2012, p.85), that is scale, proportion and quantity. According to the *Framework for K-12 Science Education* the last four concepts “systems and system models; energy and matter: flows, cycles, and conservation; structure and function; and stability and change – are interrelated in that the first is illuminated by the other three. Each concept also stands alone as one that occurs in virtually all areas of science and is an important consideration for engineers as well” (NRC, p.85). Those of you familiar with the American Association for the Advancement of Science *Benchmarks for Science Literacy (1993)* may find this call for **Crosscutting Concepts** familiar as in that seminal report they were referred to as the “common themes” across the disciplines.

#### *Practices which effect implementation – letting the SUN shine*

As this dimension is tied to promoting increased depth of understanding the **Disciplinary Core Ideas** it makes sense to call for a shake-up in the traditional practices of the sequencing of courses from middle school through college as was previously discussed. Not only is it the sequencing of courses within the same discipline that create a barrier to increased depth of understanding the **Disciplinary Core Ideas**, but it is also the belief that a certain sequence of courses from other disciplines must be mastered before participation in advanced courses of other disciplines. The traditional approach to course sequencing presents challenges when using **Crosscutting Concepts** to promote increased depth of knowledge for the **Disciplinary Core Ideas**. Norton’s study on *The Use of Design Practice to Teach Mathematics and Science (2007)* is an example of the use of the **Crosscutting Concept** of *systems and system models* to overcome the notion that one had to be well versed in mathematics in order to engage in the creation of a useful artifact. His aim was to develop each student’s “ability to know, apply and explain mathematics concepts in applied design contexts, an experience a high level of excitement about learning mathematics” (p.25). A focus on mathematics concepts, physical science concepts, connected through the **Crosscutting Concept** of *systems and system models* occurred through a challenge to construct an amusement park ride. This lesson learned from an elementary example of providing an integrated learning experience could become a SUN shine practice in higher education in courses where students are given opportunities to examine the real world connections of the discipline through the application of a **Crosscutting Concept**.

Previously I suggested an interdisciplinary approach to STEM courses and programs to promote depth of understanding for the **Disciplinary Core Ideas**. While a radical idea like that may not be feasible on most college campuses, a “doable” strategy for integrating **Crosscutting Concepts** while teaching the **Disciplinary Core Ideas** can be found in the research of Norman, et.al. (2010) in which engineers and teachers collaborated to “integrate engineering contexts into science and mathematics content” (p. 434). As a result of their study in working with teachers to build these experiences they found that “teachers recognized the design process as an important component of engineering and mathematics and science are

integrated into the design process of engineering. Teachers also had come to understand the nature of the design process through their own experiences with the MEAs (Modeling-eliciting activities). Such change of teacher perceptions of engineering has impact on teachers thinking regarding using engineering as a context in teaching mathematics and science in the classroom” (p. 443). A study by Brown, et.al. (2012) suggests a similar SUN shine practice, that of teaming teachers who might skip over science content they don’t understand it or because they don’t have the knowledge to examine the content through the use of **Crosscutting Concepts**, with a technology teachers who have the knowledge and the materials to develop a deeper understanding of the **Disciplinary Core Ideas** through the lens of **Crosscutting Concepts**. Research by Becker and Park (2011) suggest that these integrative approaches may be more effective with young learners, although successful integration is possible at higher grade levels.

Another SUN shine practice which can be implemented to promote the use of **Crosscutting Concepts** is to examine the changing role of the teacher as mentor. Research by Subotnik, et. al. (2010), suggest that shift in instructional role, directly impacted student participation in STEM courses. As they noted, while the first set of teachers may help a person fall in love with a STEM subject, it is eventually the efforts of a *mentor-teacher* that lead to talent development. It is the teacher as mentor who can guide the student’s understanding of the **Disciplinary Core Ideas** through the lens of a **Crosscutting Concept**. A study by Stage and Kinzie (2009) found that the use of undergraduate student mentors and the use of a graduate student as “super leader” can have a similar impact.

Research on the “flipped” classroom suggests that the changing role of the student can also be used to promote use of **Crosscutting Concepts** to teach **Disciplinary Core Ideas**. In a “flipped” classroom the student is responsible for learning the content outside of the classroom. The time spent in class is for deeper discussions on conceptual understanding of the content. This strategy replaces the role of college professor as sage and lecturer, to a guide responsible for concept engagement during class time (Knewton website, 2011).

Another SUN shine practice to address the need to explore a science discipline in depth through the use of **Crosscutting Concepts** is to create Learning Communities for students. Learning Communities have been identified by the American Association of Colleges and Universities as a High Impact Practice (HIP) found to increase student retention and promote deep learning in the first year of college (Kuh, 2008). As noted by Kuh, “the key goals for learning communities are to encourage integration of learning across courses and to involve students with “big questions” that matter beyond the classroom.” While the research of Whalen and Shelley (2010) did not prove this practice to neither increase nor decrease retention or graduation rates for STEM majors, they did concede that it was an effective practice for non-STEM majors. At the University of Memphis, an initiative called MemphiSTEP included the use of learning communities to improve retention of STEM majors (Russomanno, et.al., 2010). Robert Morris University used a cohort model which practiced many of the same goals of a learning community to increase student retention in STEM disciplines throughout their program (Kalevitch, et.al., 2012).

#### *Summary of SUN shine Practices for **Crosscutting Concepts***

In summary, the advancement of the dimension of **Crosscutting Concept** as articulated in the *Framework for K-12 Science Education*, can be addressed by Universities if they engage in SUN shine practices which include: 1) changing the sequence of college coursework within and across disciplines, e.g. remove the need to take calculus before you can take an advanced physics course; 2) taking an

interdisciplinary approach to course creation or the integration of engineering contexts into science or math content; 3) changing the role of the teacher from sage to mentor; 4) increasing the use of peer mentors; 5) changing the role of the learner through implementation of a “flipped” classroom; and 6) creating Learning Communities.

### Science and Engineering Practices:

Since the pivotal 1957 event of the Russian’s launching of Sputnik the call for students *doing* science instead of just *reading* about what scientists do was sounded. The National Science Foundation invested millions in the development of science curricula which promoted a “hands-on” approach to science learning. The more successful of those programs incorporated “hands-on” practices with “minds-on” challenges which lead to an increase in science achievement, understanding of science process skills, and to a better understanding of the fundamental dispositions necessary for scientific explorations. A flaw in their success was that with less preparation for teachers on the implementation of the model curriculum, hands-on approaches became synonymous with “minds-off” science teaching. The 1996 NSE Standards attempted to rectify that notion by proposing strategies for teaching science which would best reflect the lessons learned from the early effective curricula. The call for addressing *Science as Inquiry* in one of the four pillars or dimensions of science required teachers to incorporate the use of basic and integrated process skills into their science lessons. In 2012 *the Framework for K-12 Science Education* is now challenging us to move away from just talking about science process or science as inquiry, to more accurately reflect the **Disciplinary Core Ideas** deepened in understanding through the application of **Crosscutting Concepts**. To achieve the depth of understanding they propose the use of the term **Practices**, instead of skills to “emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice” (Achieve, Inc., 2011). The practices proposed by the new Science Framework include: “1) asking questions (for science) and defining problems (for engineering); 2) developing and using models; 3) planning and carrying out investigations; 4) analyzing and interpreting data; 5) using mathematics and computational thinking; 6) constructing explanations (for science) and designing solutions (for engineering); 7) engaging in argument from evidence; and 8) obtaining, evaluating, and communicating information” (NRC, p. 42).

#### *Practices which effect implementation – letting the SUN shine*

The ability to put to practice these **Science and Engineering Practices** at the K-12 level require an examination of what these look like in practice. Future teachers need opportunities to see these in practice and to apply them. One suggested SUN shine practice is to provide students with opportunities to explore STEM careers. There is much research which points to the fact that few students (pre-service teachers) know what STEM jobs entail, they see engineering as a cluster of professions and have little knowledge or understanding of the engineering method (Norman, et. al. 2010). The importance of teachers needing to better understand STEM careers is shared in the research of Subotnki, et. al. (2010). They noted the finding of a relationship between “eighth grade interest and completion of college majors in life or physical sciences, with those showing an interest in biology by eighth grade as being 1.9 times as likely to major in biology as those who did not. For physical science and engineering the difference was 3.4 times. ...roughly half the students who expected to participate in a science career when they were in eighth grade actually did major in science at the post-secondary level” (p.11). Feller (2011) calls for STEM-Centric career development so that today’s worker can keep pace with workplace demands. Fifolt and

Searby (2010) suggest that internship opportunities can provide the much needed exposure to the **Science and Engineering Practices**.

Closely tied to the exploration of STEM careers is a call for universities to increase collaboration with industry to better develop a students' understanding of **Science and Engineering Practices**. These collaborative relationships can be short term, such as an the use of a "virtual" or "classroom visit" of a visiting scientist or engineer; a summer experience through work with a practicing scientist or engineer; or they can require a long term commitment, such as the pairing of a student (at the secondary, undergraduate and graduate level) with a research scientist from an industry such as the *Learning to Engineer* initiative sponsored by Boeing (Stephens & Richey, 2011).

Another SUN shine practice to address the need to understand **Science and Engineering Practices** is to increase the use of role models. Basically this call comes out of the research on Women in Science and in examining the role culture plays in women's participation in science. Xu and Martin (2011) studied the importance of *informal professional networks* for women faculty in traditionally male dominated STEM fields. Their research indicated that participation in these networks contributed to work satisfaction and persistence to stay in STEM careers. Milgram's (2011) study of the CalWomen Tech Project, reinforced this finding by stressing that recruitment efforts of women in STEM careers should include the message that "women can work in STEM careers and be successful and fulfilled in their work life while still having a personal life, and they need to receive this message repeatedly" (p. 5). The work of Gallaher and Pearson (2000) examined the dispositions of women compared to men in STEM careers, expecting to find a difference in dispositions toward competition. Much to their surprise they found that women in STEM careers found competition to be "enjoyable and felt it promotes learning, and helps encourage collegial relationships" suggesting that these may be traits of women who choose engineering technology careers.

A final SUN shine practice for universities to assist in developing a better understanding of **Science and Engineering Practices** is to take a greater role in the development and delivery of informal science experiences. Many research institutions have museums which can be used to promote an understanding of **Science and Engineering Practices**. A quick survey of major US institutions shows that the majority of campus museums are Art Museums. This does not mean that we dismiss their value to the exploration of **Science and Engineering Practices**, in fact, an example of their importance to these practices occurred at the University of Florida's Harn Museum of Art where their most recent "Art in Engineering night brought 792 people to celebrate the creativity of engineering students and faculty. They sang, danced, fashioned games for children and showcased their paintings, photographs, race cars, robots and other engineering projects. The engagement of engineers with the arts on campus reflects their inherent interest in creative endeavors" (Nagy, 2012, blog post). The College of Engineering at this university understands the importance of providing students with experiences in "visual and performing arts ...to ignite their (students) creativity, leading to better engineering solutions and to products that have aesthetic appeal in a competitive global arena. ...they put the STEAM in STEM (Science Technology, Engineering, ART, and Math)" (Nagy, 2012). At my own university the mathematics professors have made use of the University Sculpture Park to explore practical applications of mathematics concepts and the science educator collaborated with the Art professor to developing integrated science activities for junior high teacher classroom use before, during and after a visit to the park. Other types of informal science activities include after school programs, field trips, development of curricular materials used with

organizations such as 4-H or Future Farmers of America (FFA) to provide additional experiences with **Science and Engineering Practices** (Thomasian, 2011).

#### *Summary of SUN shine Practices for Science and Engineering Practices*

In summary, the advancement of the dimension of **Science and Engineering Practices** as articulated in the Framework for K-12 Science Education, can be addressed by Universities if they engage in SUN shine practices which include: 1) providing students with opportunities to explore STEM careers; 2) increasing internship opportunities in STEM fields; 3) collaborating with industry in short and longer termed projects; 4) increasing role models so that *all* learners can see themselves in the career; and 5) participating in the development and delivery of informal science experiences.

#### **Conclusion:**

The United States is currently in the process of revising science education standards to more accurately reflect the connections between science, technology, engineering and mathematics – commonly referred to as STEM education. The current Framework for K-12 Science Education incorporates three dimensions for furthering STEM Education for all. These include: *Disciplinary Core Ideas, Crosscutting Concepts, and Science and Engineering Practices*. This framework is the basis for the development of the Next Generation Science Standards – referred by many as the *Common Core for Science Education*. Most initiatives for implementation of standards typically focus on teacher preparation and what K-12 classroom teachers must do to effectively implement the standards. This paper maintains that if STEM education is to grow, then SUN shine practices must be implemented at the University level. That is we must create a Shift from Usual to Novel practices in higher education to promote STEM growth. Some of the SUN shine practices require a fundamental shift in the way in which universities are structured, moving from separate silos of colleges operating alone and in some cases using valuable resources to replicate efforts, to a structure where more integrative approaches in program and course design can be delivered. Others practices require a modest use of university resources such as providing professional development opportunities for university faculty to learn how to “flip” their classroom or for university graduate students to enhance their pedagogical skills to better serve as leaders or mentors for the undergraduate in STEM programs. Internships and establishing relationships with industry to provide models for the application of Science and Engineering Practices also require a modest use of university resources. Other suggested SUN shine practices require little use of resources other than the use of creative thinking of university professors and their desire to increase role models for *all* students in STEM courses, to use model-eliciting activities to teach disciplinary core ideas, and to incorporate crosscutting concepts to increase the depth of understanding of core ideas.

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# 23 EKİM 2011 VAN DEPREMİNDE HASAR GÖRMÜŞ BİR YAPIDA GÜÇLENDİRME MALİYETİNİN YENİDEN YAPIM MALİYETİ İLE KARŞILAŞTIRILMASI

## A COMPARISON OF STRENGTHENING COST TO RE-CONSTRUCTION COST OF A BUILDING THAT HAS BEEN DAMAGED DUE TO 2011 VAN EARTHQUAKE

Ercan IŞIK<sup>1</sup>, Mustafa KUTANİS<sup>2</sup>, Muhammed Hamidullah ÖZLÜK<sup>3</sup>

<sup>1</sup>Bitlis Eren Üniversitesi, Müh.- Mim. Fakültesi, İnşaat Müh. Bölümü, [ercanbitliseren@gmail.com](mailto:ercanbitliseren@gmail.com)

<sup>2</sup>Sakarya Üniversitesi, Mühendislik Fakültesi, İnşaat Müh. Bölümü, [kutanis@sakarya.edu.tr](mailto:kutanis@sakarya.edu.tr)

<sup>3</sup>İnş. Müh., Bitlis Eren Üniversitesi, Yapı İşleri Teknik Daire Başkanı, [mholzluk@beu.edu.tr](mailto:mholzluk@beu.edu.tr)

### ÖZET

*Yapılar, servis ömürleri boyunca çok farklı nedenlerden dolayı onarılmakta veya güçlendirilmektedir. Bu nedenlerden biri depremdir. 23.10.2011 günü, yerel saat 13:41'de Van merkezli oluşan Mw: 7.2 büyüklüğünde depremden Bitlis İli, Adilcevaz ilçesinde bulunan Adilcevaz Meslek Yüksekokulu binası ciddi bir şekilde etkilenmiştir. AFAD ekipleri tarafından yapılan incelemede bina orta hasarlı olarak değerlendirilmiştir. İlgili kurum tarafından yapı ile ilgili yapılan detaylı incelemeler sonucu yapının güçlendirilmesine karar verilmiştir. Yapı ile ilgili güçlendirme projeleri hazırlanmış ve uygulamaya geçirilmiştir. Bu çalışmada yapının güçlendirme maliyeti ve yeniden yapım maliyeti ayrı ayrı hazırlanmış olup sonuçlar karşılaştırılmış ve öneriler getirilmiştir. 2011 yılı birim fiyatları ile yapının yeniden yapım maliyeti 3.122.900,00 TL ve yapının güçlendirme maliyeti ise 528.978,40 TL olarak hesaplanmıştır. Bu sonuçlara göre yapının güçlendirilmesi ekonomik olmaktadır. Hesaplanmış olan güçlendirme maliyeti yeniden yapım maliyetinin yaklaşık %20'si kadardır.*

**Anahtar Kelimeler:** Van depremi, Güçlendirme, yapım maliyeti,

### ABSTRACT

Buildings have been repaired or strengthened for many different reasons throughout of their service life. There can be many reasons for repairing or strengthening buildings. Earthquake is one of these reasons. A destructive earthquake happened at 13:41 in 23.10.2011 in Van of which Mw:7.2. The earthquake has been felt in some settlements, especially in Lake Van Basin where earthquake has always been neglected. The building that used as Adilcevaz Vocational High School has been affected seriously after the earthquake. This building have been confirmed as moderately damaged by AFAD teams. The institution has decided to stengthening the building after detailed analysis of building. The strengthening projects of building has been prepared and implemented. In this study strengthening cost and re-construction cost have been separetely calculated. The results have been compared and suggestions have been made. The construction costs of the Adilcevaz Vocational High School building has been calculated according to the unit production method using the unit prices of 2011. As a result, the construction costs of this building with the prices of 2011 has been found to be TL 3.122.900,00, the cost of strengthening is TL 528.978,40 and the strengthening cost is also found to be almost reaching 20% of the construction costs.

**Keywords:** Van erthquake, strengthening costs, re-construction costs

### 1-Giriş

Hasarlı veya hasarsız yapıların taşımakta olduğu ve muhtemel servis süresi boyunca üzerine etkiyebilecek deprem, rüzgar gibi yüklere karşı performanslarının artırılması amacı ile yapılan müdahalelere yapı güçlendirilmesi denilmektedir. Depremden sonra binalardaki hasarın tespit edilmesi ve hasar derecesine göre onarım ve güçlendirme veya yıkıma karar verilmesi önemlidir. İyi projelendirilmemiş veya uygulamasında özen gösterilmemiş binalarda hasar meydana gelme olasılığı, deprem şiddetine bağlı olarak yüksektir (Celep, 2007). Ülkemiz bu konuda yaşadığı acı tecrübelerden dolayı ciddi bir bilgi ve birikime sahiptir. Bu bilgilerin ışığında TDY 2007'nin Yedinci Bölüm'ü bu ihtiyaca cevap verecek niteliktedir.

Güçlendirme maliyetinin doğru hesaplanması yapı ile ilgili alınacak kararları doğrudan etkilemektedir. Güçlendirme işleminin ekonomik anlamda değer kazanması için yeniden yapım maliyeti ile karşılaştırılması gerekmektedir. Binaların güçlendirilmesi hassas bir iş olup, süreç yapının değerlendirilmesi ile başlamaktadır. Mevcut bir yapının değerlendirilebilmesi için öncelikle yapı hakkında temin edilebilecek her türlü verinin toplanması gereklidir. Bunlar, mevcut binaların taşıyıcı sistem elemanlarının kapasitelerinin hesaplanmasında ve deprem dayanımlarının değerlendirilmesinde kullanılacak eleman detayları ve boyutlarından, taşıyıcı sistem geometrisine ve malzeme

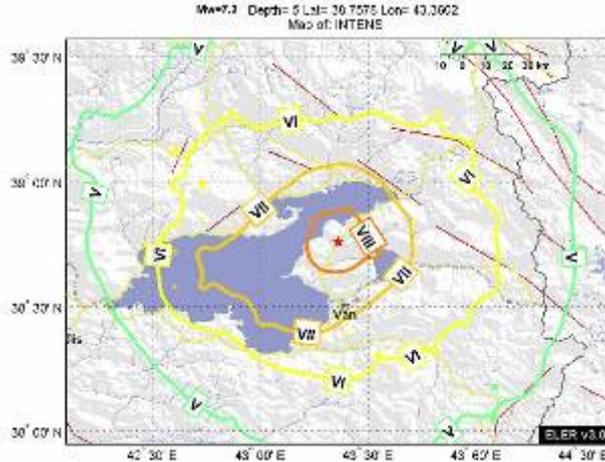
özelliklerine ilişkin bilgilerden, binaların projelerinden ve raporlarından, binada yapılacak gözlem ve ölçümlerden, binadan alınacak malzeme örneklerine uygulanacak deneylerden elde edilmektedir. Bu bilgiler ışığında yapılacak değerlendirme sonucunda binanın güçlendirilmesinin uygun olabileceği görüşü hakimse bina sahiplerinin isteği doğrultusunda binanın güçlendirme projeleri hazırlanmalıdır. Bu aşamada hazırlanan projeler ile yapım maliyeti analizi yapılarak bir karar verilmelidir. Buradaki en önemli kriter güçlendirme maliyetinin yeniden yapım maliyetinin altında veya üstünde olması durumudur. Eğer güçlendirme maliyeti yeniden yapım maliyetinin %40'nın altında kalıyorsa "güçlendirme uygundur", %40'ını aşması durumunda yıkımına karar vermek daha rasyonel bir tercih olacaktır. .

Bitlis ilinin de içinde olduğu Van Gölü Havzası, Doğu Anadolu'da oldukça şiddetli deformasyonlara uğramış bir tektonik yapı içersindedir. Aynı zamanda önemli ve kural dışı neotektonik unsurlar mevcuttur. Van Gölü havzasında meydana gelecek yıkıcı depremler bu havzada bulunan Bitlis şehir merkezi ve ilçelerini yakından etkileyecektir (Işık, 2010). Bu bağlamda 23 Ekim Van depreminin merkez üstü olan Van Merkez Tabanlı köyüne yaklaşık 65 km mesafede olan Adilceviz en fazla etkilenen yerleşim birimleri arasında yer almaktadır (Şekil 1). Bu çalışmada depremin Adilceviz ilçesindeki etkileri göz önünde bulundurularak, Bitlis Eren Üniversitesi'ne bağlı olarak faaliyetlerini sürdürmekte olan ve Van depreminde hasar alan Adilceviz Meslek Yüksekokulu için hazırlanan güçlendirme maliyeti ile yeniden yapım maliyeti karşılaştırılarak güçlendirme işleminin uygun olup olmayacağı tartışılarak öneriler getirilmiştir.



Şekil 1. Çalışma alanının deprem üssüne uzaklığı

23 Ekim Van depremi depremsellik ögesi ihmal edilen Van Gölü havzasında yer alan Adilceviz İlçesinde de yoğun bir şekilde hissedilmiştir (Şekil 2).



Şekil 2. 23 Ekim Van depreminin şiddet haritası (Koeri, 2011)

## 2- İncelenen Yapı ve Gözlemlenen Hasarlar

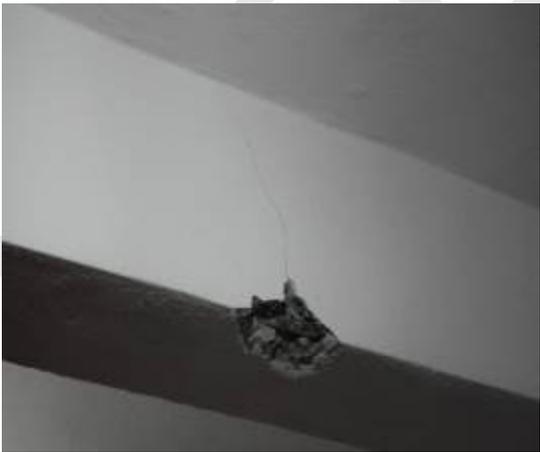
Özellikle son yıllarda dünyada ve ülkemizde oluşan yıkıcı depremler ve bu depremler sonucunda oluşan büyük çaplı can ve mal kayıpları deprem konusunda yapılan çalışmaları, araştırmaları ve alınacak önlemlerin önemini gündeme getirmiştir. Bir bölgede meydana gelebilecek bir depremde, bölgede bulunan yapıların olumsuz özellikleri oluşabilecek tehlikenin boyutunu arttıracaktır. Yapıların savunmasızlığı arttıkça depremin oluşturacağı hasar miktarı da artacaktır. Depremin büyüklüğü ve yeterli düzeyde güvenliği sağlanmamış ve yönetmeliklerde belirtilen şartlara uygun yapılmayan yani olumsuz yapı özellikleri, oluşabilecek zararı doğrudan etkileyecektir. Türkiye genelinde mevcut binaların çok az bir kısmı yönetmeliklerin şartlarını sağlayabilecek durumdadır ve bu nedenle sahip olmaları gereken emniyette değildirler.

Bu çalışmada incelenen bina Bitlis ili, Adilcevaz ilçesi, Alacaatlı Mahallesi'nde bulunan ve 1996 yılında inşa edilen Adilcevaz Meslek Yüksekokulu'dur. Bina dilatasyon derzleri ile birbirinden ayrılmış 3 adet bloktan inşa edilen zemin + 3 normal kattan oluşmaktadır. Bina boyutları 18.70m x 66.80m'dir. Binanın taşıyıcı sistemi karkas olup; betonarme perde, kolon, kiriş ve döşemeden oluşmaktadır. Binanın temel sistemi iki yönlü mütemadi temel olarak inşa edilmiştir. Binanın kat yükseklikleri zemin katta 4m, diğer katlar ise 3.2m'dir (Şekil 3).



Şekil 3: Adilcevaz Meslek Yüksekokulu binası

Binada bulunan kirişlerin çoğunda özellikle mesnet bölgelerinde kılcal boyutta eğik kesme çatlakları oluşmuştur. Betonarme çerçeve ile dolgu duvarları arasında sıva çatlakları oluşmuştur (Şekil 4).





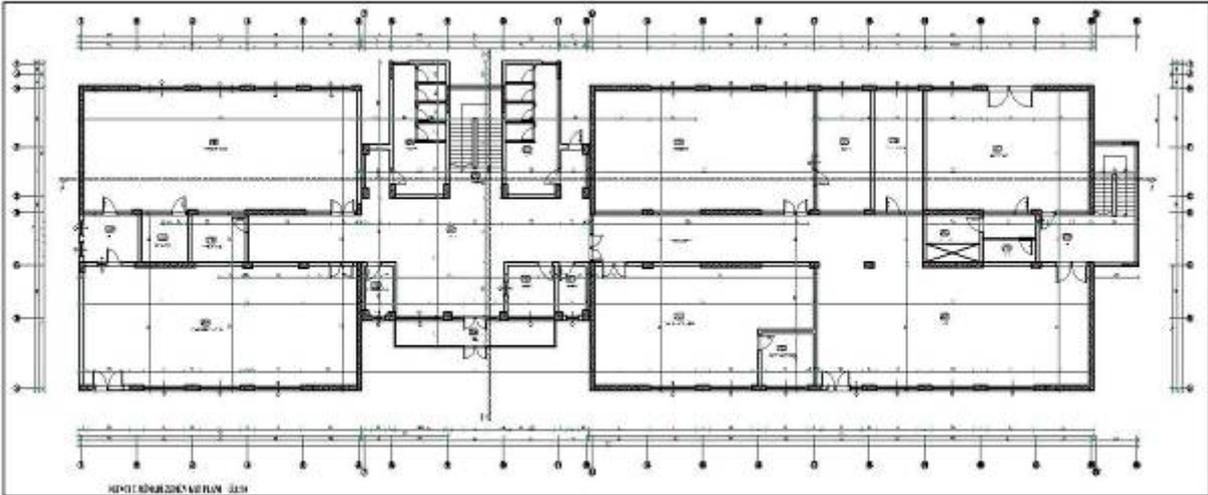
Şekil 4: Adilcevaz MYO binasında gözlemlenen hasarlar

### 3. Okul Binası Yeniden Yapım Maliyetinin Bulunması

Bir yapının toplam maliyeti; ihtiyacın belirlenmesi ile başlayan, yapının servis ömrü boyunca devam eden ve servis ömrünün sona ermesi ile ortadan kaldırma maliyeti de dâhil tüm süreçlerde yapılan harcamalardan oluşan maliyet olarak ifade edilebilir (Özgan, 2007).

Herhangi bir inşaata başlanmadan önce yapı maliyetinin çıkarılması işine ön keşif ve keşif sonunda bulunan değere de yaklaşık maliyet denilmektedir. Projeler hazırlanmadan veya proje hazırlığının ilk aşamalarında, yapının toplam inşaat alanı ve inşaat niteliği ile ilgili bazı ön tespitler yapılarak ve bazı kabullere dayanılarak yaklaşık yapı

maliyeti hesaplanabilmektedir (Pancaracı, 2002). İncelenen yapının inşaat alanı hesaplanırken zemin kat planı ve yerinde ölçümler dikkate alınmıştır (Şekil 5).



Şekil 5. Adilcevaz MYO güçlendirme öncesi zemin kat kalıp planı

Adilcevaz MYO binasının yeniden yapım maliyeti birim alan maliyeti yöntemi ile hesaplanmıştır. Bayındırlık ve İskân Bakanlığı (mülga) tarafından 28 Nisan 2011 günü 27918 sayılı Resmi Gazete’de yayınlanan tebliğine göre binanın birim maliyeti, Mimarlık ve Mühendislik Hizmet Bedellerinin hesabında kullanılacak 2011 Yılı yapı yaklaşık birim maliyetlerindeki IV sınıf A grubu yapılar içinde yer alan eğitim yapıları için belirlenen 625.00 TL/m<sup>2</sup> esas alınmıştır. Kat sayısı, kat alanı, toplam bina alanı hesap edilmiş ve birim maliyetle çarpılarak binanın toplam maliyeti bulunmuştur. Bulunan bu değerler Tablo 1’de verilmiştir.

Tablo 1: Adilcevaz MYO okul binasının toplam yeniden yapım maliyeti

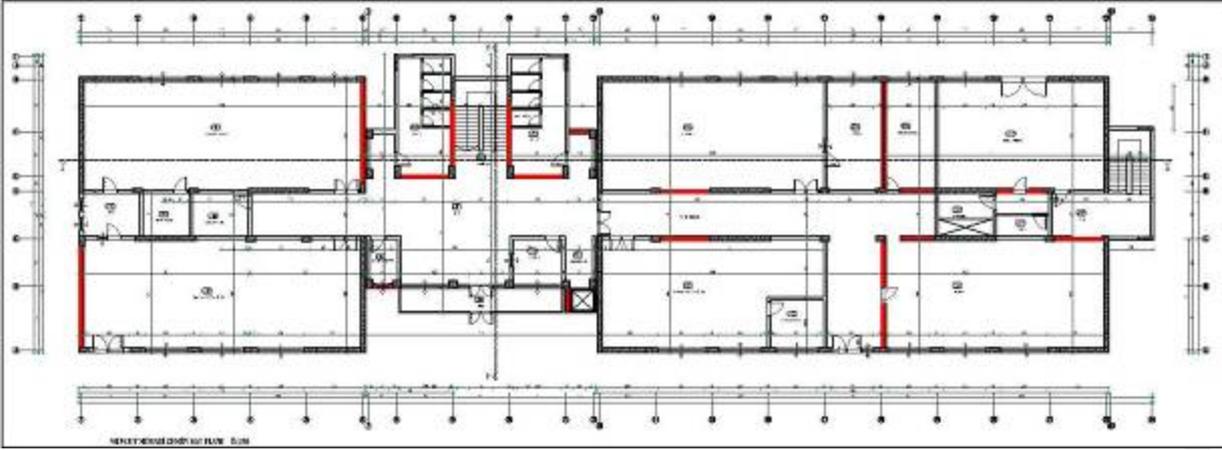
| Kat Sayısı   | Zemin Kat Alanı (m <sup>2</sup> ) | Normal Katlar Alanı (m <sup>2</sup> ) | Toplam Alan (m <sup>2</sup> ) | Toplam Yapı Mal (TL/m <sup>2</sup> ) | Toplam Maliyet (TL) |
|--------------|-----------------------------------|---------------------------------------|-------------------------------|--------------------------------------|---------------------|
| Zemin +3 Kat | 1.249,16                          | 3.747,48                              | 4.996,64                      | 625                                  | 3.122.900,00        |

#### 4. Okul Güçlendirme Maliyetinin Bulunması

Yapıların onarılması ve/veya güçlendirilmesi, durum tespiti, mevcut hasarların nedenlerinin değerlendirilmesi, yapıda örnekleme yapılarak, hasar tiplerinin dağılımlarının önemlerinin belirlenmesi, temel ve zemin durumu, beton dayanımı ve kalitesi, yapının (betonarme kesitler, taşıyıcı olmayan duvar sistemleri, vs.) projeye uygunluğunun tespiti, yapının statik değerlendirilmesi (röleve çıkarılması, röleve ile projenin karşılaştırılması, taşıyıcı sistemin incelenerek yapının yeni kullanım amacı, proje gereksinimleri ve yönetmeliklere göre yeniden çözümlenerek, yapı güvenirliliği ve gereksinimlere ne ölçüde yanıt verdiğinin tespiti) gibi son derece zahmetli ve ayrıntılı çalışmalardan sonra ancak projelendirme aşamasına gelinebilen zorlu bir süreçtir ( Yılmaz, 2007).

Bu bağlamda Adilcevaz Meslek Yüksekokulu binası için açıklanan zahmetli ve ayrıntılı çalışmalar sonucunda TDY 2007’de belirtilen usul ve esaslara göre binanın performans analizi gerçekleştirilmiştir. Elde edilen sonuçlara göre binanın TDY 2007’de belirtilen performans seviyelerinin sağlanmadığı anlaşılmaktadır. Gerekli güçlendirme projeleri hazırlandıktan sonra binanın beklenen performans seviyelerini sağlayabileceği ve hasar yüzde ve seviyelerinin makul ölçülerde kalacağı sonucu elde edilmiştir ( Rapor, 2011). Detaylı güçlendirme projelerinin yapım maliyeti hesaplanmış olup uygulamaya başlanılmıştır

Adilcevaz Meslek Yüksekokulu binası için yukarıda anlatılan işlemler gerçekleştirilmiş ve uygulama projeleri hazırlanmıştır (Şekil 6).



Şekil 6: Adilcevaz MYO güçlendirme sonrası zemin kat kalıp planı

Güçlendirme maliyetinin gerçeğe yakın hesaplanması için düzenlenen güçlendirme projesinde belirlenen tüm imalatlar metrajlanarak hesaplanmıştır. Adilcevaz Meslek Yüksekokulu güçlendirme işine ait proje üzerinden her bir imalat kalemi için imalat miktarları ayrı ayrı tespit edilmiş olup toplam 30 kalem imalattan oluşmaktadır. Bu aşamada Tablo 2'de görüleceği gibi güçlendirme için 30 kalem imalatın miktarları bulunmuş ve 2011 yılı birim fiyatları ile çarpılarak toplamı alınmış ve güçlendirme maliyeti elde edilmiştir.

Tablo 2: Adilcevaz MYO Güçlendirme İşine ait İmalat İşleri (2011 yılı Birim Fiyatları ile)

| SIRA NO | POZ NO      | YAPILACAK İMALATIN ADI  | BİRİMİ | MİKTAR I | BİRİM FİYATI (2011 YILI) | TUTARI    |
|---------|-------------|---|--------|----------|--------------------------|-----------|
| 1       | 14.012/2    | ELLE YUMUŞAK,SERT TOPRAK DAR DERİN KAZI YAPILMASI   | M3     | 195.61   | 19.60                    | 3,833.96  |
| 2       | 14.018      | DOLGUNUN ELLE TOKMAKLANARAK SIKIŞTIRILMASI  | M3     | 210.41   | 5.33                     | 1,121.49  |
| 3       | 16.003      | 250 DOZLU DEMİRSİZ BETON  | M3     | 16.30    | 97.64                    | 1,591.53  |
| 4       | 16.058/1TAK | C25 GRANULOMETRİK KUM VE ÇAKILLA YAPILAN DEMİRLİ BETON TAKVİYE PROJELERİ İÇİN   | M3     | 230.30   | 237.28                   | 54,645.58 |
| 5       | 18.071/3    | Yatay delikli fabrika tuğlası (19x19x13.5 cm) ile 250 doz çimento harçlı yarım tuğla duvar yapılması  | M2     | 150.00   | 15.40                    | 2,310.00  |
| 6       | 18.183      | PATLAYICISIZ ÇİM. HARÇLI KARGIR, HOROSAN İNŞ. YIKIMI  | M3     | 197.70   | 35.63                    | 7,044.05  |
| 7       | 18.185      | PATLAYICISIZ DEMİRLİ DEMİRSİZ BETON İNŞAAT YIKIMI   | M3     | 32.60    | 73.63                    | 2,400.34  |
| 8       | 18.192      | HER TÜRLÜ İÇ SIVA SÖKÜMÜ  | M2     | 173.88   | 2.85                     | 495.56    |
| 9       | 18.465/1    | 3MM KALINLIKTA PLASTOMER ESASLI CAMTÜLÜ TAŞ.3MM KAL.PLAST.KEÇE TAŞ.POL. BİT.ÖRT.İKİ KAT. SU YAL.YAPILMASI   | M2     | 260.00   | 26.58                    | 6,910.80  |
| 10      | 21.011/TAK  | Düz yüzeyli çıplak beton ve betonarme kalıbı TAKVİYE PROJELERİ İÇİN   | M2     | 1,283.36 | 25.51                    | 32,738.51 |
| 11      | 21.054/TAK  | AHŞAP KALIP İSKELESİ TAKVİYE PROJELERİ İÇİN   | M3     | 1,668.37 | 4.34                     | 7,240.73  |
| 12      | 21.065      | İŞ İSKELESİ (DUVAR İÇİN)  | M2     | 2,513.70 | 3.88                     | 9,753.16  |
| 13      | 23.014/TAK  | Q8-Q12 MM NERVÜRLÜ DEMİR İMALATI TAKVİYE PROJELERİ İÇİN   | TON    | 16.36    | 2,685.00                 | 43,926.60 |
| 14      | 23.015/TAK  | Q14-Q26 NERVÜRLÜ DEMİR İMALATI TAKVİYE PROJELERİ İÇİN   | TON    | 13.10    | 2,471.25                 | 32,373.38 |
| 15      | 25.036/1    | AKRİLİK ESASLI MALZEME İLE DIŞ CEPHE BOYASI   | M2     | 2,159.06 | 10.19                    | 22,000.82 |
| 16      | 25.043/1A   | Eski plastik ve sentetik boyalı yüzeylere astar çekilerek iki kat su bazlı mat plastik boya yapılması   | M2     | 7,490.92 | 6.58                     | 49,290.25 |
| 17      | 25.048/1A   | Yeni siva yüzlerine 0,350 kg macun çekilerek iki kat su bazlı mat plastik boya yapılması  | M2     | 1,400.36 | 8.81                     | 12,337.17 |
| 18      | 26.021/MK   | YİVLİ RENKSİZ KAROSİMANLA DÖŞEME KAPLAMASI YAPMA  | M2     | 200.00   | 25.70                    | 5,140.00  |
| 19      | 26.502/MK   | BEYAZ ÇİMENTOLU, SUNİ MERMER PLAKLARLA DÖŞEME KAPLAMASI YAPILMASI.  | M2     | 987.20   | 43.86                    | 43,298.59 |
| 20      | 26.007/104C | 33 x 33 cm ebadında modüler ölçüde üretilmiş düz yüzeyli, her renk ve desende, sırlı porselen (granit) karolar ile fugalı duvar ve cephe kaplaması yapılması (fayans ve seramik yapıştırıcısı ile) sırlı porselen karolar ile döşeme ve duvar kaplamaları | M2     | 1,351.28 | 22.85                    | 30,876.75 |

|                           |            |  |    |          |          |                  |
|---------------------------|------------|--|----|----------|----------|------------------|
| 21                        | 27.531/1   | KİREÇ-ÇİMENTO KARIŞIMI HARÇLA DÜZ SIVA YAPILMASI     | M2 | 1,400.36 | 10.14    | 14,199.65        |
| 22                        | M.S.B.153  | BOZUK BETONARME YÜZEYLERİN TEMİZLENMESİ              | M2 | 173.88   | 11.88    | 2,065.69         |
| 23                        | MSB.158    | PASPAYININ KIRILARAK AÇIĞA ÇIKARTILMASI(TAK PROJE)   | M2 | 173.88   | 28.50    | 4,955.58         |
| 24                        | MSB.678/B1 | Q14 DÜZ VEYA NERVÜRLÜ DEMİRLE EPOKSİ İLE FİLİZ EKİMİ | AD | 2,706.00 | 10.75    | 29,089.50        |
| 25                        | MSB.678/C  | Q16 DÜZ VEYA NERVÜRLÜ DEMİRLE EPOKSİ İLE FİLİZ EKİMİ | AD | 720.00   | 11.51    | 8,287.20         |
| 26                        | MSB.678/E  | Q20 DÜZ VEYA NERVÜRLÜ DEMİRLE EPOKSİ İLE FİLİZ EKİMİ | AD | 96.00    | 14.02    | 1,345.92         |
| 27                        | MSB.678/F  | Q22 DÜZ VEYA NERVÜRLÜ DEMİRLE EPOKSİ İLE FİLİZ EKİMİ | AD | 1,280.00 | 14.89    | 19,059.20        |
| 28                        | MSB.678/G  | Q24 DÜZ VEYA NERVÜRLÜ DEMİRLE EPOKSİ İLE FİLİZ EKİMİ | AD | 1,096.00 | 16.72    | 18,325.12        |
| 29                        | ÖZF.01TAK  | ESKİ BETONUN YENİ BETON İLE ADERANSININ SAĞLANMASI   | M2 | 173.99   | 85.80    | 14,928.34        |
| 30                        | ÖZF.02.TAK | RÖTRESİZ GENLEŞME BETONU (TAK.PROJELERİ İÇİN)        | M3 | 11.11    | 4,265.83 | 47,393.37        |
| <b>SAYFA SONU YEKÜNÜ=</b> |            |  |    |          |          | <b>528,978.4</b> |

### 5. SONUÇ VE ÖNERİLER

Yöre; taşıdığı olumsuz jeolojik ve topografik faktörler nedeniyle depreme duyarlı değildir. Bugüne kadar izlenen yapılaşmada deprensellik ögesi büyük ölçüde ihmal edilmiştir. Ancak tektonik olarak son derece hareketli kuşaklar içerisinde kalan Van Gölü Havzası'ndaki yapılaşmalarda deprensellik faktörü göz önünde bulundurulmalı ve ilgili yönetmeliklere hassasiyetle uyulmalıdır. Yeni yapılaşmanın olacağı bölgelerde deprem etkileri göz önüne alınacak şekilde düzenlenmiş kent planlaması ve arazi kullanım düzenlemelerinin yapılması önem arz etmektedir. Ayrıca mevcut yapıların incelenerek gerekli önlemlerin alınarak deprem zararlarının azaltılması hayati önem taşımaktadır.

Adilcevaz Meslek Yüksekokulu binasının 2011 yılı fiyatları ile yeniden yapım maliyeti 3.122.900,00 TL, betonarme perde duvar ilavesi ve kolon mantolama yöntemi ile güçlendirme maliyeti yine aynı yıl fiyatlarına göre 528.978,84TL olarak hesaplanmıştır. Bu sonuçlara göre Adilcevaz Meslek Yüksekokulu'nda uygulanan güçlendirme yöntemi ile sınırlı kalmak koşuluyla; güçlendirme maliyetinin yeniden yapım maliyetinin yaklaşık %20'si kadardır.

Güçlendirilmesine karar verilecek her bina için ayrı detaylı inceleme ve ayrı mühendislik hizmeti görmüş güçlendirme gereklidir. Güçlendirme işlemi yapılırken her aşamada konusunda deneyim kazanmış ve mümkünse sertifikalı elemanların çalıştırılması binanın güçlendirilmesine anlam kazandıracaktır. Aksi takdirde güçlendirme sadece binanın kusurlarının kapatılması anlamına gelecektir.

Güçlendirme maliyetinin doğru hesaplanması yapı ile ilgili alınacak kararları doğrudan etkilemektedir. Güçlendirme işleminin rasyonel olması için yeniden yapım maliyeti ile karşılaştırılması gerekmektedir. Rasyonel olmayan güçlendirilmelerin yapılmasındansa derhal yitirilmesi daha ekonomik olacaktır.

Ülke ekonomisinin lokomotif sektörlerinin başında gelen inşaat sektörü, kamu kesiminin ve özel kesimin kaynaklarının büyük bölümü ile dışarıdan bulunan yabancı kaynakların büyük bölümünü tüketmektedir. Kaynakların verimli kullanılması kalkınma hamlelerinin temel eylemidir. Bu nedenle hasarlı veya hasar görebilecek yapıların güçlendirilmesine mi yoksa yeniden yapılmasına mı karar vermek için yapılan maliyet çalışmaları, uzmanlar tarafından hassasiyetle yapılmalıdır.

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## 23.10.2011 VAN DEPREMİNDE ORTA HASARLI BİNALARIN GÜÇLENDİRME TESPİT ÇALIŞMASI

Mustafa KUTANİS<sup>1</sup>, Ercan IŞIK<sup>2</sup>, Muhammed Hamidullah ÖZLÜK<sup>3</sup>

<sup>1</sup>Sakarya Üniversitesi, Mühendislik Fakültesi, İnşaat Müh. Bölümü, [kutanis@sakarya.edu.tr](mailto:kutanis@sakarya.edu.tr)

<sup>2</sup>Bitlis Eren Üniversitesi, Müh.- Mim. Fakültesi, İnşaat Müh. Bölümü, [ercanbitliseren@gmail.com](mailto:ercanbitliseren@gmail.com)

<sup>3</sup>İnş. Müh., Bitlis Eren Üniversitesi, Yapı İşleri Teknik Daire Başkanı, [mhozluk@beu.edu.tr](mailto:mhozluk@beu.edu.tr)

### ÖZET

23.10.2011 günü, yerel saat 13:41'de Mw: 7.2 büyüklüğünde Van merkezli büyük şiddette bir deprem meydana gelmiştir. Deprem, depremsellik ögesi sürekli ihmal edilen Van Gölü Havzasında başta Van ve Van iline bağlı Erçiş İlçesi olmak üzere yerleşim bölgelerinde hissedilmiştir. Yapısal hasarlar olarak en büyük kayıplar Van ve Erçiş'te görülmüştür. Deprem sonrasında yapılarda meydana gelen hasarların ilk tespiti ve değerlendirilmesi daha sonraki zamanlarda meydana gelebilecek can ve mal kayıplarının artmaması için önem arz etmektedir. . Bu çalışmada, söz konusu depremin Van İl merkezinde bulunan ve AFAD tarafından orta hasarlı olarak tespit ettiği betonarme yapıların bir kısmının tekrar yerinde yapılan incelemeler sonucu güçlendirilme yapıp yapılmaması yönünde sonuçlar elde edilmiştir. Bu çalışmada Van il merkezinde bulunan 40 adet orta hasarlı betonarme bina için bu değerlendirmeler yapılmıştır. İncelenen binalardan alınan beton numunelerinin ortalama dayanımı ise 13.43 Mpa olarak belirlenmiştir. İncelenen 40 adet BA binadan %50'sinin güçlendirmeğe değer, %30'unun TDY 2007 hükümlerine göre detaylı olarak incelenmesine ve %20'sinde güçlendirilmesinin uygun olmayacağı sonucuna varılmıştır.

**Anahtar Kelimeler:** Van depremi, Güçlendirme tespit çalışması

### 1-Giriş

Yapıların dayanımlarının artırılması gereği değişik nedenlerle ortaya çıkmaktadır. Projesinde ve yapımında hata, kusur ve eksiklikler olan yapının çeşitli elemanlarında zaman içinde hasar ve zayıflık belirtileri ortaya çıkabilir; yapıların kullanma amacının zaman içinde değiştirilmesi sonucu yapıda bazı taşıyıcı sistem değişikliklerinin yapılması gerekebilir. Bunlardan başka yapılarda onarım ve güçlendirmeyi gerektiren en önemli olay depremlerin yapılardaki etkileridir ( Bayülke, 1995). Depremden sonra binalardaki hasarın tespit edilmesi ve hasar derecesine göre onarım ve güçlendirme veya yıkıma karar verilmesi önemlidir. İyi projelendirilmemiş veya uygulamasında özen gösterilmemiş binalarda hasar meydana gelme olasılığı, depremin şiddetine bağlı olarak büyüktür. Bunun yanında, projelendirilmesi ve uygulamasına gerekli özen gösterilen binalarda da şiddetli depremlerde hasar meydana gelebilir. Bu nedenle, hasarın belirlenmesi ve devamında gerekli güçlendirmenin yapılması deprem mühendisliği ile inşaat mühendisliğinin önemli konularından biridir (Celep, 2004).

Son yıllarda depremlerde hasar gören yapıların güçlendirilmesi her geçen gün daha da önem kazanmaktadır. Depremlerden sonra hasar tespiti yapılarak, hasar düzeyi uygun olan yapıların güçlendirilmesi gerekmektedir. En önemli sorunlardan biride güçlendirme işlemleridir. Depremlerden sonra binalarda ilk olarak hasar tespiti yapılmalıdır. Çünkü binalarda hasar sınıfı (hafif-orta-ağır) belirlenmeden onarım ve güçlendirmenin olup olmayacağı ve bunun şeklinin belirlenmesi mümkün değildir. Hasar gören binaların güçlendirilmesi de ayrı bir mühendislik sorunu haline gelmiştir.

Bu çalışmada 23 Ekim 2011 Van depreminden sonra AFAD ekipleri tarafından orta hasarlı olarak tespit edilen binalarda tekrar hasar tespitinin yapılarak binalarla ilgili güçlendirilme yapıp yapılmaması yönünde sonuçlar elde edilmiştir.

### 3- Tektonik Yapı ve 23 Ekim 2011 Van Depremi

Türkiye'de güncel sismik aktivitenin yoğun olarak yaşandığı bölgelerden biri de Doğu Anadolu Bölgesidir. Doğu Anadolu Bölgesinin genel tektonik yapısı ağırlıklı olarak Bitlis Bindirme Zonu olarak bilinen deformasyon zonu boyunca Arap Levhası ile Anadolu Levhasının çarpışması ile kuzeye doğru hareketi ile kontrol edilmektedir (Şekil 1). Çarpışma, Karlıova Üçlü Birleşim noktasında birleşen sağ yönlü doğrultu atımlı Kuzey Anadolu Fayı ve sol yönlü Doğu Anadolu Fayı ile yönetilmektedir (Şekil 1). Bunun yanı sıra Karlıova Üçlü Birleşim noktasının doğusunda bu çarpışma sebebi ile çoğunlukla KB-GD doğrultulu sağ yönlü, KD-GB doğrultulu sol yönlü faylar bölgenin baskın elemanlarıdır. D-B doğrultulu Muş-Van Gölü ve Pasinler rampa havzaları Doğu Anadolu Bölgesinin göze çarpan diğer tektonik elemanlarıdır.

Doğu Anadolu Fayı, Türkiye'nin doğusunda Karlıova ile İskenderun Körfezi arasında KD-GB doğrultusunda uzanan, yaklaşık 550km'lik uzunluğa sahip sol yanallı doğrultu atımlı bir faydır (Şekil 1). Bitlis Bindirme Zonu, Güneydoğu Türkiye'den İran'daki Zagros dağlarına kadar uzanan, kıta-kıta ve kıta-okyanus çarpışma sınırı olarak tarif edilebilecek bir komplekstir. Karlıova üçlü birleşim noktasının doğusunda kalan alan K-G yönlü sıkışma tektonik rejimi ile karakterize edilmektedir (Şekil 1).





Şekil 3. Van Depreminin Merkez Üssü (USGS)

### 3. METODOLOJİ

Binaların güçlendirilmesi, deprem hasarlarına neden olacak kusurlarının giderilmesi, deprem güvenliğini arttırmaya yönelik olarak yeni elemanlar eklenmesi, kütle azaltılması, mevcut elemanlarının deprem davranışlarının geliştirilmesi, kuvvet aktarımında sürekliliğin sağlanması türündeki işlemleri içermektedir (TDY 2007). Betonarme bir yapıda deprem sonrasında hasar değerlendirilmesi yapının hemen kullanılıp kullanılmayacağı ya da onarım ve güçlendirmeye gerek olup olmadığı gibi kararların alınması amacı ile yapılmaktadır. Yapı hasarı, yapıdaki elemanlarının hasarına bağlı olarak belirlenebilir. Binaların güçlendirilmesi hassas bir iş olup, süreç yapının değerlendirilmesi ile başlamaktadır. Mevcut bir yapının değerlendirilebilmesi için öncelikle yapı hakkında temin edilebilecek her türlü verinin toplanması gereklidir. Bunlar, mevcut binaların taşıyıcı sistem elemanlarının kapasitelerinin hesaplanmasında ve deprem dayanımlarının değerlendirilmesinde kullanılacak eleman detayları ve boyutlarından, taşıyıcı sistem geometrisine ve ölçümlerden, binadan alınacak malzeme örneklerine uygulanacak deneylerden elde edilmektedir. Bu bilgiler ışığında yapılacak değerlendirme sonucunda binanın güçlendirilmesinin uygun olabileceği görüşü hakimse bina sahiplerinin isteği doğrultusunda binanın güçlendirme projeleri hazırlanmalıdır. Binalar ile ilgili tespitler yapılırken birçok parametreye bağlı olan karmaşık bir çalışma gerekmektedir. Onarılmasına ve güçlendirilmesine karar verilmesinin en önemli adımını bu çalışma oluşturmaktadır. Bu aşamada yapılacak yanlış veya eksiklik istenmeyen sonuçlara yol açmaktadır. Hasarlı binaların hasar sınıflarının doğru olarak belirlenmesi olası ikinci bir depremde oluşacak can ve mal kayıplarını olumsuz olarak etkileyecektir. Van il merkezinde bulunan Bayram oteli ikinci depremde göçmüş ve 25 kişi hayatını kaybetmiştir. Bu çalışmada 23 Ekim 2011 Van depreminden sonra Afet ve Acil Durum Başkanlığı (AFAD) tarafından orta hasarlı olarak tespit edilen binalar Van Valiliği ile imzalanan protokol gereği tekrar incelenmiştir. Çalışmada incelenen betonarme binalar için deprem afeti sonrası hasar tespit formu kullanılmıştır (Tablo 1). Bu form İstanbul Teknik Üniversitesi, Yıldız Teknik Üniversitesi ve Sakarya Üniversitesi tarafından ortaklaşa hazırlanan bina ile ilgili birçok parametreyi içermektedir. Bu form her bir bina için ayrı ayrı doldurulmuştur.

Tablo 1: Betonarme Binalar İçin Deprem Afeti Sonrası Hasar Tespit Formu

|   |  |  |  |  |  |
|---|--|--|--|--|--|
| <b>MAHALLE</b>  |  |  | <b>TARİH</b>   |  |  |
| <b>CADDE/SOKAK</b>  |  |  | <b>AFAD SIRA NO</b>  |  |  |
| <b>KAPI NO</b>  |  |  | <b>ÜNİVERSİTE KODU</b>                                     |  |  |
| <b>KULLANIM AMACI</b>   |  |  | <b>KAT BİLGİSİ</b>   |  |  |
| <b>YAPIM YILI</b>   |  |  | <b>TOPLAM KAT SAYISI</b>                                   |  |  |
| <b>KONUMU</b>   | <input type="checkbox"/> :0  | <input type="checkbox"/> :1 <input type="checkbox"/> :2<br><input type="checkbox"/> :3 <input type="checkbox"/> :4 | <b>PLAN GEOMETRİ</b>                                       |  |  |
|   | <input type="checkbox"/> :1 <input type="checkbox"/> :2<br><input type="checkbox"/> :3 <input type="checkbox"/> :4 |  | <input type="checkbox"/> :1<br><input type="checkbox"/> :2 |  |  |
| <b>BODRUM KAT ÇEVRE PERDE DURUMU</b>                                  |  |  | <b>GÖÇME DURUMU</b>  |  |  |
| <b>TAŞIYICI SİSTEM TÜRÜ</b>   |  |  | <b>KISA KOLON DURUMU</b>                                   |  |  |
| <b>YAPIDA AĞIR KAPALI ÇIKMA DURUMU</b>                                |  |  | <b>YUMUŞAK/ZAYIF KAT DURUMU</b>                            |  |  |
| <b>EN HASARLI KATTA İNCELENEBİLEN KOLONLAR VE PERDELER İÇERİSİNDE</b> |  |  |  |  |  |
| <b>AĞIR HASARLI KOLON SAYISI</b>                                      |  |  | <b>AĞIR HASARLI PERDE SAYISI</b>                           |  |  |
| <b>ORTA HASARLI KOLON SAYISI</b>                                      |  |  | <b>ORTA HASARLI PERDE SAYISI</b>                           |  |  |
| <b>HAFİF HASARLI KOLON SAYISI</b>                                     |  |  | <b>HAFİF HASARLI PERDE SAYISI</b>                          |  |  |
| <b>HASARSIZ KOLON SAYISI</b>  |  |  | <b>HASARSIZ PERDE SAYISI</b>                               |  |  |
| <b>TAŞIYICI OLMAYAN SİSTEM ELEMANLARINA AİT HASAR DURUMU</b>          |  |  |  |  |  |
| <b>ÇATI/KALKAN DUVAR HASARI</b>                                       |  |  | <b>BACA/PARAPET HASARI</b>                                 |  |  |
| <b>MERDİVEN HASARI</b>  |  |  | <b>BÖLME DUVARLARDA KAYMA HASARI</b>                       |  |  |
| <b>KAROT SAYISI</b>   |  |  | <b>BETON BASINÇ DAYANIMI</b>                               |  |  |

Her bir bina için tespit formu doldurulduktan sonra değerlendirme aşamasına geçilmiştir. Değerlendirme sonucu binaların güçlendirilmesinin uygun olup olmayacağına veya TDY 2007 hükümlerine göre detaylı olarak incelenmesi gerektiğine karar verilmiştir. İncelenen betonarme binaların mahalle bazında dağılımı aşağıda verilmiştir (Tablo 2).

Tablo 2: İncelenen binaların mahalle bazında dağılımı

| Mahalle Adı     | İncelenen bina sayısı |
|-----------------|-----------------------|
| A.Gazi          | 1                     |
| Bekir Paşa      | 3                     |
| Selim Bey       | 1                     |
| Halil Ağa       | 9                     |
| Hatuniye        | 9                     |
| Bahçıvan        | 12                    |
| Hafiziye        | 1                     |
| Ali Paşa        | 2                     |
| Vali Mithat Bey | 2                     |
| Toplam          | 40                    |

İncelenen binalar ile ilgili olarak konumları ve geometrileri ve hasar tespit formunda yer alan bazı parametrelere ait bina sayıları Tablo 3'de gösterilmiştir.

Tablo 3. İncelenen binalara ait parametrelere ait bina sayıları

| KONUMU |    |   | GEOMETRİ |   |   | AĞIR KAPALI ÇIKMA |     | YUMUŞAK ZAYIF KAT |     | ÇATI/KALKAN DUVAR HASARI |     | MERDİVEN HASARI |     | BACA PARAPET HASARI |     | BÖLME DUVARLARDA KAYMA HASARI |     |
|--------|----|---|----------|---|---|-------------------|-----|-------------------|-----|--------------------------|-----|-----------------|-----|---------------------|-----|-------------------------------|-----|
| 0      | 1  | 2 | 1        | 2 | 3 | Yok               | Var | Yok               | Var | Yok                      | Var | Yok             | Var | Yok                 | Var | Yok                           | Var |
| 22     | 12 | 6 | 35       | 4 | 1 | 36                | 4   | 25                | 15  | 39                       | 1   | 4               | 36  | 20                  | 20  | 31                            | 9   |

İncelenen binaların; %45'inin bitişik nizamda inşa edildiği, %88'inin geometrisinin düzgün olduğu, %10'unda ağır kapalı çıkma olduğu, %38'inde yumuşak/zayıf kat olduğu, çatı/kalkan duvarı hasarının neredeyse olmadığı, %90'ında merdiven hasarının olduğu, %50'sinde baca/parapet hasarı olduğu, %23'ünde bölme duvarlarında kayma hasarı geldiği gözlemlenmiştir.

Ülkemizde mevcut yapı stoğunun çoğunluğunu betonarme yapılar oluşturmaktadır. Deprem öncesi veya sonrası mevcut betonarme yapıların güvenliğinin belirlenmesinde önemli aşamalardan birisi de beton dayanımının saptanmasıdır. Mevcut betonarme yapılarda deprem ve benzeri etkilerden dolayı oluşan yıkım ve hasarların başlıca nedeni betonun

yeterli dayanıma sahip olmamasıdır. Mevcut yapılardaki beton kalitesinin tespitinde çok değişik yöntemler mevcuttur. Bu yöntemler arasında beton dayanımını gerçekçi olarak belirlenmesine imkan sağlayan yöntemlerden biri karot alma yöntemidir (Bayülke, Ergün 2005, Öztürk 2005). Bu bağlamda incelenen binalara ait beton dayanımları yeterli miktarda karot alınmak suretiyle gerçekleştirilmiştir. Binalara ait beton dayanımları Tablo 4'te gösterilmiştir.

Tablo 4: İncelenen binalara ait beton dayanım sonuçları

| SIRA NO | MAHALLE ADI     | BETON BASINÇ DAYANIMI (Mpa) |
|---------|-----------------|-----------------------------|
| 2       | BEKİRPAŞA       | 10,65                       |
| 3       | BEKİRPAŞA       | 15,02                       |
| 4       | BEKİRPAŞA       | 22,58                       |
| 5       | SELİMBEY        | 21,87                       |
| 6       | HALİLAĞA        | 10,85                       |
| 7       | HALİLAĞA        | 10,7                        |
| 8       | HALİLAĞA        | 9,85                        |
| 9       | HALİLAĞA        | 6,8                         |
| 10      | HALİLAĞA        | 8,06                        |
| 11      | HALİLAĞA        | 7,04                        |
| 12      | HALİLAĞA        | 10,88                       |
| 13      | HALİLAĞA        | 17,22                       |
| 17      | HATUNİYE        | 19,18                       |
| 18      | HATUNİYE        | 13,33                       |
| 19      | HATUNİYE        | 6,46                        |
| 20      | HATUNİYE        | 10,33                       |
| 24      | BAHÇIVAN        | 13,98                       |
| 25      | BAHÇIVAN        | 11,2                        |
| 27      | BAHÇIVAN        | 17,73                       |
| 29      | BAHÇIVAN        | 20,42                       |
| 30      | BAHÇIVAN        | 7,24                        |
| 31      | BAHÇIVAN        | 17,12                       |
| 32      | BAHÇIVAN        | 19,46                       |
| 34      | BAHÇIVAN        | 7,82                        |
| 36      | HAFİZİYE        | 27,44                       |
| 37      | ALİ PAŞA        | 10,66                       |
| 38      | ALİ PAŞA        | 10,66                       |
| 39      | VALİ MİTHAT BEY | 12,52                       |
| 40      | VALİ MİTHAT BEY | 12,52                       |

Hesaplamalar yapıldıktan sonra binalar ile ilgili sonuç değerler Tablo 5'te gösterilmiştir.

Tablo5: İncelenen Binalara ait sonuçlar

| SIR A NO | MAHALLE ADI     | KULLANIM AMACI | KAT ADEDİ | AĞIR HASARLI KOLON SAYISI | ORTA HASARLI KOLON SAYISI | HAFİF HASARLI KOLON SAYISI | HASARLI Z KOLON SAYISI | SONUÇ                             |
|----------|-----------------|----------------|-----------|---------------------------|---------------------------|----------------------------|------------------------|-----------------------------------|
| 1        | A.GAZİ          | İŞYERİ+KONUT   | 4         | 0                         | 0                         | 3                          | 9                      | GÜÇLENDİRMEĞE DEĞER               |
| 2        | BEKİRPAŞA       | YATAKHANE      | 4         | 0                         | 0                         | 0                          | 48                     | TDY 2007 TAHKİK                   |
| 3        | BEKİRPAŞA       | İŞYERİ         | 4         | 0                         | 0                         | 0                          | 40                     | TDY 2007 TAHKİK                   |
| 4        | BEKİRPAŞA       | İŞYERİ         | 4         | 0                         | 0                         | 0                          | 32                     | TDY 2007 TAHKİK                   |
| 5        | SELİMBEY        | İŞYERİ+KONUT   | 9         | 0                         | 0                         | 5                          | 25                     | TDY 2007 TAHKİK                   |
| 6        | HALİLAĞA        | KONUT          | 7         | 0                         | 0                         | 0                          | 32                     | GÜÇLENDİRMEĞE DEĞER               |
| 7        | HALİLAĞA        | KONUT          | 8         | 0                         | 0                         | 0                          | 0                      | GÜÇLENDİRMEĞE DEĞER               |
| 8        | HALİLAĞA        | KONUT          | 4         | 0                         | 5                         | 3                          | 12                     | GÜÇLENDİRMEĞE DEĞER               |
| 9        | HALİLAĞA        | KONUT          | 6         | 0                         | 1                         | 0                          | 25                     | GÜÇLENDİRMEĞE DEĞER BULUNMAMIŞTIR |
| 10       | HALİLAĞA        | KONUT          | 7         | 0                         | 5                         | 0                          | 21                     | GÜÇLENDİRMEĞE DEĞER BULUNMAMIŞTIR |
| 11       | HALİLAĞA        | KONUT          | 7         | 0                         | 4                         | 4                          | 20                     | GÜÇLENDİRMEĞE DEĞER BULUNMAMIŞTIR |
| 12       | HALİLAĞA        | KONUT          | 8         | 0                         | 20                        | 10                         | 6                      | GÜÇLENDİRMEĞE DEĞER               |
| 13       | HALİLAĞA        | KONUT          | 8         | 0                         | 15                        | 5                          | 16                     | GÜÇLENDİRMEĞE DEĞER               |
| 14       | HALİLAĞA        | KONUT          | 4         | 0                         | 0                         | 0                          | 15                     | GÜÇLENDİRMEĞE DEĞER               |
| 15       | HATUNİYE        | KONUT          | 6         | 2                         | 5                         | 5                          | 7                      | GÜÇLENDİRMEĞE DEĞER BULUNMAMIŞTIR |
| 16       | HATUNİYE        | KONUT          | 5         | 0                         | 0                         | 0                          | 32                     | GÜÇLENDİRMEĞE DEĞER               |
| 17       | HATUNİYE        | İŞYERİ+KONUT   | 7         | 0                         | 6                         | 2                          | 8                      | GÜÇLENDİRMEĞE DEĞER               |
| 18       | HATUNİYE        | KONUT          | 6         | 0                         | 10                        | 2                          | 16                     | GÜÇLENDİRMEĞE DEĞER BULUNMAMIŞTIR |
| 19       | HATUNİYE        | KONUT          | 6         | 0                         | 2                         | 2                          | 24                     | GÜÇLENDİRMEĞE DEĞER BULUNMAMIŞTIR |
| 20       | HATUNİYE        | KONUT          | 5         | 0                         | 0                         | 0                          | 16                     | GÜÇLENDİRMEĞE DEĞER               |
| 21       | HATUNİYE        | İŞYERİ         | 3         | 0                         | 0                         | 1                          | 16                     | GÜÇLENDİRMEĞE DEĞER               |
| 22       | HATUNİYE        | İŞYERİ         | 1         | 0                         | 3                         | 2                          | 7                      | GÜÇLENDİRMEĞE DEĞER               |
| 23       | HATUNİYE        | KONUT          | 5         | 0                         | 0                         | 4                          | 20                     | GÜÇLENDİRMEĞE DEĞER               |
| 24       | BAHÇIVAN        | İŞYERİ+KONUT   | 8         | 0                         | 0                         | 1                          | 54                     | TDY 2007 TAHKİK                   |
| 25       | BAHÇIVAN        | İŞYERİ+KONUT   | 6         | 0                         | 1                         | 1                          | 30                     | TDY 2007 TAHKİK                   |
| 26       | BAHÇIVAN        | İŞYERİ+KONUT   | 7         | 0                         | 0                         | 5                          | 25                     | GÜÇLENDİRMEĞE DEĞER               |
| 27       | BAHÇIVAN        | İŞYERİ+KONUT   | 5         | 0                         | 0                         | 0                          | 36                     | TDY 2007 TAHKİK                   |
| 28       | BAHÇIVAN        | İŞYERİ+KONUT   | 5         | 0                         | 0                         | 0                          | 20                     | GÜÇLENDİRMEĞE DEĞER               |
| 29       | BAHÇIVAN        | İŞYERİ+KONUT   | 5         | 0                         | 0                         | 0                          | 0                      | TDY 2007 TAHKİK                   |
| 30       | BAHÇIVAN        | İŞYERİ+KONUT   | 6         | 0                         | 0                         | 0                          | 12                     | GÜÇLENDİRMEĞE DEĞER BULUNMAMIŞTIR |
| 31       | BAHÇIVAN        | İŞYERİ+KONUT   | 5         | 0                         | 0                         | 0                          | 40                     | TDY 2007 TAHKİK                   |
| 32       | BAHÇIVAN        | İŞYERİ+KONUT   | 7         | 0                         | 0                         | 0                          | 32                     | TDY 2007 TAHKİK                   |
| 33       | BAHÇIVAN        | İŞYERİ         | 2         | 0                         | 0                         | 1                          | 3                      | GÜÇLENDİRMEĞE DEĞER               |
| 34       | BAHÇIVAN        | İŞYERİ         | 6         | 0                         | 0                         | 0                          | 12                     | GÜÇLENDİRMEĞE DEĞER BULUNMAMIŞTIR |
| 35       | BAHÇIVAN        | İŞYERİ+KONUT   | 7         | 0                         | 0                         | 0                          | 0                      | GÜÇLENDİRMEĞE DEĞER               |
| 36       | HAFİZİYE        | KONUT          | 7         | 0                         | 0                         | 0                          | 33                     | TDY 2007 TAHKİK                   |
| 37       | ALİ PAŞA        | KONUT          | 6         | 1                         | 9                         | 8                          | 8                      | GÜÇLENDİRMEĞE DEĞER               |
| 38       | ALİ PAŞA        | KONUT          | 6         | 1                         | 10                        | 8                          | 8                      | GÜÇLENDİRMEĞE DEĞER               |
| 39       | VALİ MİTHAT BEY | İŞYERİ         | 7         | 0                         | 0                         | 0                          | 14                     | TDY 2007 TAHKİK                   |
| 40       | VALİ MİTHAT BEY | İŞYERİ         | 7         | 0                         | 2                         | 5                          | 12                     | GÜÇLENDİRMEĞE DEĞER               |

## 5- SONUÇLAR VE TARTIŞMA

Hasarların genel olarak tipik deprem hasarları ile örtüştüğü net bir şekilde gözlemlenmiştir. Usulüne uygun inşa edilmeyen çatı kalkan duvarlarının devrilmesi, betonarme yapılarda donatı hatalarının olduğu, paspayı yetersizliğinden dolayı donatılarının korozyona uğradığı, gelişigüzel olarak yapılan bitişik nizamdaki yapıların birbirini etkilemesi, yanlış duvar malzemesi seçiminden dolayı duvar hasarlarının olduğu gözlemlenmiştir. Yapı hasarların artmasına taşıyıcı sistem düzenlenmesinde yapılan hataların da etkili olduğu görülmüştür. Binaların çoğunda yanıl ötelemeyi sınırlayan betonarme perdelerin olmadığı, binaların zemin katlarının ticari alan olan kullanılması sonucu taşıyıcı sisteme deprem esnasında katkı veren dolgu duvarlarının olmaması veya çok az olması, donatı işçiliğinin ve montajının gerektiği gibi yapılmaması hasarların artmasına neden olmuştur. TDY 2007 hükümlerine göre inşa edilen yapıların hasar almamış olması yapılar ile ilgili yönetmeliklerinin yeterli olduğu ancak yönetmeliklere uygun yapı inşa edilmediği gerçeğini bir daha gözler önüne sermiştir. Özellikle küçük yerleşim birimlerinde yapıların proje aşamasından başlayarak tamamlanmasına kadar geçen sürede ihmal ve denetimsizliğin olduğu gerçeği de bu durumu doğrulamaktadır.

Yapılacak hasar tespit işlemleri onarım ve güçlendirme işleminin temel adımını oluşturmaktadır. Hasar sınıfının tespitinden, uygulanabilir proje aşamasına kadar tüm işlemler uzman ve deneyimli mühendisler tarafından gerçekleştirilmelidir. Güçlendirme işlemleri ile ilgili TDY 2007'nin 7. Bölümü ihtiyaca cevap verecek düzeydedir.

Yapılardaki deprem sonrası hasar tespitlerinin hızlı bir şekilde ve istenilen sonuçları verecek şekilde yapılabilmesi için yeterli sayıda konusunda uzman personel kullanılması elde edilecek sonuçları daha değerli kılacaktır. Bunun için hasar tespiti işlemine geçmeden önce hasar tespit kriterleri ve hasar tespit formları oluşturulmalı ve bu formların nasıl doldurulacağı ile ilgili gerekli eğitimler verilmelidir.

Ayrıca hak sahipliği çalışmaları da sonradan oluşabilecek hukuki sorunların önüne geçmek anlamında önemli bir yer tutmaktadır. Bu konuda da yeterli personelin görevlendirilmesi sorunları en aşağı seviyeye indirecektir.

Hasar tespit çalışmaları yapılırken yapı adreslerinin eksiksiz olarak tarif edilmesi, bu konuda ilgili yerel yönetimlerin yapıların adres bilgileri ile ilgili değişikliklerini kısa sürede ve kalıcı olarak güncellemesi deprem sonrası hasar tespit çalışmalarının hızını kesmeyecektir.

Güçlendirilmesine karar verilecek her bir bina için detaylı inceleme ve güçlendirme gereklidir. Güçlendirme işlemi yapılırken her aşamada bu konuda deneyim kazanmış elemanların kullanılması binanın güçlendirilmesine anlam kazandıracaktır. Aksi takdirde güçlendirme sadece binanın kusurlarının kapatılması anlamına gelecektir.

Bir betonarme yapıdan beklenen; dayanım, kalıcılık, ekonomiklik, fonksiyon ve estetiğin sağlanmasıdır. Ülkemizde yeterince önem verilmeyen ancak depremlerle ortaya çıkan binaların bakımı ve onarımı yapılmalı ve gerekli görülen yerler güçlendirilmelidir. Yapı güçlendirme çalışmaları gerek mühendislik gerekse ekonomik açıdan büyük külfet getirmektedir ve genellikle yapının yıkılıp yeniden yapılması daha sağlıklı görülmektedir. Bu durum malzeme, işçilik, zaman gibi niteliklerin kaybına neden olmaktadır.

İncelenen 40 adet BA binadan %50'sinin güçlendirmeğe değer, %30'unun TDY 2007 hükümlerine göre detaylı olarak incelenmesine ve %20'sinde güçlendirilmesinin uygun olmayacağı sonucuna varılmıştır.

Yöre; taşıdığı olumsuz jeolojik ve topografik faktörler nedeniyle depreme duyarlı değildir. Bugüne kadar izlenen yapılaşmada depremsellik ögesi büyük ölçüde ihmal edilmiştir. Ancak tektonik olarak son derece hareketli kuşaklar içerisinde kalan Van Gölü Havzasında yapılaşma esnasında depremsellik faktörü göz önünde bulundurulmalı ve ilgili yönetmeliklere hassasiyetle uyulmalıdır. Yeni yapılaşmanın olacağı bölgelerde deprem etkileri göz önüne alınacak şekilde düzenlenmiş kent planlaması ve arazi kullanım düzenlemelerinin yapılması önem arz etmektedir. Ayrıca mevcut yapıların incelenerek gerekli önlemlerin alınması deprem zararlarının azaltılması yolunda alınacak tedbirlerden biri olacaktır.

Ülke ekonomisinin lokomotif sektörlerinin başında gelen inşaat sektörü, kamu kesiminin ve özel kesimin kaynaklarının büyük bölümü ile dışarıdan bulunan yabancı kaynakların büyük bölümünü tüketmektedir. Kaynakların verimli kullanılması kalkınma hamlelerinin temel eylemidir. Bu nedenle hasarlı veya hasar görebilecek yapıların güçlendirilmesine mi yoksa yeniden yapılmasına mı karar vermek için yapılacak maliyet çalışmaları, uzmanlar tarafından hassasiyetle yapılmalıdır.

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# 4-[4-(OKTİLOKSİ)BENZOİLOKSİ]BENZOİK ASİD SIVI KRİSTALİ İLE POLİ(ETER İMİD) KARIŞIMLARININ KARIŞABİLİRLİĞİNİN İNCELENMESİ

Selma Özkal<sup>a</sup>, Fatih Çakar<sup>a</sup>, Hale Ocak<sup>a</sup>, Belkis Bilgin-Eran<sup>a</sup>, Özlem Cankurtaran<sup>a</sup>, Ferdane Karaman<sup>a</sup> ve Mithat Çelebi<sup>b</sup>

*a)Yıldız Teknik Üniversitesi, Fen-Edebiyat Fakültesi, Kimya Bölümü, 34220 İstanbul*

*b)Yalova Üniversitesi, Mühendislik Fakültesi, Polimer Mühendisliği Bölümü, Yalova*

Sıvı kristaller simetri ve yapı bakımından katı ve izotropik sıvı arasında kendine özgü bir yapı gösterir. Sıvı kristaller sıradan sıvılar gibi akar, ama molekülleri gerçek kristallerde olduğu gibi düzenli bir biçimde yerleşmiştir. Bu yüzden sıvı kristaller ve uygulamaları günümüzde birçok kullanım alanı bulunmaktadır. Son yıllarda, teknolojik uygulamaların yönlendirilmesi ile geleneksel sıvı kristallerin özelliklerini, polimerlerin avantajları ile birleştirecek çalışmalar yapılmaktadır. Boyalar, kaplamalar ve ince ekranlar gibi uygulamalarda sıvı kristallerin çözücülerde çözülmüş hallerinden ve sıvı kristal-polimer karışımlarından yararlanır. Bu uygulamaların gelişmesi için bileşenler arasındaki etkileşim ve karışabilirlik hakkında ayrıntılı bilgi gereklidir [1].

Bu çalışmada poli (eter imid) (Ultem)/4-[4-(Oktiloksi)benzoiloksi]benzoik asid (OBBA) Sıvı kristal karışımlarının karışabilirlik davranışları vizkozite ve Fourier Transform Infrared-Azaltılmış Kuvvet Spektroskopisi (FTIR-ATR) yöntemiyle çalışıldı. Bunun için Ultem/OBBA karışımlarının 30 °C'de seyreltik kloroform çözeltilisinde çeşitli konsantrasyonlarda (80/20, 60/40, 40/60 ve 80/20) ikili karışımları hazırlandı. İkili karışımların indirgenmiş vizkozite ve Huggins parametreleri belirlendi. Karışımların indirgenmiş vizkozite sonuçlarından çeşitli araştırma grupları tarafından önerilen karışabilirlik parametreleri elde edildi. Daha sonra bu çözeltilerin FTIR-ATR'leri ölçülerek Ultem/OBBA ikili karışımlarının karışabilirlikleri incelendi.

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# A FAST METHOD FOR ACCESSING NODES IN THE BINARY SEARCH TREES

İbrahim Ates<sup>1</sup>, Mustafa Akpınar<sup>1</sup>, Beyza Eken<sup>1</sup>, Nejat YUMUSAK<sup>1</sup>

<sup>1</sup>Sakarya University, Department of Computer Engineering, Adapazari, Turkey  
ibrahimates@yahoo.com, akpınar@sakarya.edu.tr, beken@sakarya.edu.tr, nyumusak@sakarya.edu.tr

**Abstract:** In this study, a method that makes easy to process in the search trees is presented. A data structure which uses this method is also explained. It is explained how this method is used for strings. Performance comparisons with other trees like AVL, RB tree are showed. A hash table and a balanced binary search tree are used to implement this data structure. It is built the categorized subtrees according to data. Hash table is used to access data in the subtrees. It is aimed to process on relatively less amount of data collections instead of large amount of data collections. In this way the numbers of the process will be decreased. It will make positive affect on the program performance.

**Keywords:** Balanced binary search tree, Hash table, AVL, RB Tree, Salkim Tree

## 1. Introduction

The study of data structures is core to computer science. A wide range of container structures have been developed to meet different problem situations. The focus on data structures that efficiently store large collections of data (Tremblay J. P., 2003; Ford W. and Top W. 2002).

Data structure determines performance of the software. When program use large collections of data then data structure selection is getting more important. The structures have operations to access items, insert items and remove items from the collection. Effectiveness of a program depends on performance of deletion, insertion and searching process (Robson R, 1999; Weiss M. A., 1994).

Data can be stored in a memory sequentially or associatively. Data structures which are stored sequentially save data with position in a memory. When a data with value is wanted to be found,  $O(n)$  times search will be needed. Data structures, which save data with value in memory, are more suitable in this situation. This type of data structures is called associative data structures. These data structures are updated by using values, instead of using positions in associated data structures. Tree, is an example of this kind of data type (Larsen Kim S., 2000). AVL (Adelson Velskii and Landis) and Red-Black trees are the most important examples of tree data structure.

## 2. AVL Trees

AVL trees are binary search trees which are locally balanced. Depth of the AVL trees is arranged as  $O(\log n)$ . This means that AVL trees have the same depth of the left and right sub trees. The difference between left and right sub trees of any node can be one or zero. Cost of AVL algorithms is  $O(\log N)$ , when these algorithms are used for building tree, deletion, insertion and searching process (Larsen Kim S., 2000, Gabarró J. and Messeguer X., 1998; Cameron H. and Wood D., 1994).

AVL (Adel'son-Vel'skii and Landis) trees are efficient data structures for implementing dictionaries. AVL trees are binary search trees which are locally balanced; that is, for any internal node, the heights of its left and right subtrees may differ by at most one. The local balance at each node guarantees that the height of an  $n$ -key search tree will always be bounded above by  $1.44 \log(n + 2)$ . Since AVL trees are the most efficient method of balancing binary search trees, they are utilized in a wide variety of applications such as databases, operating systems, and symbol tables in compilers.

$T$ , an AVL tree, is a binary tree in which the difference between the heights of the left and right subtrees of any node is at most one. Elements from a totally-ordered domain are stored in the leaves with smaller data to the left of larger ones. For each internal node  $v$ , we use  $k(v)$  to refer to the key value stored in it and  $l(v)$  and  $r(v)$  to denote the left and right children, respectively. Moreover,  $k(v)$  always equals the key value of the largest element stored in node  $v$ 's left subtree. Such trees are usually referred to the literature as external AVL trees.

When we insert a new node into an AVL tree, some external nodes are replaced by a new internal node (and two external nodes as its children), and the height of the parent of new node may have been increased by one. As a result, if the height of newly inserted node is increased, the property of AVL tree may be lost at the ancestors of this new node.

When the insertion causes an AVL tree to lose its balance, applying exactly one of the four rotations—*single rotations LL or RR* and *double rotations LR or RL*—will restore it.

### 3. Red-Black Trees

The red-black tree is a balanced binary search tree whose height is  $O(\log n)$  and dictionary operations such as search, insertion, and deletion are performed in  $O(\log n)$  time in sequential computation, where  $n$  is the number of nodes in the red-black tree.

In Red-Black tree (RB tree), every node has RED or BLACK attributes. Tree operations, except insertion, are costed  $O(\log n)$  in RB tree. Insertion of an element will violate balance of tree which must be rebalanced. Rebalance process can be achieved with a simple operation, called rotation (Park H. and Park K., 2001; Cameron H. and Wood D., 1994).

Let  $\text{root}(T)$  denote the root node of a red-black tree  $T$  and  $\text{item}(x)$  denote the item stored in node  $x$ . Let  $p(x)$  denote the parent of node  $x$  and  $p^{n+1}(x)$  the parent of  $p^n(x)$ ,  $n \geq 1$ . Let  $\text{rchild}(x)$  denote the right child of node  $x$  and  $\text{lchild}(x)$  the left child of  $x$ . The successor of node  $x$  is the node with the smallest item larger than  $\text{item}(x)$ . The predecessor of node  $x$  is the node with the largest item smaller than  $\text{item}(x)$ . Each node  $x$  has a space for its item, a bit for its color (red or black), and three pointers to  $p(x)$ ,  $\text{lchild}(x)$ , and  $\text{rchild}(x)$ . If a node does not have a parent or a child, nil is stored in the corresponding pointer. We will regard nil as a pointer to an external node (leaf) and the nodes holding items as internal nodes.

A red-black tree is a binary search tree satisfying the following red-black properties (Park H. and Park K., 2001).

1. Every node is either red or black.
2. Every external node (nil) is black.
3. If a node is red, then both its children are black.
4. Every simple path from a node to a descendant leaf contains the same number of black nodes.

The red-black properties can be rewritten using nonnegative ranks instead of red and black colors

- (a) If  $x$  is any node with a parent,  $\text{rank}(x) \leq \text{rank}(p(x)) \leq \text{rank}(x) + 1$ .
- (b) If  $x$  is any node with a grandparent,  $\text{rank}(x) < \text{rank}(p^2(x))$ .
- (c) If  $x$  is an external node,  $\text{rank}(x) = 0$  and  $\text{rank}(p(x)) = 1$  if  $x$  has a parent.

The above conditions (a)–(c) are called balance conditions. The rank of node  $x$  corresponds to the number of black nodes in any simple path from  $x$  to a descendant leaf. Hence,  $\text{rank}(p(x)) = \text{rank}(x) + 1$  if  $x$  is black and  $\text{rank}(p(x)) = \text{rank}(x)$  otherwise. Note that  $\text{rank}(x)$  need not be stored in  $x$ . (Park H. and Park K., 2001; Cameron H. and Wood D., 1994).

### 4. Salkim Tree

A data structure is a systematic way of organizing and accessing data. It is focused on data structures that store large collections of data. It is needed new data structures that can efficiently add and remove items without involving the entire collection of elements. In this study, Salkim tree is proposed to address this problem.

A hash table and RB binary search tree are used together to build Salkim tree. Collision case of hash table is used to categorize data. Selected hash function generates same index for different data in same category. Data are stored in a special form of binary search tree. In this form, root has one element which provides connection between tree and hash table. Data are stored in meaningful subtrees instead of one tree. When a process is needed for an element, process will work in related subtrees instead of all trees.

#### 4.1 Implementation

When this data structure is wanted to build for letters, records are generated for each letter in hash table (Hrádek J., 2003; Zobel J., 2001). For this aim, hash function is used to generate index. Index value shows location of each letter in hash table. The root addresses of each subtree are stored in hash table. Hash function is shown in equation 1.

$$H(x) = \text{ascii}(x) - 65 \quad (1)$$

Address records of subtrees are generated statically in hash table. Initial value of address records are NULL. When a string is wanted to be added to the structure, firstly hash table is checked whether subtree is created or not. If related subtree is created then string will be added to this subtree, otherwise a root will be created and string will be added to this root. The address of the created root will be written to the related place in the hash table.

Searching process of an element; hash table is checked whether related subtree exists or not. If subtree does not exist, no need more completion, it can be said that element does not exist in structure. Otherwise searching process will continue in related subtrees.

For example, let's assume that 'train' word is wanted to search in structure, Firstly index value of 't' is calculated using hash function (index value of 't' is equal to 19). 19 th section of hash table is checked whether any address exists or not. If 19 th section value of hash table is NULL, then it can be said that 'train' does not exist in the structure, otherwise 'train' word will be searched in 't' subtree. If 'train' word is wanted to search in any tree, all trees must be searched though it does not exist. This situation increases the cost of searching process in an ordinary binary search tree.

For example, cost of searching an element, in a balanced tree with 26000 elements, is 15. Salkim trees's cost is 10 in the same situation (when all letter categories have 1000 element).

Assuming that number of element is N and number of element started with 'i' is Ni,

$$N = N_a + N_b + \dots + N_i + \dots + N_z \tag{2}$$

Assuming that all element is not started with 'i', it can be said that

$$\log_2 N > \log_2 N_i \tag{3}$$

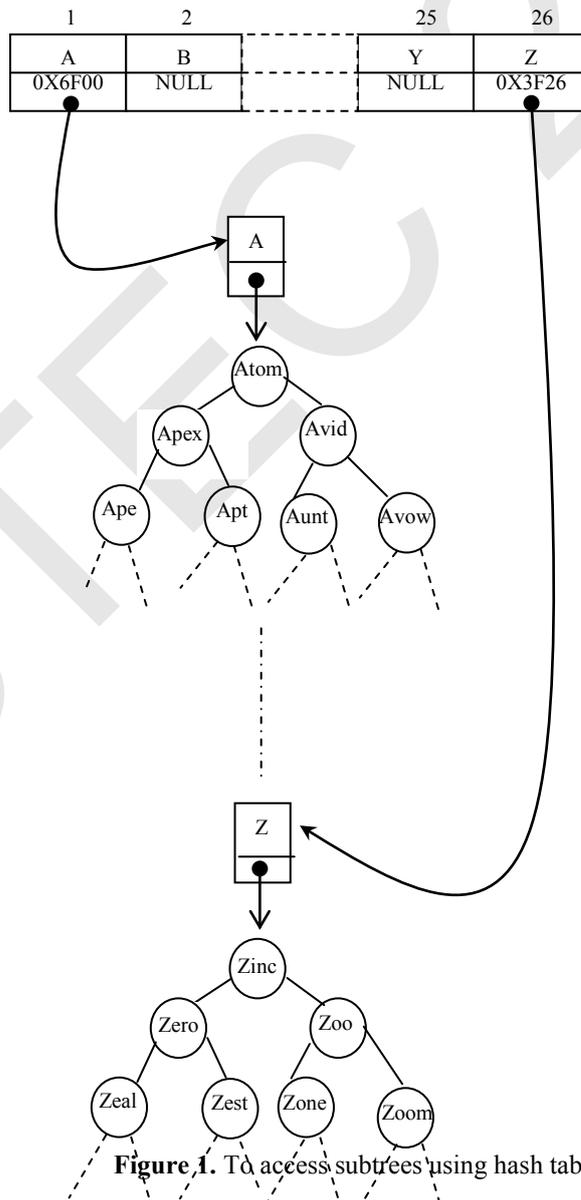


Figure 1. To access subtrees using hash table

## 5. Results

An application program is written to analyse building structure, inserting an item and searching an item performances of AVL, RB tree and Salkim.

Performances of building structure are examined for five different data sets. Amount of data in data sets are 25000, 275000, 350000, 550000, 1100000. X axis of figures demonstrates these data sets. Y axis demonstrates process time. Build performance of those data structures is shown in Figure 2.

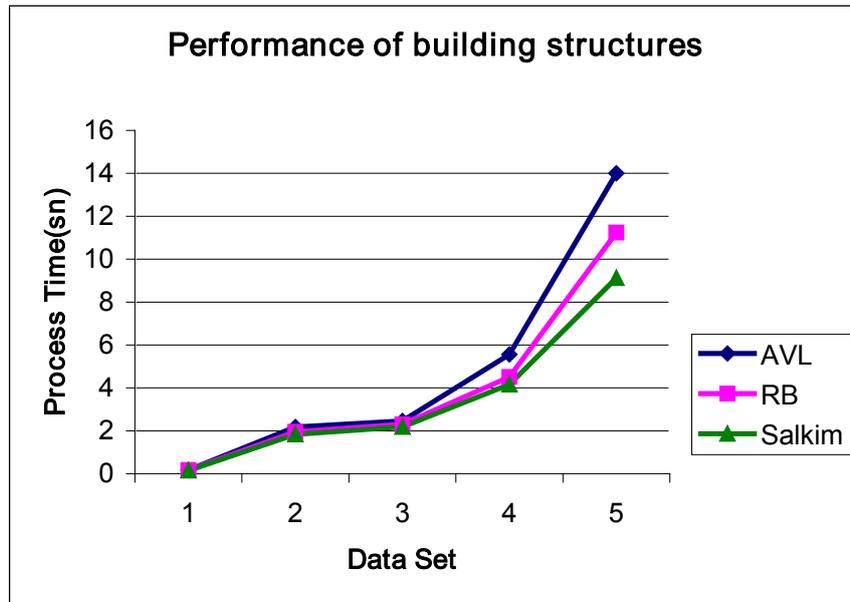


Figure 2. Performances of building structures

Table 1. Performance values of building structure test.

| Data Set | Number of Data | AVL    | RB     | Salkim |
|----------|----------------|--------|--------|--------|
| 1        | 25.000         | 0,17   | 0,17   | 0,15   |
| 2        | 275.000        | 2,173  | 1,956  | 1,833  |
| 3        | 350.000        | 2,46   | 2,303  | 2,18   |
| 4        | 550.000        | 5,56   | 4,506  | 4,156  |
| 5        | 1.100.000      | 14,006 | 11,237 | 9,124  |

Insertion performance of AVL, RB and Salkim tree is shown in Figure 3 and Table2. Note that all data structure was including 25000 elements before insertion test. Insertion performance is tested for four cases, in first case 100000, in second case 1000000, in third case 5000000, and in fourth case 10000000 elements are added into each structure.

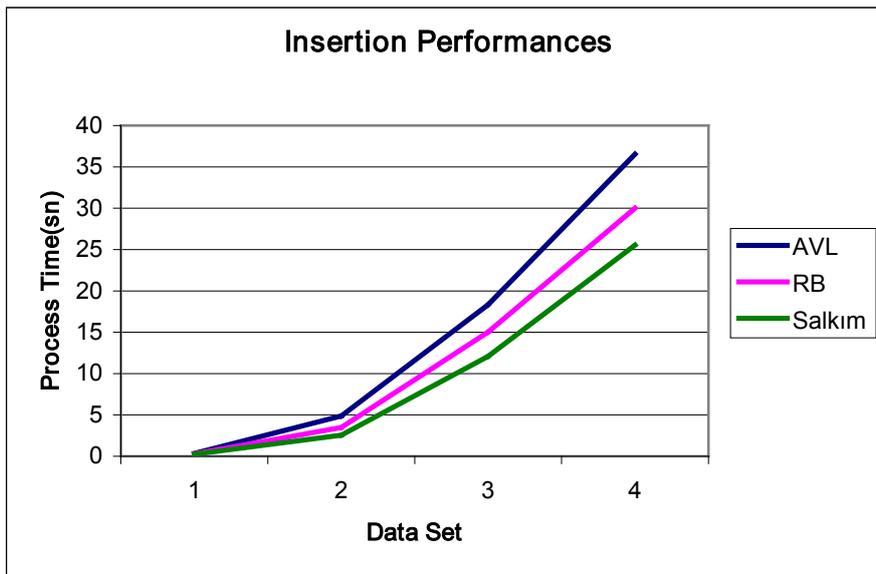


Figure 3. Performances of insertion item

Table 2. Performance values of insertion item test

| Data Set | Number of inserted data | AVL    | RB     | Salkim |
|----------|-------------------------|--------|--------|--------|
| 1        | 100.000                 | 0,341  | 0,29   | 0,25   |
| 2        | 1.000.000               | 4,87   | 3,475  | 2,56   |
| 3        | 5.000.000               | 18,326 | 15,02  | 12,083 |
| 4        | 10.000.000              | 36,532 | 30,014 | 25,543 |

Search performance of structures is shown in Figure 4 and Table3. Note that all data structure was including 25000 elements before search test. Search performance of structures is tested for four cases. In first case 100000, in second case 1000000, in third case 5000000, and in fourth case 10000000 elements are searched on each structure.

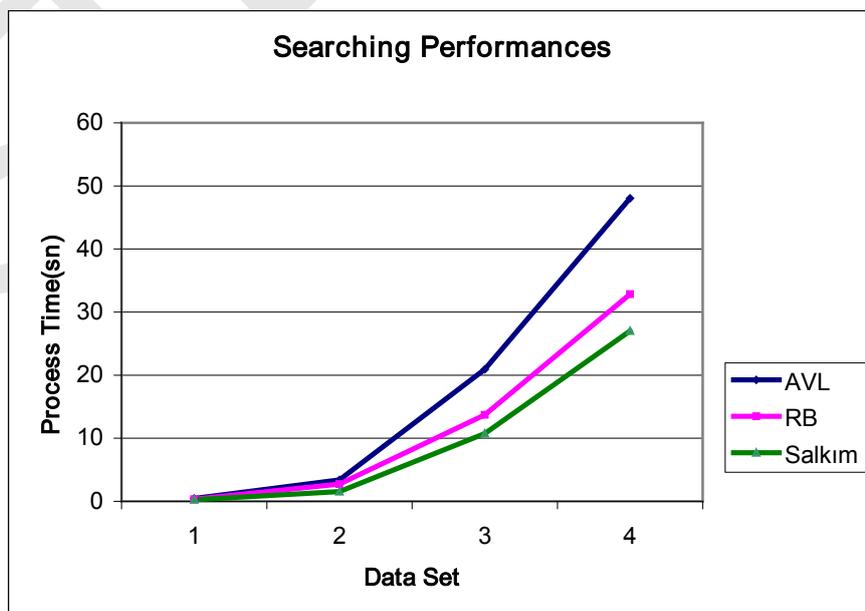


Figure 4. Performances of searching item

**Table 3.** Performance values of searching item test

| Data Set | Number of searched data | AVL    | RB     | Salkim |
|----------|-------------------------|--------|--------|--------|
| 1        | 100.000                 | 0,451  | 0,341  | 0,25   |
| 2        | 1.000.000               | 3,395  | 2,744  | 1,542  |
| 3        | 5.000.000               | 20,92  | 13,71  | 10,752 |
| 4        | 10.000.000              | 48,037 | 32,837 | 27,01  |

## 6. Conclusion

Performance of Salkim tree is better than AVL and RB tree which are preferred in a lot of applications. Especially, search performance and insertion performance of Salkim tree's superiority is getting clearer when number of data increase.

## Acknowledgement

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# A MODEL FOR MEASURING INSTITUTIONALIZATION LEVEL OF SMES

Özer UYGUN<sup>1</sup>, Tuba CANVAR KAHVECI<sup>1</sup>, Harun TAŞKIN<sup>1</sup>, Beytullah PRIŞTİNE<sup>2</sup>

<sup>1</sup>Department of Industrial Engineering, Sakarya University, Esentepe Campus, Serdivan, Turkey

<sup>2</sup>Master Student in the Department of Industrial Engineering, Sakarya University, Esentepe Campus, Serdivan, Turkey  
ouygun@sakarya.edu.tr, tcanvar@sakarya.edu.tr, taskin@sakarya.edu.tr, beytullah@arvena.com.tr

**Abstract:** Institutionalization help an organization to gain legitimacy, increase resources and maintain survival. In other words, institutionalization is realized by developing appropriate and meaningful behaviors with the environment to gain legitimacy and conformity and transferring them to next generations. It is a crucial issue especially for small and medium sized enterprises (SMEs) to adopt themselves according to the changes in the environment, and sustain competitive. In this study, fuzzy hybrid multi-criteria decision making approach is used in order to measure institutionalization level of SMEs. For achieving this, first of all, criteria that indicate the institutionalization level of SMEs are determined. Then cause and effect interaction among main criteria is determined by fuzzy DEMATEL method. According to the inter influence derived from fuzzy DEMATEL, fuzzy analytic network process (ANP) is implemented in order to obtain the weights of the criteria. Expert opinions and group decision making approach are utilized during both fuzzy DEMATEL and fuzzy ANP methods. After acquiring the weights, several SMEs are evaluated according to the criteria predefined and VIKOR method is implemented for measuring the level of institutionalization of the SMEs.

**Keywords:** Institutionalization, multi-criteria decision making, Fuzzy DEMATEL, Fuzzy ANP, VIKOR

## 1. Introduction

The organizations are not stable; they change with the time in common with their environment. While some of the organizations manage to survive during this period, some of them cannot survive because of not being institutionalized. The main reasons of not being able to survive are the resistance to the change in the organization environment, innovation and improvement, not having strategic thinking and successful knowledge management system. The basic result of the institutionalization is to make the organizations more surviving and consistent. So the institutionalization has come up due to the modern society

Institutionalization is the administration of the enterprise within a set objectives and targets as well as principles and values. These values are comprised of vision, mission, principles and values. The set objectives, principles and values are combining every employee including the managers within a corporation (Kahveci, 2007). Institutionalization is also defined as processes which include creation of a formal structure, emergence of informal norms, development of impersonal/objective procedures, administrative rituals, ideologies, legalization, and focus on legitimization (Alpay et al., 2008).

Institutionalization processes include creation of a formal structure, emergence of informal norms, development of impersonal/objective procedures, administrative rituals, ideologies, legalization, and focus on legitimization. Institutional theory therefore traces the “emergence of distinctive forms, processes, strategies, outlooks, and competences” (Selznick, 1996) from patterns of organizational interaction and adaptation in response to internal and external environments.

Attempts to measure institutionalization at the firm level are rare (Alpay et al, 2008). One of the main objectives of this study is to measure institutionalization level of an organization. The assessment of institutionalization process is based on multiple criteria. Therefore, multi-criteria decision making techniques are used in this study. The process also requires more than one expert opinion. That is why group decision making approach is applied in the measurement model.

## 2. Literature Review

### 2.1. Institutionalization

The institutionalization is defined in different ways the literature. The institutional is generally defined by expressing the characteristics of the institutionalized organizations. If the organization is institutionalized, its activities

must be performed systematically according to the particular rules. According to these view, the institutionalization is becoming a system. The institutionalized organizations have the common and eligible organizational culture. The professionalism is the other character of the institutionalized organizations (Kahveci, 2007). The organizational culture must be structured based on the strategic management activities and supported by the information systems to gain the expected results of the institutionalization process.

Actually, the institutionalization is an organizational theory which explains the interaction between the organizations and the environment they operate in. It is mainly concerned with the reasons of the changes within the organizations that occur due to pressures by the institutional environment which mainly consists of the governments and some professional organizations. This theory accepts that organizations can not just act rationally to follow their interests. They also have to take the expectations of the institutional environment into consideration. So the decisions maker of the organizations must to consider these expectations and pressures for their decisions.

Institutionalization is the organizational progress in common with the environmental change, and obtaining the standards. In this definition, three following subject are remarkable; (1) The institutionalized organizations changes along with the environmental change; (2) They learn this change; (3) They develop the new standards according to the new circumstance.

The researcher who firstly mentions this theory is Selznick and he notices that organizations adapt and *develop values specific to organization* to adapt to environment thus become legal and reach stability. Zucker considers institutionalization as a tool which provides social stability. According to him, institutionalization is realized by *developing appropriate and meaningful behaviors with the environment* to gain legitimacy and conformity and transferring them to next generations. Meyer and Rowan mentioned that the purpose of institutionalization is to gain legitimacy, increase resources and maintain survival of organizations. They argue that the institutionalization occurs by *developing shared values with the environment*. From another point of view, DiMaggio and Powell posit that institutionalization occurs by *imitating other successful competitors* as a means of adaptation to environment. According to Friedland and Alford, organizations institutionalize in order to affect cognitive and normative pressures *by trying to manipulate the environment* (Apaydin, 2009).

The common idea the researchers mentioned above is that, institutionalization is a process which influences every aspect of organizations, e.g. strategies, structure, decisions, activities, behaviors and performance. As it has a wide and deep impact on organizations, it deserves further researches (Apaydin and Coşkun, 2008).

Ironically, however, the institutional approach has yet to become institutionalized here is very little consensus on the definition of key concepts, measures or methods within this theoretic tradition. Also there has been little attention given to conceptualizing and specifying the processes of institutionalization. In the other words, the process-based approach to institutionalization has not been followed in most organizational analyses. Instead, institutionalization is almost always treated as a qualitative state: structures are institutionalized, or they are not. The institutionalization theory cannot provide the sufficient and concrete suggestions the way of the institutionalization. Consequently, important questions of the determinants of variations in levels of institutionalization, and of how such variation might affect the degree of similarity among sets of organizations, have been largely neglected. There is the need to develop more direct measures and better documentation of claims of the institutionalization of structures, since outcomes associated with a given structure are likely to depend on the stage or level of institutionalization. Also, attempts to measure institutionalization at the firm level are rare (Alpay et al, 2008).

## 2.2. Multi-Criteria Decision Making

Many traditional multi-criteria decision making (MCDM) methods are based on the additive concept along with the independence assumption (Zeleny, 1982). Several previously proposed MCDM methods are very useful but they have generally considered only for independent effects during selection or evaluation of criteria. DEMATEL method and its fuzzy version take into account that any factor of MCDM may affect other factors or may be affected by others.

Wu (2008) stated that knowledge management (KM) strategy selection is a kind of multiple criteria decision-making problem, which requires considering a large number of complex factors as multiple evaluation criteria. He proposed an effective solution based on a combined ANP and DEMATEL approach to help organizations evaluating and selecting KM strategies. Several multi-criteria decision making methods can be implemented in a combined manner. DEMATEL method is very suitable to be combined with ANP as can be seen in Yang and Tzeng (2011), Lee et al (2011) and Wu (2008). Some examples about combination of DEMATEL, ANP and VIKOR techniques can be found in Ho et al. (2011), and Liou and Chuang (2010). DEMATEL, ANP and TOPSIS combinations can be seen in Lin et al. (2010) and combination of three models in fuzzy environment can be seen in Büyüközkan and Çifçi (2012). There are some other combined methods also. In this paper DEMATEL, fuzzy ANP and VIKOR methods are implemented for assessing institutionalization level of organizations.

## 3. Readiness Assessment Model for Institutionalization

As there is not common key concepts about the institutionalization process, the components of this process are defined in the different ways too. According to Korkmaz, the basic components of the institutionalization are defined as

knowledge, foresight, rationalism, consistency, constancy, reliability, adaptability, flexibility and maintainability. So, the institutionalization is making these components dominant over the organizations to institutionalize the organizations (Korkmaz, 2003). In the other study, the components of the institutionalization are stated as simplicity, diversification, flexibility and autonomy. These components can be used to determine the institutionalization level of the organizations (Karpuzoğlu, 2004). The dimensions of institutionalization are formalization, professionalism, cultural strength, consistency and accountability. Essentially, all of them are either the results of the institutionalization process or the characteristics of the institutionalized organizations. However, the way of institutionalization and measuring the level of institutionalization were not mentioned in the literature.

The simplicity of the job and maintaining it as simplicity cause the Simplicity component of the institutional. The simplicity of the job only can be done by applying the process management approach. On the other hand, when the enterprise handles the competition primarily, focuses on the market and human resources, and concentrates in the main goals, it achieves the Diversification in its structure and operations.

The other component of the institutionalization is the Flexibility which is the adaptability of the enterprise to its environment, can be done by networking, continuous revolution for continuance in the market, monitoring the basic cycles, establishing the systems such as production planning, strategic planning and investment planning.

Finally, the strategic view, the mission union, the managing with the reality and determining the priorities are composing the corporate identity and also provide the Autonomy. The other determinative of the autonomy is certainly capital structure.

When the enterprise is evaluated from the simplicity of their job, the processes should be the focus of this evaluation. The enterprise can gain the diversification on account of its product, human resources and technological resources in the environment. The flexibility is exactly the conformity to the environment. The autonomy of the enterprise is based on the strategy of the enterprise. Consequently, the enterprise should implement strategic management, process management, technology management, human resource management, product management, knowledge management and consider its environment. As a result the evaluation criteria used in institutionalization assessment model are summarized in Table 1.

**Table 1.** Main and sub-criteria of the institutionalization assessment model

| Main Criteria                 | Sub-criteria  |
|-------------------------------|---|
| C1: Strategic Management      | C11: Strategic Analysis<br>C12: Strategy Definition and Planning<br>C13: Strategic Performance Evaluation   |
| C2: Process Management        | C21: Process Identification and Monitoring<br>C22: Process Improvement and Innovation<br>C23: Process Implementation  |
| C3: Technology Management     | C31: Technology Planning<br>C32: Research and Development, Innovation Management<br>C33: Marketing and Commercialization of Technology  |
| C4: Product Management        | C41: Product Planning& Product Data Management<br>C42: Product Specifications<br>C43: Product Innovation  |
| C5: Knowledge Management      | C51: Enterprise Knowledge Definition and Storage<br>C52: Usage of Knowledge and Knowledge Technology<br>C53: Knowledge Culture and Performance of Knowledge Management                              |
| C6: Human Resource Management | C61: Human Resource Planning, Selection and Orientation<br>C62: Personnel Development and Performance Evaluation<br>C63: Participation of management, labour relations and organizational structure |
| C7: Enterprise Environment    | C71: Suppliers<br>C72: Market and Competitors<br>C73: Customers   |

## 4. Technical Background

### 4.1. Fuzzy DEMATEL Method

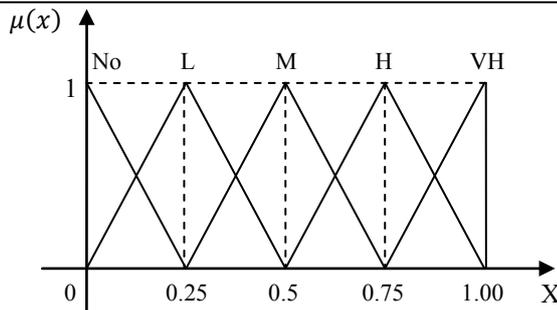
The DEMATEL method was developed by Gabus and Fontela (1972). It analyzes the influential status and strength between the factors and converts them into an explicit structural mode of a system (Lin and Wu, 2008). Lin and Wu (2004, 2008) developed a fuzzy DEMATEL method to gather group ideas and analyze the cause and effect relationship of complex problems in fuzzy environments. The procedure of the fuzzy DEMATEL method implemented in this study is explained below:

*Step 1: Identify the decision goal and set up a committee.* During the group decision making process, decision goal is decided first, and subsequently a committee is set up for gathering group knowledge for problem solving.

*Step 2: Develop the evaluation criteria and design the fuzzy linguistic scale.* For evaluation, sets of criteria are established. Since evaluation criteria have the nature of causal relationship and usually comprise several complicated aspects, and to deal with the ambiguities of human assessments, the fuzzy linguistic scale is used in the group decision making. The different degrees of influence are expressed with five linguistic terms as {No, Low, Medium, High, Very high} and their corresponding positive triangular fuzzy numbers are shown in Table 2 and see Fig. 1.

**Table 2.** The correspondence of linguistic terms and linguistic values

| Linguistic terms         | Linguistic values  |
|--------------------------|--------------------|
| No Influence (N)         | (0, 0, 0.25)       |
| Low Influence (L)        | (0, 0.25, 0.50)    |
| Medium Influence (M)     | (0.25, 0.50, 0.75) |
| High Influence (H)       | (0.50, 0.75, 1.00) |
| Very High Influence (VH) | (0.75, 1.00, 1.00) |



**Fig. 1.** Triangular fuzzy numbers for linguistic variables.

*Step 3: Acquire and average the assessments of decision makers.* In this step, a group of  $p$  expert is asked to acquire sets of pair-wise comparisons of the criteria  $\square = \{\square_{ij} | i, j = 1, 2, \dots, \square\}$  by linguistic terms in order to measure the relationship between criteria. So,  $p$  fuzzy matrices  $\tilde{\square}^1, \tilde{\square}^2, \dots, \tilde{\square}^p$  were obtained, each corresponding to an expert. Then, the average fuzzy matrix  $\tilde{\square}$  is calculated as below and is called the initial direct-relation fuzzy matrix.

$$\tilde{\square} = \frac{\tilde{\square}^1 \oplus \tilde{\square}^2 \oplus \dots \oplus \tilde{\square}^p}{p} \quad (1)$$

The initial direct-relation fuzzy matrix  $\tilde{\square}$  is shown as following

$$\tilde{\square} = \begin{bmatrix} 0 & \tilde{\square}_{12} & \dots & \tilde{\square}_{1\square} \\ \tilde{\square}_{21} & 0 & \dots & \tilde{\square}_{2\square} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\square}_{\square 1} & \tilde{\square}_{\square 2} & \dots & 0 \end{bmatrix}$$

where  $\tilde{\square}_{ij} = (\square_{ij}, \square_{ij}, \square_{ij})$  are triangular fuzzy numbers.  $\tilde{\square}_{ij}$  ( $i = 1, 2, \dots, n$ ) is shown as zero but whenever is necessary it will be regarded as triangular fuzzy number (0, 0, 0).

*Step 4: Acquire the normalized direct-relation fuzzy matrix.* By normalizing the initial direct-relation fuzzy matrix, normalized direct-relation fuzzy matrix  $\tilde{\square}$  is obtained by using

$$\tilde{\square} = \begin{bmatrix} \tilde{\square}_{11} & \tilde{\square}_{12} & \dots & \tilde{\square}_{1\square} \\ \tilde{\square}_{21} & \tilde{\square}_{22} & \dots & \tilde{\square}_{2\square} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\square}_{\square 1} & \tilde{\square}_{\square 2} & \dots & \tilde{\square}_{\square\square} \end{bmatrix}$$

where

$$\tilde{\square}_{ij} = \frac{\tilde{\square}_{ij}}{\square} = \left( \frac{\square_{ij}}{\square}, \frac{\square_{ij}}{\square}, \frac{\square_{ij}}{\square} \right) \quad (2)$$

and

$$\square = \max_{1 \leq i \leq \square} \left( \sum_{j=1}^{\square} \square_{ij} \right) \quad (3)$$

It is assumed at least one  $i$  such that  $\sum_{j=1}^{\square} \square_{ij} < \square$  and this assumption is well satisfied in practical cases.

Step 5: Acquire the total-relation fuzzy matrix. Let  $\tilde{\square}_{\square\square} = (\square'_{\square\square}, \square'_{\square\square}, \square'_{\square\square})$  and define three crisp matrices, whose elements are extracted from  $\tilde{\square}$ , as follows:

$$\square_{\square\square} = \begin{bmatrix} 0 & \square'_{12} & \dots & \square'_{1\square} \\ \square'_{21} & 0 & \dots & \square'_{2\square} \\ \vdots & \vdots & \ddots & \vdots \\ \square'_{\square 1} & \square'_{\square 2} & \dots & 0 \end{bmatrix} \quad \square_{\square\square} = \begin{bmatrix} 0 & \square'_{12} & \dots & \square'_{1\square} \\ \square'_{21} & 0 & \dots & \square'_{2\square} \\ \vdots & \vdots & \ddots & \vdots \\ \square'_{\square 1} & \square'_{\square 2} & \dots & 0 \end{bmatrix} \quad \square_{\square\square} = \begin{bmatrix} 0 & \square'_{12} & \dots & \square'_{1\square} \\ \square'_{21} & 0 & \dots & \square'_{2\square} \\ \vdots & \vdots & \ddots & \vdots \\ \square'_{\square 1} & \square'_{\square 2} & \dots & 0 \end{bmatrix}$$

As in the crisp DEMATEL, total-relation fuzzy matrix  $\tilde{\square}$  is defined as  $\tilde{\square} = \lim_{\square \rightarrow \infty} (\tilde{\square} + \tilde{\square}^2 + \dots + \tilde{\square}^{\square})$  and is shown as:

$$\tilde{\square} = \begin{bmatrix} \tilde{\square}_{11} & \tilde{\square}_{12} & \dots & \tilde{\square}_{1\square} \\ \tilde{\square}_{21} & \tilde{\square}_{22} & \dots & \tilde{\square}_{2\square} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\square}_{\square 1} & \tilde{\square}_{\square 2} & \dots & \tilde{\square}_{\square\square} \end{bmatrix} \quad \text{where } \tilde{\square}_{\square\square} = (\square''_{\square\square}, \square''_{\square\square}, \square''_{\square\square}) \text{ and}$$

$$[\square''_{\square\square}] = \square_{\square\square} \times (\square - \square_{\square\square})^{-1} \quad (4)$$

$$[\square''_{\square\square}] = \square_{\square\square} \times (\square - \square_{\square\square})^{-1} \quad (5)$$

$$[\square''_{\square\square}] = \square_{\square\square} \times (\square - \square_{\square\square})^{-1} \quad (6)$$

Step 6: Obtaining  $(\tilde{\square}_{\square\square} + \tilde{\square}_{\square\square})^{\square\square\square}$  and  $(\tilde{\square}_{\square\square} - \tilde{\square}_{\square\square})^{\square\square\square}$  values. Each  $\tilde{\square}_{\square\square} = (\square''_{\square\square}, \square''_{\square\square}, \square''_{\square\square})$  triangular fuzzy numbers of total-relation fuzzy matrix  $\tilde{\square}$  is defuzzified and  $\tilde{\square}^{\square\square\square}$  matrix is obtained as defined below:

$$\tilde{\square}^{\square\square\square} = \begin{bmatrix} \tilde{\square}_{11}^{\square\square\square} & \tilde{\square}_{12}^{\square\square\square} & \dots & \tilde{\square}_{1\square}^{\square\square\square} \\ \tilde{\square}_{21}^{\square\square\square} & \tilde{\square}_{22}^{\square\square\square} & \dots & \tilde{\square}_{2\square}^{\square\square\square} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\square}_{\square 1}^{\square\square\square} & \tilde{\square}_{\square 2}^{\square\square\square} & \dots & \tilde{\square}_{\square\square}^{\square\square\square} \end{bmatrix} \quad \text{where } \tilde{\square}_{\square\square}^{\square\square\square} = (\square''_{\square\square}, \square''_{\square\square}, \square''_{\square\square})^{\square\square\square}$$

Then,  $\tilde{\square}_{\square\square}^{\square\square\square}$ ,  $\tilde{\square}_{\square\square}^{\square\square\square}$ ,  $(\tilde{\square}_{\square\square}^{\square\square\square} + \tilde{\square}_{\square\square}^{\square\square\square})$  and  $(\tilde{\square}_{\square\square}^{\square\square\square} - \tilde{\square}_{\square\square}^{\square\square\square})$  values are calculated as in crisp DEMATEL method where  $\tilde{\square}_{\square\square}^{\square\square\square}$  and  $\tilde{\square}_{\square\square}^{\square\square\square}$  are the sum of rows and columns of matrix  $\tilde{\square}^{\square\square\square}$ , respectively.

In this study CFCS (Converting Fuzzy data into Crisp Scores) defuzzification method proposed by Opricovic and Tzeng (2003) is used for calculating defuzzified total-relation matrix  $\tilde{\square}^{\square\square\square}$ .

## 4.2. CFCS Defuzzification Method

There are several defuzzification methods. The most commonly used defuzzification method is the Centroid (Center of gravity) method (Yagler and Filev, 1994), but this does not distinguish between two fuzzy numbers which have the same crisp value in spite of different shapes. Therefore CFCS defuzzification method is used since it can give a better crisp value than the Centroid method.

CFCS method is generated by Opricovic and Tzeng (2003) for multi-criteria decision making which can distinguish two symmetrical triangular fuzzy numbers with the same mean, whereas the Centroid method does not distinguish between two such fuzzy numbers. CFCS method can also be applied when some values are crisp,  $\tilde{\square} = u$ .

Let  $\tilde{\square}_{\square\square} = (\square_{\square\square}, \square_{\square\square}, \square_{\square\square}), j=1, 2, \dots, J$  be triangular fuzzy numbers, where  $J$  is the number of alternatives. The crisp value of  $i$ -th criterion could be determined by the following four step CFCS algorithm:

1. Normalization:

$$\square = \max_{\square} \square_{\square\square}, \square = \min_{\square} \square_{\square\square} \text{ and } \Delta = \square - \square$$

Compute for each alternatives

$$\square_{\square\square} = (\square_{\square\square} - \square)/\Delta, \square_{\square\square} = (\square_{\square\square} - \square)/\Delta, \square_{\square\square} = (\square_{\square\square} - \square)/\Delta \quad (7)$$

2. Compute left score (ls) and right score (rs) normalized values:

$$\square_{\square\square}^{\square\square} = \square_{\square\square}/(1 + \square_{\square\square} - \square_{\square\square}) \text{ and } \square_{\square\square}^{\square\square} = \square_{\square\square}/(1 + \square_{\square\square} - \square_{\square\square}) \quad (8)$$

3. Compute total normalized crisp value:

$$\alpha_{ij}^{\text{total}} = [\alpha_{ij}^{\text{local}} \times (1 - \alpha_{ij}^{\text{local}}) + \alpha_{ij}^{\text{local}} \times \alpha_{ij}^{\text{total}}] / [1 - \alpha_{ij}^{\text{local}} + \alpha_{ij}^{\text{total}}] \quad (9)$$

4. Compute crisp values for  $\tilde{\alpha}_{ij}$ :

$$\tilde{\alpha}_{ij}^{\text{total}} = \alpha_{ij}^{\text{total}} + \alpha_{ij}^{\text{total}} \times \Delta \quad (10)$$

### 4.3. Fuzzy ANP Method

Analytic network process (ANP) is the general form of analytic hierarchy process (AHP) and was proposed by Saaty (1996) to overcome the problem of interrelation among criteria or factors. Through a supermatrix, whose entries are themselves matrices of column priorities, the ANP synthesizes the outcome of dependence and feedback within and between clusters of elements (Yang and Chang, 2012). The initial supermatrix must be transformed to a matrix in which each of its columns sums to unity. For this reason, this matrix must be normalized by the cluster's weight to get the column sums to unity. Hence, the weighted supermatrix is obtained (Saaty and Vargas, 1998). The supermatrix representation is given in Fig. 2.

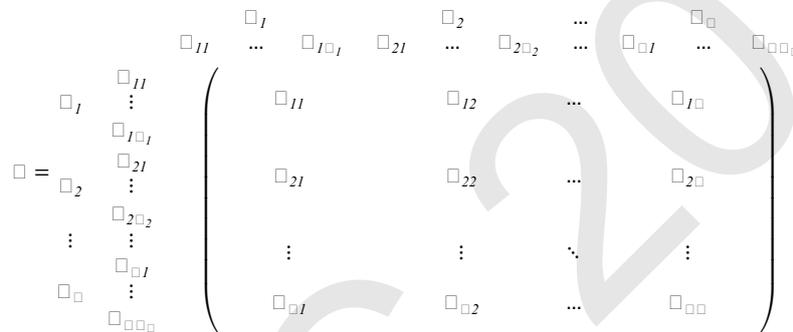


Fig. 2. The supermatrix representation

ANP equipped with fuzzy set theory helps in overcoming the impreciseness or vagueness in the preferences. Fuzzy set theory is more advantages than traditional set theory when describing set concepts in human language. The Fuzzy ANP (FANP) method can easily accommodate the interrelationships existing among the functional activities (Mohanty et al., 2005). Table 3 gives the fuzzy linguistic terms and corresponding triangular fuzzy numbers (TFNs) which are used for pairwise comparisons. The pairwise comparisons are implemented according to Fuzzy ANP method within each cluster or main criteria, and according to dependency relationships which are obtained from DEMATEL in order to generate relative importance weights.

Table 3. The Linguistic variables and triangular fuzzy numbers for importance

| Linguistic variables      | Fuzzy number | Triangular fuzzy number | Triangular fuzzy reciprocal number |
|---------------------------|--------------|-------------------------|------------------------------------|
| Equally Important (EI)    | $\tilde{1}$  | (1, 1, 1)               | (1, 1, 1)                          |
| Weekly Important (WI)     | $\tilde{3}$  | (1, 3, 5)               | (1/5, 1/3, 1)                      |
| Strongly Important (SI)   | $\tilde{5}$  | (3, 5, 7)               | (1/7, 1/5, 1/3)                    |
| Very Important (VI)       | $\tilde{7}$  | (5, 7, 9)               | (1/9, 1/7, 1/5)                    |
| Absolutely Important (AI) | $\tilde{9}$  | (7, 9, 9)               | (1/9, 1/9, 1/7)                    |

There are many fuzzy AHP methods for calculating weights to be used in supermatrix of ANP. These methods were proposed by various authors in the literature (Buckley, 1985; Chang, 1992, 1996; Cheng, 1997; Deng, 1999; Leung & Cao, 2000; Mikhailov, 2004; Van Laarhoven & Pedrycz, 1983). These methods are systematic approaches to the alternative selection and justification problem by using the concepts of fuzzy set theory and hierarchical structure analysis (Yüksel and Dağdeviren, 2010). In this study, Chang's (1996) extent analysis method is employed. The extent analysis method is described below.

Let  $\square = \{\square_1, \square_2, \dots, \square_\square\}$  be an object set, and  $\square = \{\square_1, \square_2, \dots, \square_\square\}$  be a goal set. According to the method, each object is taken and extent analysis for each goal,  $\square_\square$ , is performed, respectively. Therefore,  $m$  extent analysis values for each object can be obtained with the following signs:

$$\square_{\square_\square}^1, \square_{\square_\square}^2, \dots, \square_{\square_\square}^\square, \quad \square = 1, 2, \dots, \square$$

where all the  $\square_{\square_\square}^\square$  ( $\square = 1, 2, \dots, \square$ ) are triangular fuzzy numbers (TFNs).

The steps of the extent analysis method are given below:

*Step 1:* The value of fuzzy synthetic extent with respect to the  $i$ th object is defined as

$$\square_\square = \sum_{\square=1}^\square \square_{\square_\square}^\square \otimes \left[ \sum_{\square=1}^\square \sum_{\square=1}^\square \square_{\square_\square}^\square \right]^{-1} \quad (11)$$

To obtain  $\sum_{\square=1}^\square \square_{\square_\square}^\square$ , perform the fuzzy addition operation of  $m$  extent analysis values for a particular matrix such that

$$\sum_{\square=1}^\square \square_{\square_\square}^\square = (\sum_{\square=1}^\square \square_\square, \sum_{\square=1}^\square \square_\square, \sum_{\square=1}^\square \square_\square), \quad (12)$$

and to obtain  $\left[ \sum_{\square=1}^\square \sum_{\square=1}^\square \square_{\square_\square}^\square \right]^{-1}$ , perform the fuzzy addition operation of  $\square_{\square_\square}^\square$  ( $\square = 1, 2, \dots, \square$ ) values such that

$$\sum_{\square=1}^\square \sum_{\square=1}^\square \square_{\square_\square}^\square = (\sum_{\square=1}^\square \square_\square, \sum_{\square=1}^\square \square_\square, \sum_{\square=1}^\square \square_\square) \quad (13)$$

and then compute the inverse of the vector in Eq. (9) such that

$$\left[ \sum_{\square=1}^\square \sum_{\square=1}^\square \square_{\square_\square}^\square \right]^{-1} = \left( \frac{1}{\sum_{\square=1}^\square \square_\square}, \frac{1}{\sum_{\square=1}^\square \square_\square}, \frac{1}{\sum_{\square=1}^\square \square_\square} \right) \quad (14)$$

*Step 2:* The degree of possibility of  $\square_2 = (\square_2, \square_2, \square_2) \geq \square_1 = (\square_1, \square_1, \square_1)$  is defined as

$$\square(\square_2 \geq \square_1) = \square \square \square \left[ \square \square \square \left( \square_{\square_1}(\square), \square_{\square_2}(\square) \right) \right]$$

and can be equivalently expressed as follows:

$$\square(\square_2 \geq \square_1) = \square \square \square (\square_1 \cap \square_2) = \square_{\square_2}(\square) = \begin{cases} 1, & \text{if } \square_2 \geq \square_1, \\ 0, & \text{if } \square_1 \geq \square_2, \\ \frac{\square_1 - \square_2}{(\square_2 - \square_2) - (\square_1 - \square_1)}, & \text{otherwise,} \end{cases} \quad (15)$$

where  $d$  is the ordinate of the highest intersection point  $d$  between  $\square_{\square_1}$  and  $\square_{\square_2}$  (see Fig. 3). Both values of  $\square(\square_1 \geq \square_2)$  and  $\square(\square_2 \geq \square_1)$  are required in order to compare  $\square_1$  and  $\square_2$ .

*Step 3:* The degree possibility for a convex fuzzy number to be greater than  $k$  convex fuzzy numbers  $\square_\square$  ( $\square = 1, 2, \dots, \square$ ) can be defined by

$$\begin{aligned} \square(\square \geq \square_1, \square_2, \dots, \square_\square) &= \square[(\square \geq \square_1) \text{ and } (\square \geq \square_2) \text{ and } \dots \text{ and } (\square \geq \square_\square)] \\ &= \min \square(\square \geq \square_\square), \quad \square = 1, 2, \dots, \square. \end{aligned} \quad (16)$$

Assume that

$$\square'(\square_\square) = \min \square(\square_\square \geq \square_\square) \quad \text{for } \square = 1, 2, \dots, \square; \square \neq \square. \quad (17)$$

Then the weight vector is given by

$$\square' = \left( \square'(\square_1), \square'(\square_2), \dots, \square'(\square_\square) \right)^\square, \quad (18)$$

where  $\square_\square$  ( $\square = 1, 2, \dots, \square$ ) are  $n$  elements.

*Step 4:* Via the normalization, the normalized weight vectors are

$$\square = \left( \square(\square_1), \square(\square_2), \dots, \square(\square_\square) \right)^\square, \quad (19)$$

where  $\square$  is a nonfuzzy number.

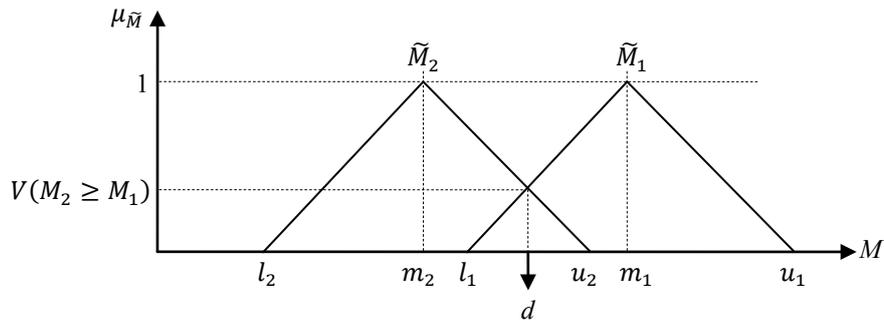


Fig. 3. The intersection between  $\square_1$  and  $\square_2$

### 4.3. VIKOR Method

VIKOR was developed by Opricovic (1998) and Opricovic and Tzeng (2002) with the Serbian name: ViseKriterijumska Optimizacija I Kompromisno Resenje, means multi-criteria optimization and compromise solution. The VIKOR method was developed for multicriteria optimization of complex systems and this method focuses on ranking and selecting from a set of alternatives, and determines compromise solutions for a problem with conflicting criteria, which can help the decision makers to reach a final decision. Development of the VIKOR method started with the following form of Lp-metric:

$$\square_{\square}^{\square} = \{[\sum_{\square=1}^{\square} \square_{\square} (|\square_{\square}^* - \square_{\square\square}|) / (\square_{\square}^* - \square_{\square}^{-})]^{\square}\}^{1/\square} \quad (20)$$

where  $1 \leq \square \leq \infty$ ; alternatives  $i = 1, 2, \dots, m$ ;  $\square_{\square}$  is derived from fuzzy ANP.

In the VIKOR method  $\square_{\square}^{\square=1}$  (as  $\square_{\square}$ ) and  $\square_{\square}^{\square=\infty}$  (as  $\square_{\square}$ ) are used to formulate ranking measure. The solution obtained by  $\square_{\square}$  is with a maximum group utility (“majority” rule), and the solution obtained by  $\min \square_{\square}$  is with a minimum individual regret of the “opponent”.

The main steps of the algorithm are taken from Sanayei et al.’s (2010) study:

*Step 1: Obtain an aspired or tolerable level.* Calculate the best  $\square_{\square}^*$  values (aspired level) and the worst  $\square_{\square}^{-}$  values (tolerable value) for all criterion  $j = 1, 2, \dots, n$ . Suppose the  $j$ th function denotes benefits:

$$\square_{\square}^* = \square \square \square \square \square \square \square$$

$$\square_{\square}^{-} = \square \square \square \square \square \square \square$$

or these values can be set by decision makers.

*Step 2: Calculate mean of group utility and maximal regret.*  $\square_{\square}$  is the synthesized gap for all criteria and  $\square_{\square}$  is the maximal gap in  $i$  criterion for prior improvement.

$$\square_{\square} = \sum_{\square=1}^{\square} \square_{\square} (|\square_{\square}^* - \square_{\square\square}|) / (\square_{\square}^* - \square_{\square}^{-}) \quad (21)$$

$$\square_{\square} = \max_{\square} (|\square_{\square}^* - \square_{\square\square}|) / (\square_{\square}^* - \square_{\square}^{-}) \quad (22)$$

*Step 3: Calculate the index value.*

$$\square_{\square} = \square \frac{(\square_{\square} - \square_{\square}^*)}{(\square_{\square}^{-} - \square_{\square}^*)} + (1 - \square) \frac{(\square_{\square} - \square_{\square}^*)}{(\square_{\square}^{-} - \square_{\square}^*)} \quad (23)$$

where

$$\square^* = \square \square \square \square \square \square, \square^{-} = \square \square \square \square \square \square, \square^* = \square \square \square \square \square \square, \square^{-} = \square \square \square \square \square \square$$

and  $\nu$  is introduced as the weight for the strategy of maximum group utility, whereas  $(1 - \nu)$  is the weight of the individual regret.

*Step 4: Rank or improve the alternatives for a compromise solution.* Order them decreasingly by the value of  $\square_{\square}$ ,  $\square_{\square}$  and  $\square_{\square}$ . Propose the alternative  $\square^{(I)}$  as a compromise solution which is arranged by the measure  $\min \square_{\square}$  when the two conditions are satisfied:

**C1.** Acceptable advantage:

$$|r_{(2)} - r_{(1)}| \geq 1/(m - 1)$$

where  $m$  is the number of alternatives and  $r_{(2)}$  is the second position in the alternatives ranked by  $r_{(1)}$ .

**C2.** Acceptable stability in decision making: Alternative  $r_{(1)}$  must also be the best ranked by  $r_{(2)}$  or/and  $r_{(3)}$ .

If one of the conditions is not satisfied, then a set of compromise solutions is proposed, which consist of:

- Alternatives  $r_{(1)}$  and  $r_{(2)}$  if only the condition C2 is not satisfied,
- or
- Alternatives  $r_{(1)}, r_{(2)}, \dots, r_{(M)}$  if the condition C1 is not satisfied.  $r_{(M)}$  is determined by the relation  $Q(r_{(M)}) - Q(r_{(M+1)}) < DQ$  for maximum  $M$  (the positions of these alternatives are close).

## 5. Implementation and Discussion

The case study is implemented in Sakarya, Turkey. First, interactions among the main criteria are derived asking expert opinions and using fuzzy DEMATEL approach. Then fuzzy ANP method is implemented according to the expert opinions in order to calculate the local weights of the sub-criteria. After determining the weights, five SMEs are investigated and graded according to each sub-criterion. As a result, each SME is scored between 0 and 100 implementing TOPSIS method.

The evaluation of one of the experts in terms of the effect between the criteria is given in Table 4. The corresponding triangular fuzzy numbers for the linguistic terms of the expert are given in Table 5. The linguistic terms and corresponding fuzzy numbers which were used during fuzzy DEMATEL approach were given in Table 2. Similarly, all of the evaluations from the rest of the experts are obtained and then averages of related triangular fuzzy numbers are calculated using Eq. (1). The average values are given in Table 6. The normalized direct-relation fuzzy matrix is obtained using Eqs. (2 and 3) and the result is shown in Table 7. After calculating the normalized direct-relation fuzzy matrix, the total-relation fuzzy matrix is obtained using Eqs. (4, 5, and 6). The total-relation fuzzy matrix is shown in Table 8.

**Table 4.** Linguistic evaluation of an expert in terms of effect among the criteria

|    | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|----|----|----|----|----|----|----|----|
| C1 | N  | M  | H  | H  | VH | VH | M  |
| C2 | M  | N  | L  | M  | M  | M  | M  |
| C3 | H  | L  | N  | H  | M  | M  | M  |
| C4 | H  | H  | M  | N  | L  | L  | L  |
| C5 | VH | H  | H  | H  | N  | M  | H  |
| C6 | H  | L  | M  | L  | M  | N  | M  |
| C7 | VH | L  | M  | H  | M  | M  | N  |

**Table 5.** Corresponding triangular fuzzy number for linguistic evaluation

|    | C1   |      |      | C2   |      |      | C3   |      |      | C4   |      |      | C5   |      |      | C6   |      |      | C7   |      |      |
|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| C1 | 0.00 | 0.00 | 0.00 | 0.25 | 0.50 | 0.75 | 0.50 | 0.75 | 1.00 | 0.50 | 0.75 | 1.00 | 0.75 | 1.00 | 1.00 | 0.75 | 1.00 | 1.00 | 0.25 | 0.50 | 0.75 |
| C2 | 0.25 | 0.50 | 0.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.50 | 0.25 | 0.50 | 0.75 | 0.25 | 0.50 | 0.75 | 0.25 | 0.50 | 0.75 | 0.25 | 0.50 | 0.75 |
| C3 | 0.50 | 0.75 | 1.00 | 0.00 | 0.25 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.75 | 0.25 | 0.50 | 0.75 | 0.25 | 0.50 | 0.75 | 0.25 | 0.50 | 0.75 |
| C4 | 0.50 | 0.75 | 1.00 | 0.50 | 0.75 | 1.00 | 0.25 | 0.50 | 0.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.50 | 0.00 | 0.25 | 0.50 | 0.00 | 0.25 | 0.50 |
| C5 | 0.75 | 1.00 | 1.00 | 0.50 | 0.75 | 1.00 | 0.50 | 0.75 | 1.00 | 0.50 | 0.75 | 1.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.50 | 0.75 | 0.50 | 0.75 | 1.00 |
| C6 | 0.50 | 0.75 | 1.00 | 0.00 | 0.25 | 0.50 | 0.25 | 0.50 | 0.75 | 0.00 | 0.25 | 0.50 | 0.25 | 0.50 | 0.75 | 0.00 | 0.00 | 0.00 | 0.25 | 0.50 | 0.75 |
| C7 | 0.75 | 1.00 | 1.00 | 0.00 | 0.25 | 0.50 | 0.25 | 0.50 | 0.75 | 0.50 | 0.75 | 1.00 | 0.25 | 0.50 | 0.75 | 0.25 | 0.50 | 0.75 | 0.00 | 0.00 | 0.00 |

**Table 6.** The initial direct-relation fuzzy matrix

|    | C1    |       |       | C2    |       |       | C3    |       |       | C4    |       |       | C5    |       |       | C6    |       |       | C7    |       |       |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| C1 | 0.000 | 0.000 | 0.000 | 0.542 | 0.792 | 0.917 | 0.417 | 0.667 | 0.875 | 0.375 | 0.625 | 0.833 | 0.625 | 0.875 | 1.000 | 0.583 | 0.833 | 0.958 | 0.250 | 0.500 | 0.750 |
| C2 | 0.500 | 0.750 | 0.917 | 0.000 | 0.000 | 0.000 | 0.333 | 0.583 | 0.833 | 0.333 | 0.583 | 0.833 | 0.417 | 0.667 | 0.875 | 0.208 | 0.458 | 0.708 | 0.167 | 0.417 | 0.667 |
| C3 | 0.417 | 0.667 | 0.917 | 0.417 | 0.667 | 0.875 | 0.000 | 0.000 | 0.000 | 0.583 | 0.833 | 0.958 | 0.417 | 0.667 | 0.875 | 0.375 | 0.625 | 0.833 | 0.250 | 0.500 | 0.750 |
| C4 | 0.458 | 0.708 | 0.875 | 0.458 | 0.708 | 0.917 | 0.417 | 0.667 | 0.875 | 0.000 | 0.000 | 0.000 | 0.292 | 0.542 | 0.792 | 0.333 | 0.583 | 0.792 | 0.333 | 0.583 | 0.792 |
| C5 | 0.667 | 0.917 | 1.000 | 0.458 | 0.708 | 0.917 | 0.458 | 0.708 | 0.917 | 0.458 | 0.708 | 0.958 | 0.000 | 0.000 | 0.000 | 0.458 | 0.708 | 0.917 | 0.542 | 0.792 | 1.000 |
| C6 | 0.542 | 0.792 | 1.000 | 0.250 | 0.500 | 0.750 | 0.333 | 0.583 | 0.792 | 0.250 | 0.500 | 0.708 | 0.417 | 0.667 | 0.875 | 0.000 | 0.000 | 0.000 | 0.250 | 0.500 | 0.750 |
| C7 | 0.583 | 0.833 | 0.958 | 0.042 | 0.292 | 0.542 | 0.250 | 0.500 | 0.750 | 0.500 | 0.750 | 0.958 | 0.292 | 0.542 | 0.792 | 0.292 | 0.542 | 0.792 | 0.000 | 0.000 | 0.000 |

**Table 7.** The normalized direct-relation fuzzy matrix

|    | C1    | C2    | C3    | C4    | C5    | C6    | C7    |
|----|-------|-------|-------|-------|-------|-------|-------|
| C1 | 0.000 | 0.000 | 0.095 | 0.139 | 0.161 | 0.073 | 0.117 |
| C2 | 0.088 | 0.131 | 0.161 | 0.000 | 0.000 | 0.058 | 0.102 |
| C3 | 0.073 | 0.117 | 0.161 | 0.073 | 0.117 | 0.153 | 0.000 |
| C4 | 0.080 | 0.124 | 0.153 | 0.080 | 0.124 | 0.161 | 0.073 |
| C5 | 0.117 | 0.161 | 0.175 | 0.080 | 0.124 | 0.161 | 0.080 |
| C6 | 0.095 | 0.139 | 0.175 | 0.044 | 0.088 | 0.131 | 0.058 |
| C7 | 0.102 | 0.146 | 0.168 | 0.007 | 0.051 | 0.095 | 0.044 |

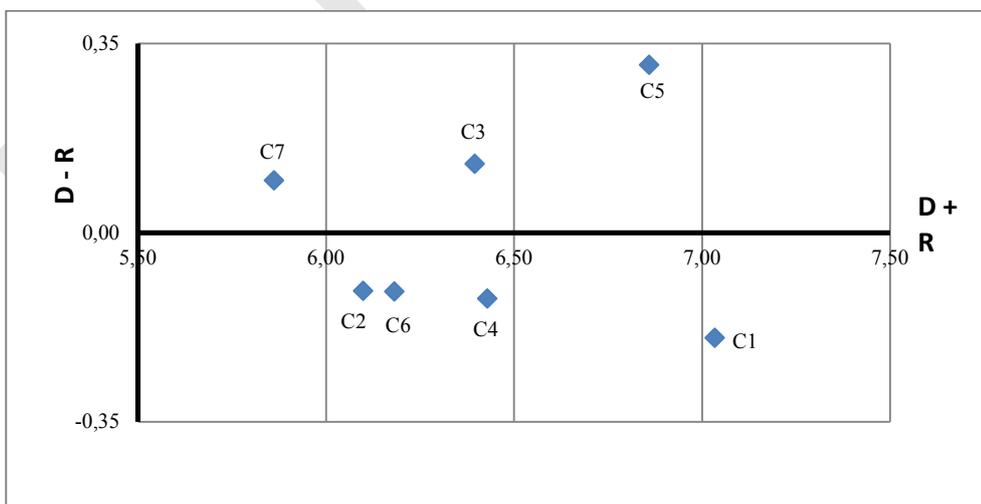
**Table 8.** The total-relation fuzzy matrix

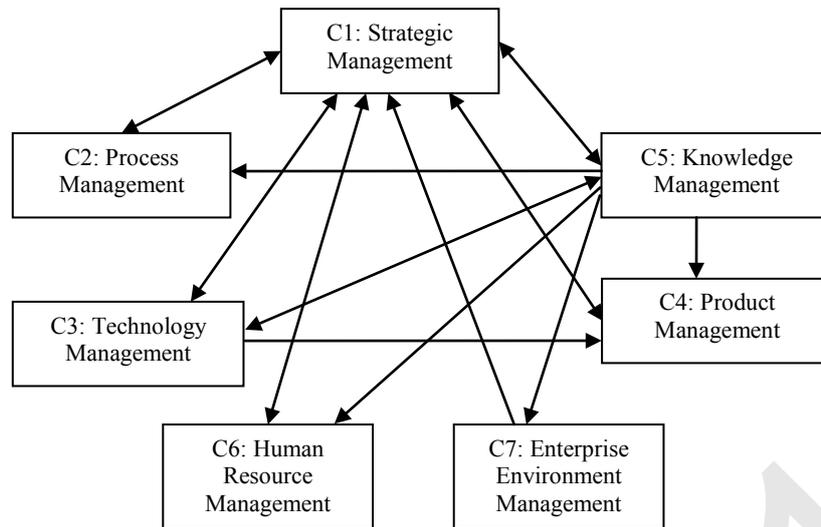
|    | C1    | C2    | C3    | C4    | C5    | C6    | C7    |
|----|-------|-------|-------|-------|-------|-------|-------|
| C1 | 0.071 | 0.280 | 1.285 | 1.139 | 0.352 | 1.282 | 0.120 |
| C2 | 0.132 | 0.347 | 1.319 | 0.040 | 0.192 | 1.051 | 0.093 |
| C3 | 0.130 | 0.364 | 1.396 | 0.115 | 0.318 | 1.252 | 0.046 |
| C4 | 0.132 | 0.359 | 1.353 | 0.117 | 0.315 | 1.224 | 0.110 |
| C5 | 0.182 | 0.433 | 1.509 | 0.130 | 0.350 | 1.347 | 0.129 |
| C6 | 0.140 | 0.358 | 1.339 | 0.082 | 0.275 | 1.175 | 0.094 |
| C7 | 0.144 | 0.359 | 1.315 | 0.048 | 0.241 | 1.130 | 0.080 |

The fuzzy values in total-relation fuzzy matrix is defuzzified by CFCS method using Eqs. (7-10). Then  $(\tilde{r}_{ij}^{+} + \tilde{r}_{ij}^{-})$  and  $(\tilde{r}_{ij}^{+} - \tilde{r}_{ij}^{-})$  values are calculated and shown in Table 9. The threshold value is determined as 0.48 according to the expert opinions. The values above the threshold are represented in bold in the table which gives the cause and effect relationship among the criteria. By using the dataset  $(\tilde{r}_{ij}^{+} + \tilde{r}_{ij}^{-})$  and  $(\tilde{r}_{ij}^{+} - \tilde{r}_{ij}^{-})$  given in Table 9, the causal diagram could be plotted as in Fig 3. The impact relation map indicating cause and effect relationship among main criteria can be illustrated as in Fig. 4, based on the information given in Table 9.

**Table 9.** Defuzzified total-relation matrix

|                   | C1          | C2          | C3          | C4          | C5          | C6          | C7          | $\tilde{r}_{ij}^{+} + \tilde{r}_{ij}^{-}$ | $\tilde{r}_{ij}^{+} - \tilde{r}_{ij}^{-}$ |
|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---|---|
| C1                | 0.45        | <b>0.50</b> | <b>0.49</b> | <b>0.50</b> | <b>0.53</b> | <b>0.51</b> | 0.44        | 3.42                                      | 7.03                                      |
| C2                | 0.50        | 0.34        | 0.44        | 0.45        | 0.46        | 0.42        | 0.39        | 3.00                                      | 6.10                                      |
| C3                | <b>0.53</b> | 0.47        | 0.37        | <b>0.51</b> | <b>0.49</b> | 0.47        | 0.42        | 3.26                                      | 6.40                                      |
| C4                | <b>0.52</b> | 0.46        | 0.46        | 0.37        | 0.46        | 0.45        | 0.42        | 3.15                                      | 6.43                                      |
| C5                | <b>0.59</b> | <b>0.51</b> | <b>0.51</b> | <b>0.53</b> | 0.43        | <b>0.52</b> | <b>0.50</b> | 3.59                                      | 6.86                                      |
| C6                | <b>0.52</b> | 0.43        | 0.44        | 0.44        | 0.47        | 0.35        | 0.40        | 3.04                                      | 6.18                                      |
| C7                | <b>0.51</b> | 0.39        | 0.42        | 0.47        | 0.44        | 0.43        | 0.31        | 2.98                                      | 5.86                                      |
| $\bar{R}_i^{def}$ | 3.61        | 3.10        | 3.13        | 3.28        | 3.27        | 3.15        | 2.88        |   |   |


**Fig. 3.** The influence diagram of the main criteria



**Fig. 4.** The impact relation map for main criteria

According to the cause and effect relationship extracted from the fuzzy DEMATEL method, the weights of the sub-criteria are calculated following fuzzy ANP approach in order to form the supermatrix. For example, since “C1: Strategic Management” effects “C2: Process Management”, the fuzzy evaluation of importance of sub-criteria of C2 (C21, C22 and C23) in terms of C11 is given in Table 10. Then geometric average is taken after obtaining evaluations of the rest of the experts in order to calculate the local weights using Eqs. (11-19). The result is shown in Table 11.

The rest of the local weights are calculated in the same way based on the interaction derived from the fuzzy DEMATEL. The supermatrix is formed for the sub-criteria and the local weights calculated are placed into the matrix accordingly. The unweighted supermatrix is presented in Table 12. Then, unweighted supermatrix is normalized to transform it the weighted supermatrix in which each of its columns sums to 1. The power of the weighted supermatrix is taken until the values of each column are stabilized and equal. These calculations are implemented using MATLAB software and the limit supermatrix is obtained which is given in Table 13. Any column of the matrix shows the weights of corresponding sub-criteria.

**Table 10.** Pairwise comparison matrix of an expert terms of C11: Strategic Analysis

| Linguistic variables | Fuzzy numbers |     |     |     |      |      |      |      |      |      |      |      |      |
|----------------------|---------------|-----|-----|-----|------|------|------|------|------|------|------|------|------|
|                      | C21           | C22 | C23 | C21 |      |      | C22  |      |      | C23  |      |      |      |
| C21                  | EI            | SI  | VI  | C21 | 1.00 | 1.00 | 1.00 | 3.00 | 5.00 | 7.00 | 5.00 | 7.00 | 9.00 |
| C22                  |               | EI  | WI  | C22 | 0.14 | 0.20 | 0.33 | 1.00 | 1.00 | 1.00 | 1.00 | 3.00 | 5.00 |
| C23                  |               |     | EI  | C23 | 0.11 | 0.14 | 0.20 | 0.20 | 0.33 | 1.00 | 1.00 | 1.00 | 1.00 |

**Table 11.** Geometric average of all the expert evaluations, and the weights

|     | C21  |      |      | C22  |      |      | C23  |      |      | Wi          |
|-----|------|------|------|------|------|------|------|------|------|-------------|
| C21 | 1.00 | 1.00 | 1.00 | 3.87 | 5.92 | 7.94 | 5.92 | 7.94 | 9.00 | <b>0.95</b> |
| C22 | 0.12 | 0.17 | 0.26 | 1.00 | 1.00 | 1.00 | 1.00 | 3.00 | 5.00 | <b>0.05</b> |
| C23 | 0.11 | 0.13 | 0.17 | 0.20 | 0.33 | 1.00 | 1.00 | 1.00 | 1.00 | <b>0.00</b> |

**Tablo 12.** Unweighted supermatrix

|     | C11  | C12  | C13  | C21  | C22  | C23  | C31  | C32  | C33  | C41  | C42  | C43  | C51  | C52  | C53  | C61  | C62  | C63  | C71  | C72  | C73  |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| C11 | 0    | 0    | 0    | 0.36 | 0.32 | 0.23 | 0.00 | 0.00 | 0.25 | 0.35 | 0.77 | 0.37 | 0.84 | 0.36 | 0.05 | 0.36 | 0.35 | 0.36 | 0.00 | 0.19 | 0.08 |
| C12 | 0    | 0    | 0    | 0.32 | 0.34 | 0.00 | 0.73 | 0.79 | 0.48 | 0.52 | 0.12 | 0.44 | 0.08 | 0.43 | 0.45 | 0.32 | 0.28 | 0.32 | 0.52 | 0.62 | 0.45 |
| C13 | 0    | 0    | 0    | 0.32 | 0.33 | 0.77 | 0.27 | 0.21 | 0.26 | 0.13 | 0.11 | 0.20 | 0.08 | 0.21 | 0.50 | 0.32 | 0.37 | 0.32 | 0.48 | 0.18 | 0.47 |
| C21 | 0.95 | 0.32 | 0.00 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.68 | 0.37 | 0.02 | 0    | 0    | 0    | 0    | 0    | 0    |
| C22 | 0.05 | 0.42 | 0.60 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.00 | 0.52 | 0.49 | 0    | 0    | 0    | 0    | 0    | 0    |
| C23 | 0.00 | 0.26 | 0.40 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.32 | 0.10 | 0.49 | 0    | 0    | 0    | 0    | 0    | 0    |
| C31 | 0.53 | 0.35 | 0.28 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.50 | 0.12 | 0.53 | 0    | 0    | 0    | 0    | 0    | 0    |
| C32 | 0.47 | 0.58 | 0.23 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.45 | 0.77 | 0.31 | 0    | 0    | 0    | 0    | 0    | 0    |
| C33 | 0.00 | 0.07 | 0.49 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.05 | 0.11 | 0.16 | 0    | 0    | 0    | 0    | 0    | 0    |
| C41 | 0.52 | 0.39 | 0.38 | 0    | 0    | 0    | 0.00 | 0.00 | 0.03 | 0    | 0    | 0    | 0.58 | 0.45 | 0.33 | 0    | 0    | 0    | 0    | 0    | 0    |
| C42 | 0.11 | 0.26 | 0.05 | 0    | 0    | 0    | 0.10 | 0.00 | 0.36 | 0    | 0    | 0    | 0.21 | 0.00 | 0.33 | 0    | 0    | 0    | 0    | 0    | 0    |
| C43 | 0.37 | 0.35 | 0.57 | 0    | 0    | 0    | 0.90 | 1.00 | 0.62 | 0    | 0    | 0    | 0.21 | 0.55 | 0.33 | 0    | 0    | 0    | 0    | 0    | 0    |
| C51 | 0.43 | 0.39 | 0.43 | 0    | 0    | 0    | 0.00 | 0.00 | 0.00 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| C52 | 0.20 | 0.00 | 0.21 | 0    | 0    | 0    | 0.95 | 1.00 | 0.49 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| C53 | 0.38 | 0.61 | 0.36 | 0    | 0    | 0    | 0.05 | 0.00 | 0.51 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| C61 | 0.63 | 0.77 | 0.35 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.46 | 0.33 | 0.34 | 0    | 0    | 0    | 0    | 0    | 0    |
| C62 | 0.00 | 0.12 | 0.37 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.09 | 0.35 | 0.14 | 0    | 0    | 0    | 0    | 0    | 0    |
| C63 | 0.37 | 0.11 | 0.28 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.45 | 0.32 | 0.51 | 0    | 0    | 0    | 0    | 0    | 0    |
| C71 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.61 | 0.33 | 0.36 | 0    | 0    | 0    | 0    | 0    | 0    |
| C72 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.39 | 0.33 | 0.28 | 0    | 0    | 0    | 0    | 0    | 0    |
| C73 | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0.00 | 0.33 | 0.36 | 0    | 0    | 0    | 0    | 0    | 0    |

**Tablo 13.** Limit supermatrix

|     | C11   | C12   | C13   | C21   | C22   | C23   | C31   | C32   | C33   | C41   | C42   | C43   | C51   | C52   | C53   | C61   | C62   | C63   | C71   | C72   | C73   |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| C11 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 | 0.138 |
| C12 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 | 0.158 |
| C13 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 |
| C21 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 |
| C22 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 |
| C23 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 |
| C31 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 | 0.040 |
| C32 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 | 0.047 |
| C33 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 |
| C41 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 |
| C42 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 |
| C43 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 | 0.073 |
| C51 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 |
| C52 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 |
| C53 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 |
| C61 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 | 0.057 |
| C62 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 |
| C63 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 | 0.029 |
| C71 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 |
| C72 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 |
| C73 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |

After calculating the weights of the criteria, it is time to implement VIKOR method, which is going to score institutionalization level of the SMEs investigated. Five SMEs are investigated in Sakarya region and assigned a score between 0-100 to each SME for each criterion. The scores are given in Table 14.  $\square_{\bar{}}^*$  is taken as 100 since it is the maximum score of each criterion and  $\square_{\bar{}}$  is taken as 0 since it is the minimum score of each criterion.

VIKOR method is implemented by using Eq. (21-23) in order to obtain  $\square_{\bar{}}$ ,  $\square_{\bar{}}$  and  $\square_{\bar{}}$  values. Table 15 shows the results ranked by  $\square_{\bar{}}$ ,  $\square_{\bar{}}$  and  $\square_{\bar{}}$ . It is found out that, firm D is the best institutionalized one among the alternatives. The rest of the SMEs are ranked as A, C, E and B.

**Table 14.** Evaluation of the firms in terms of the sub-criteria

|     | A     | B     | C     | D     | E     | $\square_{\square}^*$ | $\square_{\square}^-$ |
|-----|-------|-------|-------|-------|-------|-----------------------|-----------------------|
| C11 | 75.0  | 87.5  | 87.5  | 87.5  | 100.0 | 100                   | 0                     |
| C12 | 81.3  | 0.0   | 68.8  | 75.0  | 75.0  | 100                   | 0                     |
| C13 | 75.0  | 80.0  | 75.0  | 90.0  | 65.0  | 100                   | 0                     |
| C21 | 63.4  | 60.3  | 75.9  | 65.6  | 41.5  | 100                   | 0                     |
| C22 | 56.3  | 68.8  | 81.3  | 68.8  | 56.3  | 100                   | 0                     |
| C23 | 100.0 | 100.0 | 100.0 | 75.0  | 75.0  | 100                   | 0                     |
| C31 | 75.0  | 62.5  | 85.0  | 80.0  | 62.5  | 100                   | 0                     |
| C32 | 81.3  | 47.5  | 70.0  | 92.5  | 56.3  | 100                   | 0                     |
| C33 | 50.0  | 87.5  | 50.0  | 100.0 | 75.0  | 100                   | 0                     |
| C41 | 82.5  | 67.5  | 82.5  | 85.0  | 62.5  | 100                   | 0                     |
| C42 | 87.5  | 89.3  | 78.6  | 87.5  | 75.0  | 100                   | 0                     |
| C43 | 75.0  | 65.0  | 55.0  | 95.0  | 75.0  | 100                   | 0                     |
| C51 | 88.5  | 55.8  | 94.2  | 65.4  | 59.6  | 100                   | 0                     |
| C52 | 81.3  | 87.5  | 96.9  | 68.8  | 50.0  | 100                   | 0                     |
| C53 | 75.0  | 59.4  | 78.1  | 68.8  | 50.0  | 100                   | 0                     |
| C61 | 81.8  | 79.5  | 95.5  | 63.6  | 54.5  | 100                   | 0                     |
| C62 | 75.0  | 53.9  | 86.8  | 57.9  | 57.9  | 100                   | 0                     |
| C63 | 75.0  | 51.6  | 95.3  | 68.8  | 67.2  | 100                   | 0                     |
| C71 | 75.0  | 58.3  | 95.8  | 66.7  | 70.8  | 100                   | 0                     |
| C72 | 100.0 | 37.5  | 100.0 | 68.8  | 68.8  | 100                   | 0                     |
| C73 | 90.0  | 77.5  | 95.0  | 85.0  | 72.5  | 100                   | 0                     |

**Table 15.** Ranking the SMEs

| $\square_{\square}$ | Rank by $\square_{\square}$ | $R_{\square}$ | Rank by $R_{\square}$ | $Q_{\square}$ | Rank by $Q_{\square}$ |
|---------------------|-----------------------------|---------------|-----------------------|---------------|-----------------------|
| 0,205               | D                           | 0,034         | A                     | 0,021         | D                     |
| 0,206               | C                           | 0,039         | D                     | 0,059         | A                     |
| 0,227               | A                           | 0,042         | E                     | 0,062         | C                     |
| 0,312               | E                           | 0,049         | C                     | 0,319         | E                     |
| 0,391               | B                           | 0,158         | B                     | 1,000         | B                     |

## 6. Conclusion

One of the main objectives of this study is to measure institutionalization level of small and medium sized enterprises (SMEs). The assessment of institutionalization process is based on multiple criteria. Therefore, multi-criteria decision making techniques are implemented. The process also requires more than one expert opinion. That is why group decision making approach is applied in the measurement model.

In this study, fuzzy hybrid multi-criteria decision making approach is used in order to measure institutionalization readiness of SMEs. For achieving this, first of all, criteria and sub-criteria that indicate the institutionalization readiness level of SMEs are determined. Then, interactions among main criteria are derived by using fuzzy DEMATEL approach. According to the influence of each criterion over other criteria, the weights of the sub-criteria are calculated obtaining experts' opinion, and by using fuzzy ANP method. Several SMEs are evaluated in terms of the criteria predefined and VIKOR method is implemented for measuring the institutionalization level of the SMEs. The proposed approach can be applied for other multi-criteria decision making problems.

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# A MODIFIED P&O MPPT ALGORITHM FOR PHOTOVOLTAIC SYSTEMS

Zekiye Erdem<sup>a</sup>, Ayhan Özdemir<sup>a</sup>

<sup>a</sup>Electrical and Electronics Engineering Department, Sakarya University, Esentepe Campus, 54100 Sakarya, Turkey

zekiye@sakarya.edu.tr, aozdemir@sakarya.edu.tr

**Abstract** In most Photovoltaic (PV) systems, perturbation and observation (P&O) algorithm is used for tracking the maximum power point in the output power curve of the photovoltaic systems due to its easy implementation. Beside the easy implementation and quick response, P&O algorithm has an important disadvantage in oscillation around the maximum power point. This disadvantage causes a considerable power loss, which is crucial in PV systems. This paper provides a modified P&O algorithm for photovoltaic systems which eliminates undesirable oscillation very easily and effectively. In this method, the algorithm sets the power at the maximum power point and eliminates the oscillation when the power difference drops under an amount of delta. The proposed PV system has been simulated in MATLAB/Simulink and simulation results compared with particle swarm optimization method in PV systems. Most maximum power tracking applications especially in partial shade conditions use particle swarm optimization method to find the global maximum point in the output of the PV system. Therefore, the performances of both algorithms are also examined in this study under partial shade conditions.

**Key words:** Maximum Power Point Tracker, Modified Perturb and Observe Algorithm, Oscillation

## Introduction

Renewable energy systems are very important issue for our future energy politic. Solar energy is the most important renewable energy resource because sun has an endless power source and it can be implement all kind of electrical machines easily. As is known, on the output power curve of the Photovoltaic (PV) systems except the partial shaded occasion, only one maximum point arises. Therefore, it is necessary to use –MPPT- Maximum Power Point Tracker for increasing PV efficiency and obtaining the maximum power through PV.

The output power of PV module is nonlinear function of temperature, insolation, and thus linear control theory is not suitable for MPPTs. There are few MPPT methods have been presented in related literature. The “perturbation and observation” (P&O) method with fixed perturbation step, which is well known as the “hill-climbing method,” is widely applied in these controllers since the structure of PV generation systems are not complex [1].

However, power oscillations always appear in the method under steady states and reduce the efficiency of PV module. Some methods for avoiding the problems of the P&O method have been proposed. One of them is the “short-circuit current method”. Although this method does not have power oscillations like those appearing in the P&O method, the power loss may increase since the short-circuit current is measured [2].

Furthermore, the variations of the proportionality coefficient between the optimal current of maximum power point (MPP) and the short-circuit current due to the temperature changing of PV module could reduce the control performance. Another proposed method is fuzzy control that focuses on the nonlinear characteristics of PV module, can adjust the perturbation step according to the work point of PV module. Power oscillation with enough small perturbation step may be reduced around MPP, however it is necessary to build control rules that meet the output characteristics of the PV module, the methods lack versatility. In addition, it takes much time to acquire the maximum power (MP) after extending or updating the PV modules. Moreover, there is the “incremental conductance method,” which can reduce the oscillation appearing in the ordinary P&O method. This technique searches for the MPP while checking the sign of the incremental conductance ( $dI/dV$ ) [3].

In PV systems, PV modules are connected in series and parallel to obtain the desired voltage level. However, of all the PV arrays, not every module receives the same amount of solar energy (striking of photons on the PV module) at all time. There are times where some part of the PV arrays might be shaded by heavy cloud, trees, or nearby buildings. The shaded PV cells absorb a large amount of electric power generated by other PV cells that receive high illumination and convert it into heat. This situation is called the hot-spot problem, which may damage the PV cells with low illumination. In order to relieve the stress on the shaded PV cells, bypass diodes are normally connected in parallel with each PV modules. The inserted bypass diodes may cause multiple peaks are established in the P-V characteristic curves under partial shaded conditions [4].

Classic MPPT algorithms stack in to local maximum partial shade conditions. Herewith, designer needs a global maximum search algorithm in multiple peak conditions in PV systems. Particle Swarm Optimization (PSO) method is a

global maximum search algorithm which inspired from collective behavior of swarms. PSO algorithm is a robust and successful algorithm in PV systems for detecting global maximum point under partial shade conditions.

In this paper firstly, mathematical model of photovoltaic will be analyzed. In section 3 classical, modified P&O MPPT algorithm and PSO algorithms will be introduce and in section 4 simulation and comparison results under unshaded conditions between classic and modified P&O MPPT algorithms will be shown. In section 5, simulation and comparison results under partial shade condition between PSO algorithm and modified P&O algorithm will be given. The conclusion and comments about simulation results will be discuss in section 6.

## Mathematical Model of Photovoltaic Cell

1.

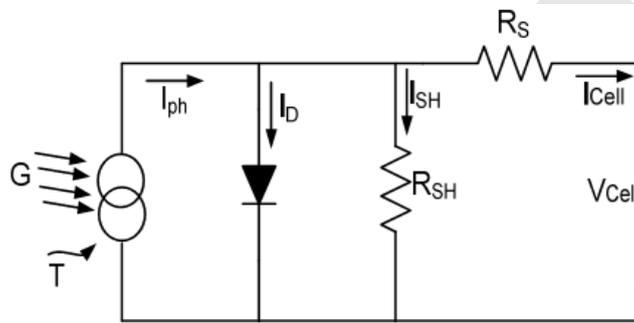


Figure 1. PV Cell equivalent circuit

The simplest model of a PV cell consists of a current source in parallel connection with a diode as shown in figure 1. Photo current  $I_{ph}$  is directly proportional to solar radiation  $G$ . Temperature  $T$  and photo current  $I_{ph}$  have a linear relationship according to equation (1), where  $I_{ph(T_{ref})}$  is photo current which corresponds to reference temperature  $T_{ref}$ . Equation (2) gives photo current at reference temperature. is a constant given by (3). In equation (2) and (3)  $T_{ref}$  is the nominal radiation given by PV's constructor and  $I_{SC}$  is the short circuit current. All symbols are presented on figure 1 and used in equations refer to a single PV cell.

$$I_{ph} = I_{ph(T_{ref})} \cdot (1 + K_0 \cdot (T - T_{ref})) \quad (1)$$

$$I_{ph(T_{ref})} = \frac{G}{G_{ref}} \cdot I_{SC(T_{ref})} \quad (2)$$

$$K_0 = \frac{I_{SC(T)} - I_{SC(T_{ref})}}{T - T_{ref}} \quad (3)$$

Diode's current is given by (4), where  $V_{Cell}$  and  $I_{Cell}$  are output voltage and current for a single PV cell respectively,  $I_o$  is diode's saturation current,  $V_T$  thermal voltage of it and  $R_S$  is in series resistance.

$$I_D = I_o \cdot \left[ \exp\left(\frac{V_{Cell} + I_{Cell} \cdot R_S}{V_T}\right) - 1 \right] \quad (4)$$

Current  $I_{SH}$  through shunt resistance  $R_{SH}$  according to Ohm's law is equal to:

$$I_{SH} = \frac{V_{Cell} + I_{Cell} \cdot R_S}{R_{SH}} \quad (5)$$

Taking into account equations (1) – (5) and applying Kirchhoff's current law, I – V characteristic equation (6) is resulted for PV cell:

$$I_{Cell} = I_{ph} - I_o \cdot \left[ \exp\left(\frac{V_{Cell} + I_{Cell} \cdot R_S}{V_T}\right) - 1 \right] - \frac{V_{Cell} + I_{Cell} \cdot R_S}{R_{SH}} \quad (6)$$

Substituting in (6) equations (7) and (8) which gives output voltage V and current I respectively for  $N_s$  in series and  $N_p$  in parallel PV cells and ignoring current through shunt resistance, equation (9) gives the general I – V characteristic for PVs. Equation (10) gives the output power of a PV module consisted of ( $N_s \times N_p$ ) cells.

$$V = N_s \cdot V_{Cell} \quad (7)$$

$$I = N_p \cdot I_{Cell} \quad (8)$$

$$I = N_p - I_{ph} - N_p \cdot I_o \cdot \left[ \exp\left(\frac{V + I \left(\frac{N_s}{N_p}\right) \cdot R_S}{N_s \cdot V_T}\right) - 1 \right] \quad (9)$$

$$P = (N_s \cdot N_p) \cdot V_{Cell} \cdot I_{Cell} \quad (10)$$

Where  $N_s$  is the number of cells in series connected in a PV module. Equation (10) is able to be extended for a single PV array which consists of a number of PV modules and for a PV farm with many arrays [6].

The MATLAB simulation model of a PV module where  $N_s$  cells in series connected is shown in Fig 2.

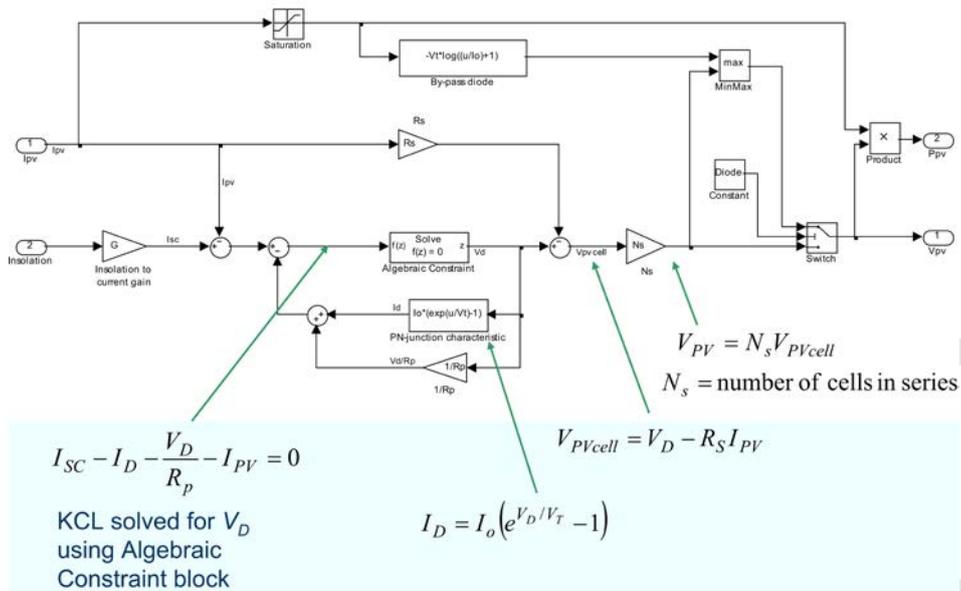
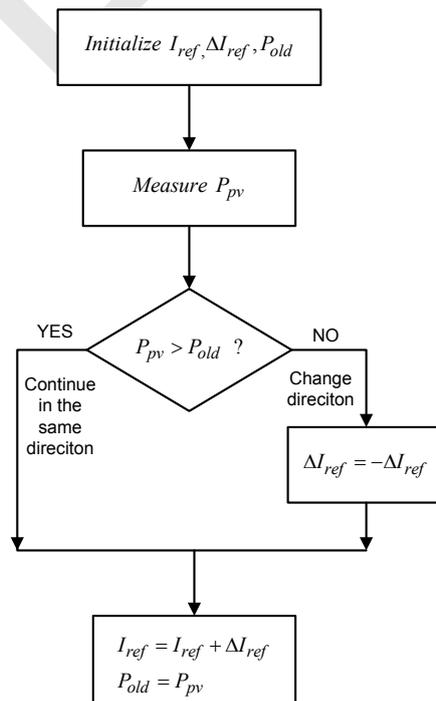


Figure 2 MATLAB Simulation model of PV module

## Classical P&O, Modified P&O and PSO MPPT Algorithms

### Classical P&O Algorithm:

A Classic P&O method is the most simple, which moves the operating point toward the maximum power point periodically increasing or decreasing the PV array current by comparing power quantities between in the present and in the past. The basic flowchart of the P&O method is illustrated in Fig. 3. The drawbacks will be analyzed in following paragraphs.



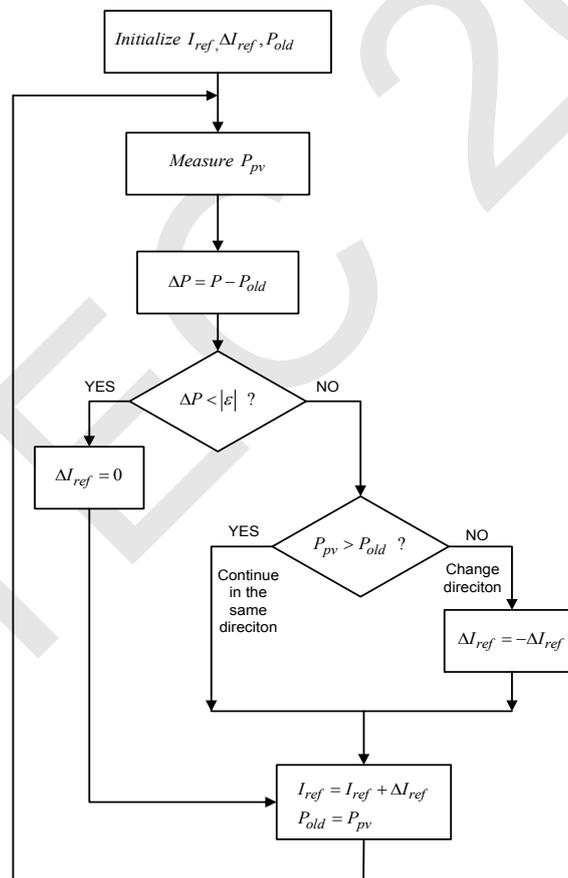
**Figure 3** The basic flowchart of Classic P&O Algorithm

It was proved that the P&O method control system sometimes deviates from the maximum operating point. When the MPP is reached, the P&O method will oscillate around it in case of constant or slowly varying atmospheric conditions. This problem can be solved to decrease the perturbation step; however, the tracking response will be slower. In case of rapidly changing atmospheric conditions, the P&O method can occasionally make the system operation point far from the MPP [6].

These control problems may be reduce by improving the algorithm. In the following sections, a modified P&O tracking algorithm will be presented.

**Modified P&O MPPT Algorithm:**

Modified P&O algorithm flowchart is shown in Fig 4. Minimum difference in output of PV power is assumed as  $\varepsilon$  or ( $\Delta P = P - P_{old}$ ). This “ $\varepsilon$ ” value can be assumed as starting variation value of oscillation in the output PV power. This value can be determined as “ $\varepsilon = \Delta I_{ref} * V * k$ ”. If the difference between previous and current power is smaller than “ $\varepsilon$ ”, the reference current will be reset ( $\Delta I_{ref} = 0$ ) and so oscillation will be extirpate.


**Figure 4** The flowchart of Modified P&O algorithm

**PSO MPPT Algorithm:**

The PSO method is a simple and effective metaheuristic approach that can be applied to a multivariable function optimization having many local optimal points [7,8,9,10]. Several cooperative agents are used, and each agent shares or exchanges information obtained in its respective search process. In this method, each agent moves with a velocity  $v_i^k$  search space, and this movement depends on two factors: 1) its own previous best position and 2) the previous best position attained among all the agents. These points are expressed mathematically in two equations which specify the velocity and position update of the agent:

$$v_i^{k+1} = wv_i^k + c_1r_1p_{best_i} + c_2r_2g_{best} \quad (11)$$

$$s_i^{k+1} = s_i^k + v_i^{k+1} \quad (12)$$

where  $w$  is the learning factor;  $c_1$  and  $c_2$  are positive constants;  $r_1$  and  $r_2$  are the normalized random numbers and their range is (0—1). The variable  $p_{best_i}$  is used to store the best position that the  $i^{th}$  agent has found so far, and its position (13), is updated if condition (14) is satisfied.

$$p_{best_i} = s_i^k \quad (13)$$

$$f(s_i^k) > f(p_{best_i}) \quad (14)$$

Here  $f$  is the objective function that is maximized in each iteration cycle. The variable  $g_{best}$  is used to store the best position attained among the agents. During this optimization process, the agents movement is spread over the search space in different directions and for illustration; the trajectory of various quantities for one iteration cycle is drawn in Fig. 5.

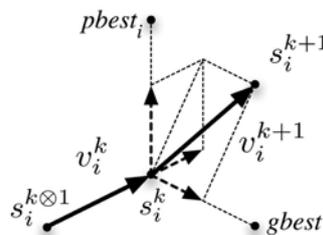


Figure 5 Movement of a PSO agent in search space

MATLAB Simulation model of implementing modified P&O MPPT algorithm in a PV system is shown in Fig 6. In this model six PV modules are connected in series for improving the outside power of PV system.

### Simulation Results under unshaded conditions

The result of modified P&O MPPT algorithm and comparison between classic P&O algorithm and modified P&O algorithm is shown in Fig. 7.

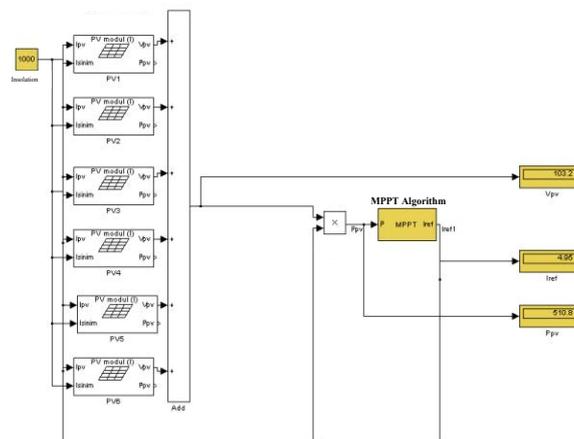
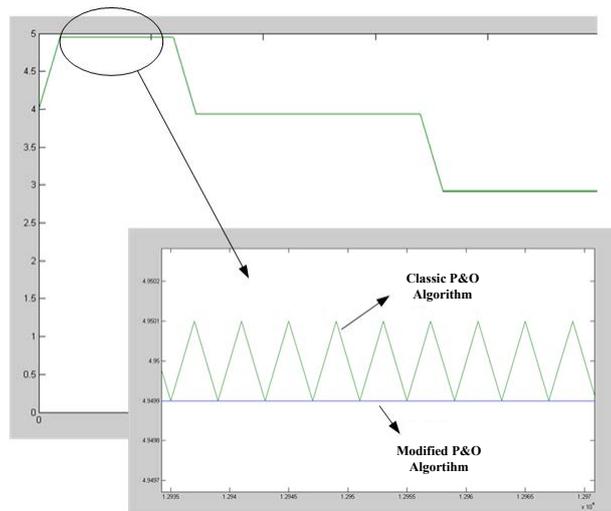
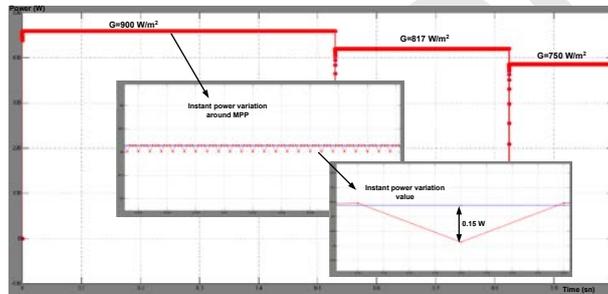


Figure 6. MATLAB Simulation model of MPPT algorithm



**Figure 7.** Comparison between classic P&O algorithm and modified P&O algorithm

Instant power variation around MPP between classic Algorithm and the modified P&O algorithm is given in Fig. 8



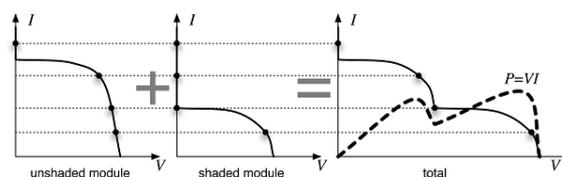
**Figure 8** Instant power variation around MPP between classic Algorithm and the modified P&O algorithm

It can be clearly seen from Fig. 7 and fig. 8 that modified P&O MPPT algorithm removes the oscillation around the MPP. Also it can be seen from same figures the algorithm is operating properly under different insolation.

### Partially shaded condition in PV systems

If a PV array is partially shaded by a building, a tree, and/or clouds, it becomes insufficient for conventional MPPT schemes to extract maximum power. If modules with different optimal currents, caused by uneven insolation, are connected in series-parallel, MPPs often appear in the power versus voltage characteristic. This is because the optimal current of each PV module is nearly proportional to the insolation on it. Under these conditions, the conventional MPPT algorithm mostly finds local MPP instead of finding the global MPP. Hence, the generated PV power, as well as the overall system efficiency, is low [7].

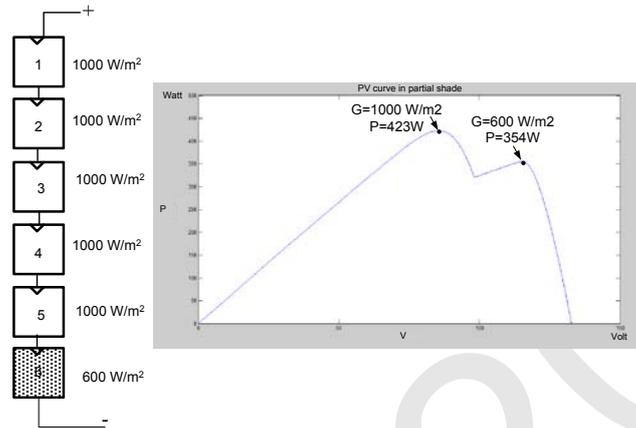
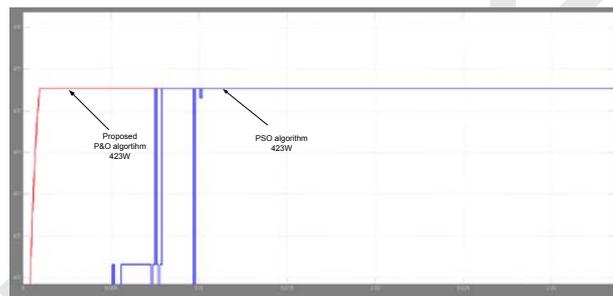
A typical PV generation system is composed of several such modules to meet the load power demand. Let us assume that one module is fully illuminated, while the second one is partially shaded. Under this condition, the current flowing through the two modules is the same as the modules are connected in series, but the current generated by the second module is less than that of the fully illuminated module. Hence, the excess current must flow through the bypass diode. The  $V - I$  characteristics of an individual module as well as the total PV system are shown in Fig. 9 where the existence of two MPPs, i.e., the local and global MPPs, are indicated. If there are more modules, the characteristics under uneven insolation are complicated, and may exhibit two or more MPPs. In such cases, it becomes difficult to realize the MPPT using conventional methods. Even if it is possible to identify the global MPP, each module cannot be operated at the optimal condition, as their optimal current is inherently different at different insulations.



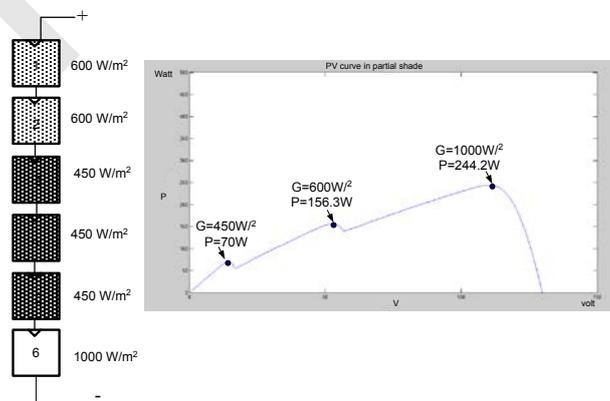
**Figure 9** Characteristic of Modules connected in series [7]

### Simulation results under partial shade Conditions

Simulation results of P&O and PSO algorithms under different partial shade conditions are given below. In figure 10 the 6<sup>th</sup> module of the PV system is exposed to shade with 60%. The same figure P-V curve of the system is also shown. The maximum power is 423 W under this shade conditions. From Fig.9 it could be clearly seen that the global maximum point is appear in the first hill. Therefore, proposed modified P&O algorithm could detect the global maxima in this shade condition. P&O and PSO algorithm results are given in Fig. 11. PSO and proposed modified P&O algorithms track same maximum power point under these conditions.


**Figure 10** PV array with 1000 W/m<sup>2</sup> solar irradiance with a 60% shade on sixth module.

**Figure 11** PSO and proposed P&O algorithm results under determined shade conditions

A different shade pattern applied to the same 6<sup>th</sup> moduled PV system. The shade percentages and maximum power points (MPP) are shown in Fig. 12.


**Figure 12** PV array with 1000 W/m<sup>2</sup> solar irradiance with a 60% shade on first and second, 45% on third, fourth and fifth module.

Under this shade conditions which is given in Fig. 11, proposed modified P&O algorithm will hit the first peak of the local MPP. On the other hand, PSO will detect the global MPP in PV characteristic due to its global search behaviour. Simulation result of proposed modified P&O algorithm and the PSO algorithm are given in fig. 13.

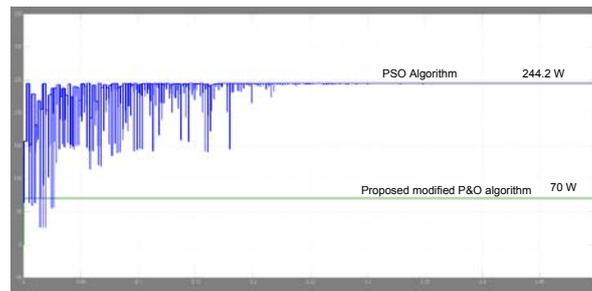


Figure 13 PSO and proposed P&O algorithm results under determined shade conditions

## Conclusion and Comments

Proposed modified P&O MPPT algorithm is removed the oscillation around the MPP which is a common problem in classical P&O algorithms. This algorithm also can be implemented very easily than the other modified P&O MPPT algorithms. Also this algorithm does not intent any additional complicated mathematical equations so this algorithm will be as fast as a classic P&O algorithm and implementation process will be extremely easy. Modified P&O algorithm has convincing results under unshaded conditions however the results will be considerably different under partial shaded conditions. The main reason of this result is about the behavior of P&O algorithms. This algorithm is a member of the hill climbing based algorithms which belongs to the family of local search. P&O is an iterative algorithm that starts with an arbitrary solution to a problem, then attempts to find a better solution by incrementally changing a single element of the solution. If the change produces a better solution, an incremental change is made to the new solution, repeating until no further improvements can be found. As a consequence, this behavior could reduce the output of the PV system power considerably under partial shade conditions. On the contrary, PSO algorithm is a highly convenient algorithm type towards partial shade conditions.

As a result proposed algorithm has a good advantage about removing the oscillation in the classic P&O algorithms. Oscillation around MPP is the biggest problem of classic P&O algorithms and this algorithm solves this problem with a tiny change under unshaded conditions. However, from the results it could be easily said that under partial shade conditions PSO is a better choice for find the global maximum power point.

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## A NEW LAMINATE COMPOSITE SYSTEM: METALLIC-INTERMETALLIC LAMINATE MATERIAL

Tuba Yener

Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering  
([tcerezci@sakarya.edu.tr](mailto:tcerezci@sakarya.edu.tr))

Zeynep Öztekin

Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering  
([g080108004@sakarya.edu.tr](mailto:g080108004@sakarya.edu.tr))

İbrahim Altınsoy

Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering  
([ialtinsoy@sakarya.edu.tr](mailto:ialtinsoy@sakarya.edu.tr))

Gözde F.Çelebi Efe

Sakarya University, Karasu Vocational High School, Department of Machinery and Metal Technologies.  
([gcelebi@sakarya.edu.tr](mailto:gcelebi@sakarya.edu.tr))

Sakin Zeytin

Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering  
([zeytin@sakarya.edu.tr](mailto:zeytin@sakarya.edu.tr))

**Abstract:** Metallic-intermetallic laminate (MIL) composites consisting of alternating layers of Ta, Al and the intermetallic  $Al_3Ta$  have been fabricated by reactive foil sintering in open atmospheric furnace. In this study, tantalum and aluminum foils with initial thicknesses of 250  $\mu m$  were used. Sintering process has carried at 850-900 and 950  $^{\circ}C$  for 5 and 7.5 hours under 2 MPa pressure. The aluminium foil was consumed by forming a tantalum aluminide intermetallic compound. Thus, the final microstructure consists of alternating layers of intermetallic compound and unreacted Ta metal. Microstructural characterizations of produced composites have conducted by using scanning electron microscope. Hardness values of test samples have also measured by vickers indentation method.

**Key Words:** Intermetallic, tantalum aluminide, laminate composite, sintering

### Introduction

It is well known that the widespread engineering application of ceramics and other highly brittle materials, e.g. intermetallic compounds, is severely limited by their low toughness. A number of toughening strategies have been proposed to improve the critical stress intensity required for crack propagation. One of the most effective toughening techniques is to introduce a ductile phase, which remains intact and bridges the crack faces in the wake of a growing crack. Under such a circumstance, the crack tip is shielded by the closure traction imposed by the plastic deformation of ductile ligaments. In particular, when layered ductile phases are incorporated, laminate composites can be formed, which enhance the toughness (Oktay, 2010, p.1043-1050, Peng, 2004, p.243-248).

Metallic-intermetallic composites can be designed for structural use to optimize the unique properties and benefits of the constituent components, resulting in materials that have the high strength and stiffness of the intermetallic phase and the high toughness of the metal. Pro intermetallics have been reinforced with particles, rods, or layers of ductile metals in efforts to increase toughness. Ductile phase reinforcement of brittle materials utilizes crack-laminate interactions to generate a zone of bridging ligaments that restrict crack opening and growth by generating closure tractions in the crack wake and utilize the work of plastic deformation in the ductile metal phase to increase fracture resistance of the composite (David, 2005).

Laminate composites are being intensively studied for a number of potential applications: electronic devices, structural components, armor, etc. Ceramic-ceramic, metal-ceramic, metal-metal, metal-ceramic-intermetallic and metal-intermetallic systems have shown desirable properties (Tiezheng, 2004, p.10-26). In particular, the Ti- $Al_3Ti$  system has a great potential for structural applications because of its low density and excellent specific mechanical properties (Rohatgi, 2003, p.2933-2957, Price, 2011, p.1334-1346)

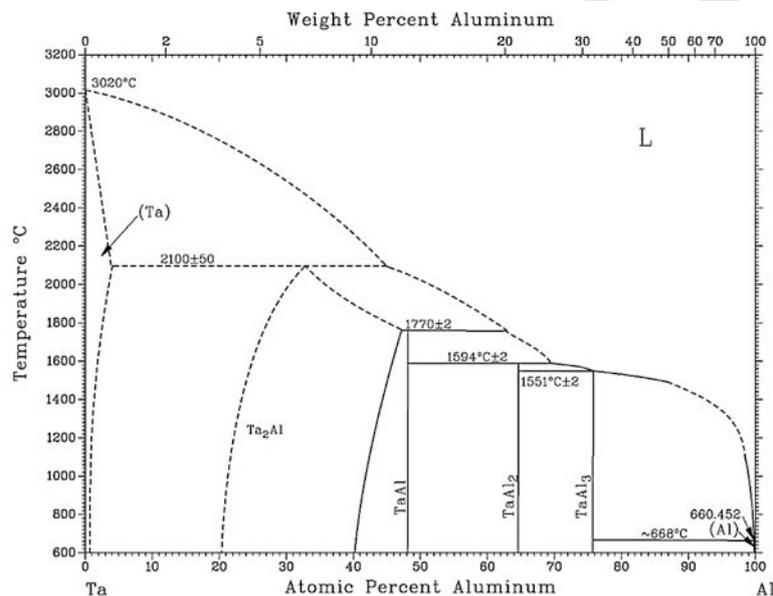
Titanium-titanium tri-aluminide (Ti- $Al_3Ti$ ) metallic-intermetallic laminate (MIL) composites have been produced from elemental titanium and aluminum foils by a novel one-step process utilizing a controlled reaction at elevated

temperature and pressure. Of the various possible aluminides in the Ti–Al system, the formation of the intermetallic  $\text{Al}_3\text{Ti}$  is thermodynamically and kinetically favored over the formation of other aluminides when reacting Al directly with Ti. This preferential formation of  $\text{Al}_3\text{Ti}$  is fortuitous as its Young's modulus (216 GPa) and oxidation resistance are higher, and the density ( $3.3 \text{ g/cm}^3$ ) lower than that of the other titanium aluminides such as  $\text{Ti}_3\text{Al}$  and  $\text{TiAl}$  (Rohatgi, 2003, p.2933-2957, Zeytin, 2008).

Intermetallic compounds based upon aluminides of several transition metals such as iron, nickel, titanium, cobalt, niobium, and tantalum have been recognized as potential candidates for the high-temperature structural applications. Among various aluminides of transition metals, the compounds in the Ta–Al system have been of great interest for their excellent mechanical properties and high degree of structural complexity. The Ta–Al phase diagram depicted in Fig. 1 shows the existence of four aluminides, including  $\text{Ta}_2\text{Al}$ ,  $\text{TaAl}$ ,  $\text{TaAl}_2$ , and  $\text{TaAl}_3$ . (Yeh, 2010, p.153-158).

They are stable, refractory and reflective, and have been proposed as mirror coatings for use in the IR. Melting point of  $1400^\circ\text{C}$  and the density is  $7.02 \text{ g/cm}^3$ . Because of this aspects, tantalum aluminides are can be used in high temperature applications (<http://en.wikipedia.org/>,2012)

Tantalum-aluminum system is one of the most well known in terms of the formation of intermetallic phase. This system is also in the priority among in laminate composite systems. The objective of the present research is to synthesize tantalum-tantalum aluminide metallic-intermetallic composites and its microstructural characterization.



**Figure 1:** Ta-Al phase diagram (Yeh, 2010, p.153-158)

## Materials and Method

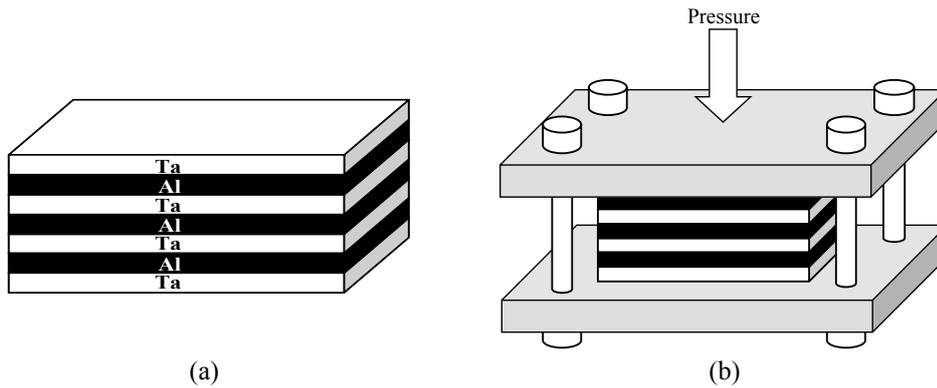
The MIL process consists of stacking commercial purity aluminum and tantalum aluminide foils in alternating layers. The foils were provided from Alfa Aesar Company and their properties are shown in the table 1.

**Table 1:** Properties of foils used in experiments

| Foil | Thickness, $\mu\text{m}$ | Purity, % |
|------|--------------------------|-----------|
| Ta   | 250                      | 99,5      |
| Al   | 250                      | 99,0      |

The foil dimensions were initially selected to completely consume the aluminum in forming the intermetallic compound with alternating layers of partially unreacted Ta metal. The dimensions of the processed samples are in the shape of platelets as  $10\text{mm}\times 10\text{mm}$ . Samples were cleaned with alcohol and dried before stacking process. In each stack was consisting of 4 tantalum and 3 aluminum foil as in shown Fig.2a. An initial pressure of 2.0 MPa is applied at room

temperature to ensure good contact between foils (Fig.2b). Sintering process is applied in an open air, electrical resistance furnace at 850-900-950 °C for 5 and 7.5 hours for each temperature.

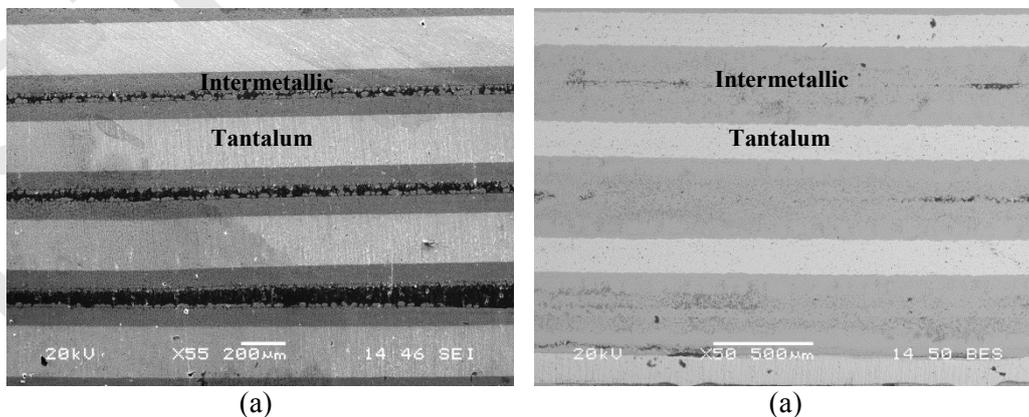


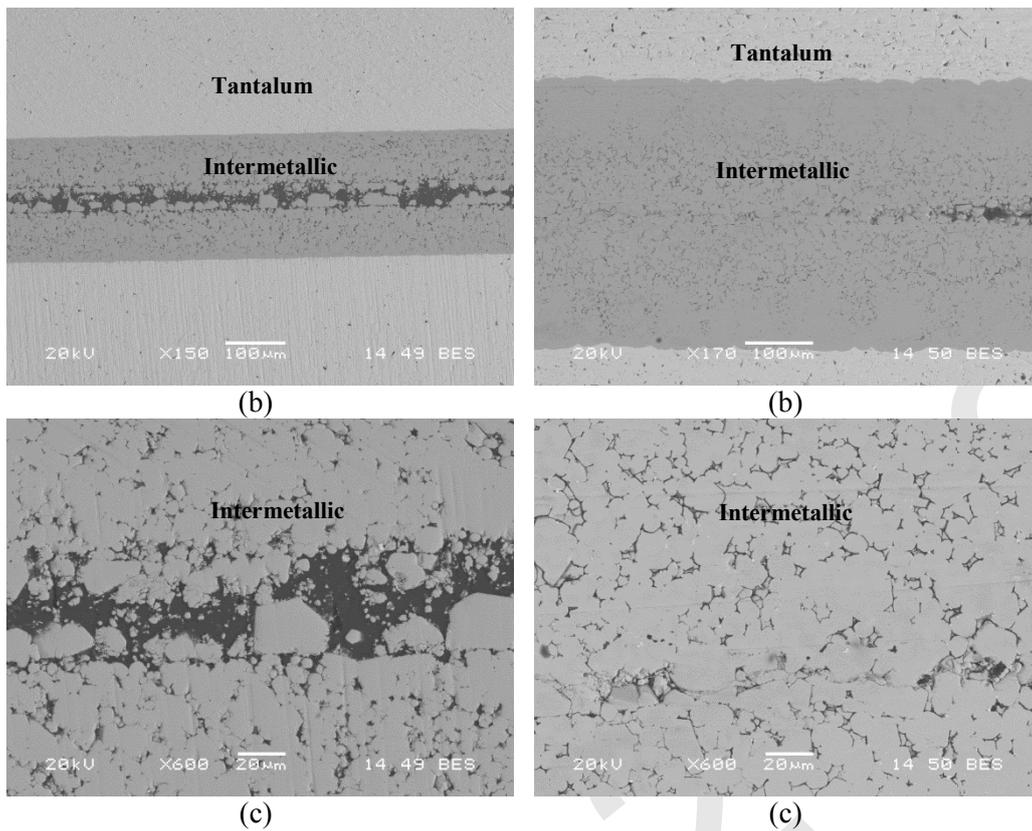
**Figure 2:**(a) Tantalum-Aluminum stack, (b) Schematic diagram of the synthesis apparatus. Image is not to scale and does not show the load frame (İpek, 2008, p.1262-1268)

Samples were ground and polished using standard metallographic techniques. Microstructure analyses of composites were performed with a JEOL JSM-5600 model scanning electron microscope (SEM). The presence of phases formed within the sintered samples was determined by Energy Dispersive Spectroscopy (EDS). Microhardness of composites were determined using a Leica WMHT-Mod model Vickers hardness instrument under an applied load of 300 g for intermetallic zone, and 100 g for metallic zone.

## Results and Discussion

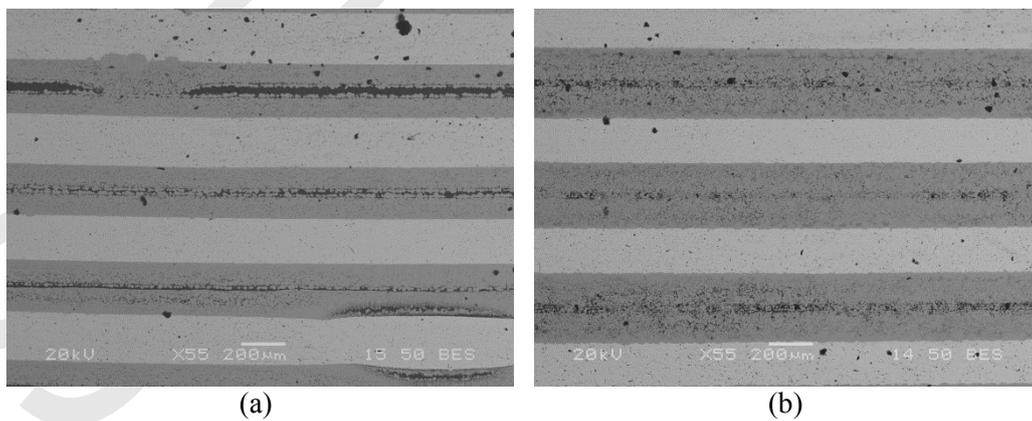
The typical microstructures of the MIL composites are shown in Fig.3-5. The presence of different regions indicates that different phases in the composites. In relatively low magnification (Fig.3.a) it is shown that foils are stacked properly. Furthermore, the laminated composites are well-bonded. There is a symmetric change from a light colored phase to another. Following the light colored phase there is a grey colored formation, subsequently, darker grey colored phase and in the center line a black colored phase. The light colored layers consist of unreacted Ta, which are separated by the apparently darker  $Al_3Ta$ -layers, as was identified by quantitative EDS analysis (Fig. 6). In metallic-intermetallic composites, interaction initially occurs at the interface then progress along the center of aluminum foil as well as along tantalum foil. But this progress reaction along tantalum is slower than that of in aluminum. As tantalum and aluminum react with each other, the impurities in aluminum or interface of Ta-Al, shifts in the front of the reaction. If the reaction ended before aluminum consuming these impurities deposited in aluminum, otherwise in centerline of the intermetallic. Because of this it is understood that the centerline is a problematic zone. As evidence in laminate composites centerline is one of the preferred zones for the formation of cracks.



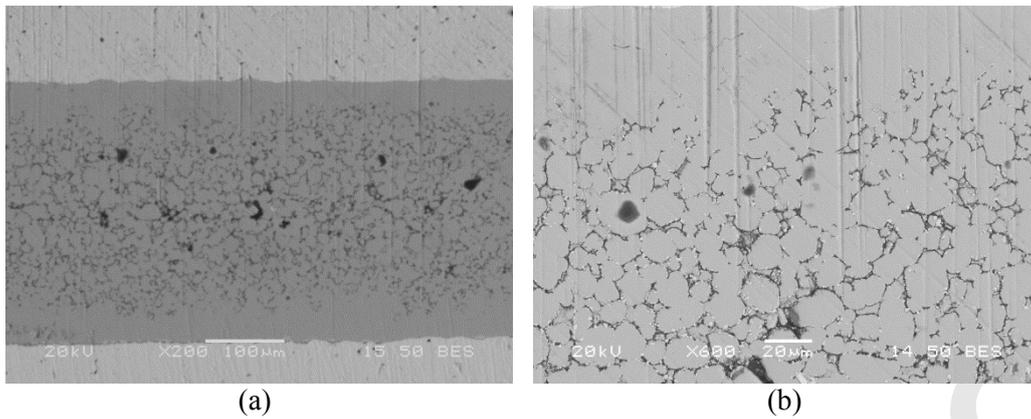


**Figure 3:** SEM micrographs of Ta-Al metallic–intermetallic composites in the left sintered at 850 °C, 5 h (a) 55X, (b) 150X, (c) 600X, in the right sintered at 850 °C, 7.5 h (a) 50X, (b) 170X, (c) 600X

It is clearly seen in metallic intermetallic Ta-Al composites sintered at 850 °C for 5 hours, the middle grey-black zone essentially formed by various phases such as residual aluminum,  $TaAl_3$ . As the sintering time increases from 5 hours to 7.5 hours, residual aluminum layer at the intermetallic centerline decreases. Moreover sintering process is better at relatively high temperature and time.

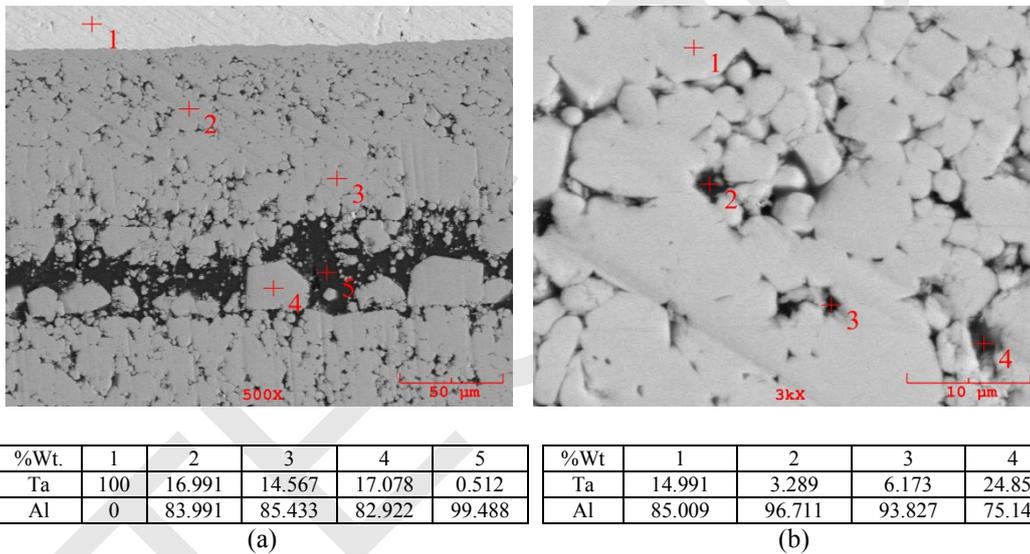


**Figure 4:** SEM micrographs of Ta-TaAl<sub>3</sub> metallic–intermetallic composites 900 °C, (a) 5 h-55X, (b) 7.5 h-55X



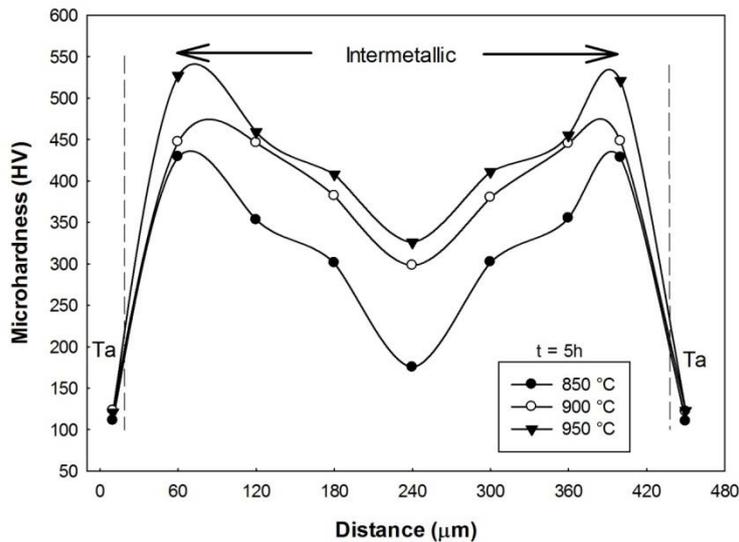
**Figure 5:** SEM micrographs of Ta-TaAl<sub>3</sub> metallic–intermetallic composites 950 °C, 5 hour, (a)200X, (b)600X

From SEM micrographs for 850-900 and 950°C (Fig:3-5) it is seen that interface of metallic tantalum and tantalum-aluminum intermetallic is quite smooth. To form Ta-Al intermetallic, reaction between tantalum and aluminum initiate with nucleation in a number of different regions. These nucleuses grow and merge with each other. A whole aluminide layer form in this way. Stable metallic-intermetallic structure occurs when suitable temperature and time conditions are provided.



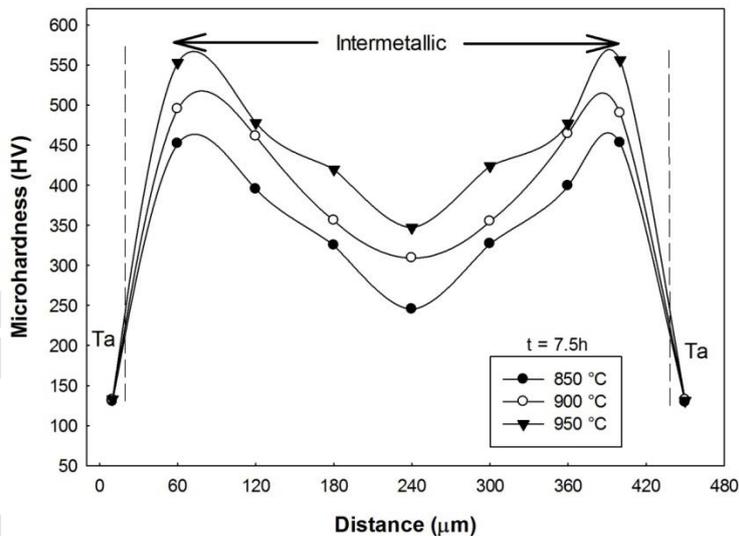
**Figure 6:** SEM-EDS analysis of Ta-Al metallic-intermetallic composite sintered at 850°C for 5 h.(a) 500X, (b) 3000X.

As in shown in Fig 6.a, spot 1 is located in the unreacted Ta layer and spots 2, 3 and 4 in the Al<sub>3</sub>Ta layer with different positions. Some dark particles, identified as residual Al are also observed in the Al<sub>3</sub>Ta layers. Furthermore, the laminated composites are well-bonded and remain some residual porosity in the final microstructure due to the relatively low temperature and time. Also in this EDS analyses show that, formation of intermetallic hasn't completed yet.



**Figure 7:** Hardness graphic of Ta-Al metallic-intermetallic composites sintered at 850, 900, 950 °C, 5 hours.

The ceramic-like aluminide phases ( $\text{Al}_3\text{Ti}$  or  $\text{Ni}_3\text{Al}$ ) give high hardness and stiffness to the composite, while the unreacted Ti or Ni provides the necessary high strength, toughness and ductility for the system to concurrently be flexible. The multi-layered structure of the composite allows for variations in the layer thickness and phase volume fractions of the Al and Ti or Ni components simply through the selection of initial thickness, which consequently allows for the optimization of mechanical and thermal management properties for practical application (Peng, 2005, 309-318).



**Figure 8:** Hardness graphic of Ta-Al metallic-intermetallic composites sintered at 850, 900, 950 °C, 7.5 hours.

The microhardness profile measured for several layers of the composite is shown in Fig.7, 8. As known, hardness value of metallic tantalum and its intermetallic structure is quite different. The average microhardness values for tantalum, aluminum and  $\text{TaAl}_3$  are 120, 475 and 45 HV, respectively. While the hardness of the intermetallic layer is highest at the border  $\text{TaAl}_3$ -Ta, it gradually decreases toward the border  $\text{TaAl}_3$ -Al. These results are in good agreement with the literature. In addition, relatively high temperature and time is also very effective on sintering metallic-intermetallic laminate composite. As time and temperature increase, the hardness values raise because of bonding in the interface improved and residual aluminum started the consuming.

## Conclusions

The conclusions of this research can be summarized as follows:

- By controlling the duration of the reactive foil sintering process, composites can be fabricated in which a tailored amount of residual aluminum remains at the intermetallic centerline. The result is a well-bonded composite with a high degree of microstructural control.
- Ta–Al<sub>3</sub>Ta metal–intermetallic laminate (MIL) composites have been successfully synthesized by reactive foil sintering technique in open air at 850-900 and 950 °C for 5 and 7.5 hours under 2 MPa pressure. The laminated structure is well-bonded, nearly fully dense.
- Microstructural characterization by, SEM and EDS indicates that Al<sub>3</sub>Ta is the only intermetallic phase. Tantalum aluminide phase occurs due to the thermodynamics of the reaction between Ta and Al. The existence of liquid Al phase plays important roles in the nucleation and growth of Al<sub>3</sub>Ta particles and the eventual formation of continuous alternative Al<sub>3</sub>Ta intermetallic layers.
- The mechanic properties of hardness of the fabricated laminated composites were examined. Whereas the hardness of metallic aluminum and tantalum respectively is about 45, 120 HV, hardness of intermetallic zone is approximately 450-500 HV. The results showed that as time and temperature increase, the hardness values raise because of bonding in the interface improved and residual aluminum started the consuming.

## Acknowledgements

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( <http://en.wikipedia.org/>,2012)

## A REVIEW ON NATURAL FIBER- EPOXY BASED COMPOSITES

Venkata Parasuram Kommula, Obi Reddy Kanchireddy, Mukul Shukla, Marwala Tshilidzi

**Abstract:** Biodegradable nature, good strength per unit weight than most inorganic fillers, lower density and their abundance in nature make them attractive as reinforcements of engineering polymer systems. On the other hand, they also have some deficiencies such as incompatibility with the hydrophobic polymer matrix, the tendency to form aggregates during processing and poor resistance to moisture greatly limit the potential use of natural fibers as reinforcements in polymers. In this paper, the effects of different chemical treatments on cellulosic fibers that are used as reinforcements for thermoset plastics are studied and the results from the literature is summarized, focusing final properties of natural fibers with thermoset (epoxy) polymeric matrices with respect to their use of physical and chemical treatments for the improvement of fiber-matrix interaction.

**Key words:** Reinforcements, chemical treatment.

## ***ACACIA DECURRENS* (WILLD): AN INVASIVE SPECIES IN THE AREA OF EL-KALA (ALGERIAN NORTH-EASTERN)**

**Arifa Beddiar**<sup>(1,2)</sup>, **Ahcène Merabet**<sup>(2)</sup>, **Meriem Adouane**<sup>(1,2)</sup>

<sup>(1)</sup> Laboratory of Plant Biology and Environment, Department of Biology,  
University of Badji Mokhtar-Annaba, P.O. Box 12, Annaba 23000, Algeria

<sup>(2)</sup> National Observatory of the Environment and Sustainable Development (ONEDD),  
Ministry of Territory Management and Environment, Algeria, 8 Mohamed Tazairt, Algiers, Algeria  
E-mail: fragbed@yahoo.fr

**Abstract:** In 1970, in the area of El-Kala (Algerian North-eastern), *Acacia decurrens* plantations in 10% mixture with *Eucalyptus camaldulensis* were realized in the degraded zones of cork oak forest. *Acacia* was introduced for its ability to be a fixing nitrogen tree in order to rehabilitate the soil and to allow a good emerging of the eucalyptus. However, since about fifteen years, we attend a spectacular invasion of the surrounding forest by this exotic tree. In this study, we charted the surfaces occupied by acacia, examined its invasive character and its impact on the area, the structure and the plant biodiversity of the around cork oak land like on the cork oak mycorrhizal status. The results show that *Acacia* progress in a remarkable way in the cork oak forest. On its way, the ecosystem structure is strongly modified and the plant biodiversity reduced significantly. The cork oak mycorrhizal status is affected as well. Strategies of control and fight must be taken urgently to slow down the acacia progression which constitutes a potential threat of landscape homogenisation in El-Kala area.

**Key words:** Biological invasion, *Acacia decurrens*, Cork oak land, Algerian North-eastern.

### **Introduction**

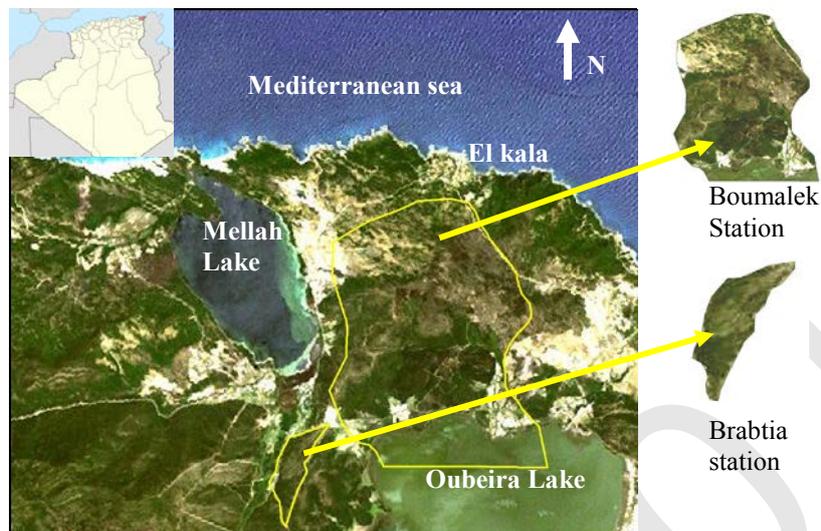
In the Algerian North-East, cork oak occupies nearly 230 000 ha. It is a strategic species in regard to its socio-economical and ecological roles. However, many factors have been contributing to the destruction of this species and its forest stand, such as the anthropic pressure increased by the demographic growth which results in the clearing, overgrazing, repeated fires, wood and cork oak overexploitation ... etc. (Madani and *Al.*, 2001). All these factors contributed to the reduction of the cork oak land everywhere in Algeria. In front of this established fact, the foresters searched to renovate the cork oak land by tests of cork oak plantations or by direct seeding which often showed failures. According to them, the introduction of species with fast growth constituted an alternative for the restoration of the forest resources and the protection of soils and the environment. It is within this framework that, in the Seventies, the choice of two species was decided, *Eucalyptus camaldulensis* Dehnh and *Acacia decurrens* Willd were selected to reforest the thinning in cork oak land in the North-East Algeria. They were planted at a rate of one acacia for ten eucalyptus. *Acacia* was forseen in order to rehabilitate and to enrich the soil because it is a fixing nitrogen tree. However, these two last decades, it was noted a spectacular proliferation of *Acacia decurrens* to the detriment of cork oak and eucalyptus with a remarkable reduction of the biodiversity. In this present work, we propose to (i) - chart the surfaces occupied by acacia in the canton of Boumalek, (ii) **demonstrate** its invasive character (iii)- estimate its impact on the structure and the plant biodiversity of the surrounding cork oak land and on the growth and the mycorrhizal status of young cork oak seedlings.

### **Material and methods**

#### **Presentation of zone and stations**

The study concerned the area of El-Kala (extreme Algerian North-East) (Fig. 1). It belongs to the wet complex of Eastern Numidia (Samraoui and De Belair, 1998) and is entirely included in the national park of El-Kala. Two stations were selected there: the station of Brabtia (36°51'744N, 008°20'363E) who is a natural cork oak forest. With a covering rate from 80 to 90%, it contains all the species of cork oak forest stand. The second station is that of Boumalek (36°52'220N, 008°21'923E), located 2 km far from the first station. Its covering rate is 90%. It is especially constituted of *Eucalyptus* and *Acacia* with a clear predominance of *Acacia* in its western limit. According to the meteorological data of the El-Kala station for the period (1985/2010), the study zone is characterized by a Mediterranean climate with a maximum temperature in August of 27.01°C and a minimal temperature in January of 12.61° C and 70% of mean monthly air moisture. According to Bagnouls and Gaussen ombrothermic diagram (1953) for the period (1985- 2010), the dry season lasts 5 month whereas it was 4 months for the period (1913/1938), this indicates an increase of the drought in this area. As for as the Emberger pluviothermal quotient (1955) for the same

periods, it shows that the study zone, moved from soft sub wet bioclimate ( $Q_2 = 103.20$ ) to lime sub humide bioclimate ( $Q_2 = 139, 38$ ). With regard to the soils, those most evolved are under the oaks and the pines, they are brown forest soils.



**Figure 1.** Localization of study zone and stations

#### - Floristic and cartographic study of the stations

In each station, a floristic inventory was established on the diagonal of  $400 \text{ m}^2$  surface in spring 2010. Each species was affected with Abundance/Dominance, Sociability and Presence indices (Braun Blanquet, 1951). Five samples were taken randomly in each station.

The aim of this study is to propose a mapping a soil occupation in the Boumalek station on the basis of satellite image and use of the geographical information system (GIS). In our work, we used three (03) spectral bands of the thematic improved cartography instrument (Enhanced Thematic Mapper), (Landsat ETM 7) recorded on July 2000, a digital terrain model for obtaining slopes, altitude and exposure maps from data SRTM (Shuttle Radar Topography Mission), topographic maps 1/50.000 of the study zone since 1996, one vegetation map of El-Kala national park (1/107100) (Saidi, 1999) one receptor GPS and various software such as ENVI 4.5 of RSI, MAPINFO 8.0 s, Global mapper ...etc. In addition, for know the density of *Acacia decurrens*, two plots of land numbered  $400 \text{ m}^2$  were randomly selected; one located at northern of Oubeira lake, the other inside the Boumalek station. In each area, the total individual number of acacias, cork oak and eucalyptus was recorded and percentage of presence for each species was estimated compared to the total number of the individuals of the 3 species present in the area.

#### - Effect of soil collected under *Acacia decurrens* and *Eucalyptus camaldulensis* on the early growth of *Quercus suber* and its ectomycorrhizal status

The objective of this experiment is to verify if the soil on which *Acacia decurrens* or *Eucalyptus camaldulensis* developed could act on the germination of cork oak seeds, on its early growth and its ectomycorrhizal status. Cork oak acorns were directly subtracted from trees and were superficially disinfected with Hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) at 30 volumes then put in pregermination at darkness at ambient temperature. Six weeks after, the rate of germination was calculated then each pre-germinate acorn was transplanted in 2kg pot repeated 5 times on the following natural soils or sterilized twice by autoclaving: (a) Soil collected under cork oak in Brabtia cork oak forest, (b) Soil collected under acacia in the station of Boumalek, (c) Soil collected under eucalyptus in the station of Boumalek. After 5 months of growth in environmental conditions, mean height of each seedling was measured. In the treatments that have not been sterilised, ectomycorrhizal colonization of cork oak roots was estimated according to Brundrett *et al.* (1996) method and ectomycorrhizal morphotypes was described according to Agerer criteria's (1997).

## Results

### - Map of soil occupation

Figures 2 and 3 shows the distribution of the various forests stands in the Boumalek station. We can notice that the central part of the map is occupied either by the acacia alone or by acacia in mixture with the cork oak or with the eucalyptus. Acacia invades approximately 452,6 ha, it tends to move in all directions by fleeing the bordering zones of Oubeira lake and moves towards North and North-West where the relief is more high and sunny as well. The estimate of acacia density in two 400 m<sup>2</sup> land plots, showed how much this tree threatens the natural formations in the area of El-Kala (Fig. 4). In this station, Acacia dominates because of its strong reproduction capacity and with its propagation capacities which are multiple (Beddiar *et al*, 2010). Conscious of the dangers which this species presents, the staff of the forests engaged, in 2008, cleansing campaign for cutting operations in the Boumalek station to stop its propagation. Separations of the 50 meters firewall type were also installed between the zone affected by the acacia and the healthy zones. These very expensive operations showed very poor results, because the acacia began again quickly its invasive aspect. So, the separation seemed useless because some trees were found in the healthy zones confirming thus the dispersal of its seeds by wind and animals. Floristic inventory indicates also that plant biodiversity decreases significantly in the station of Boumalek, up to 75%

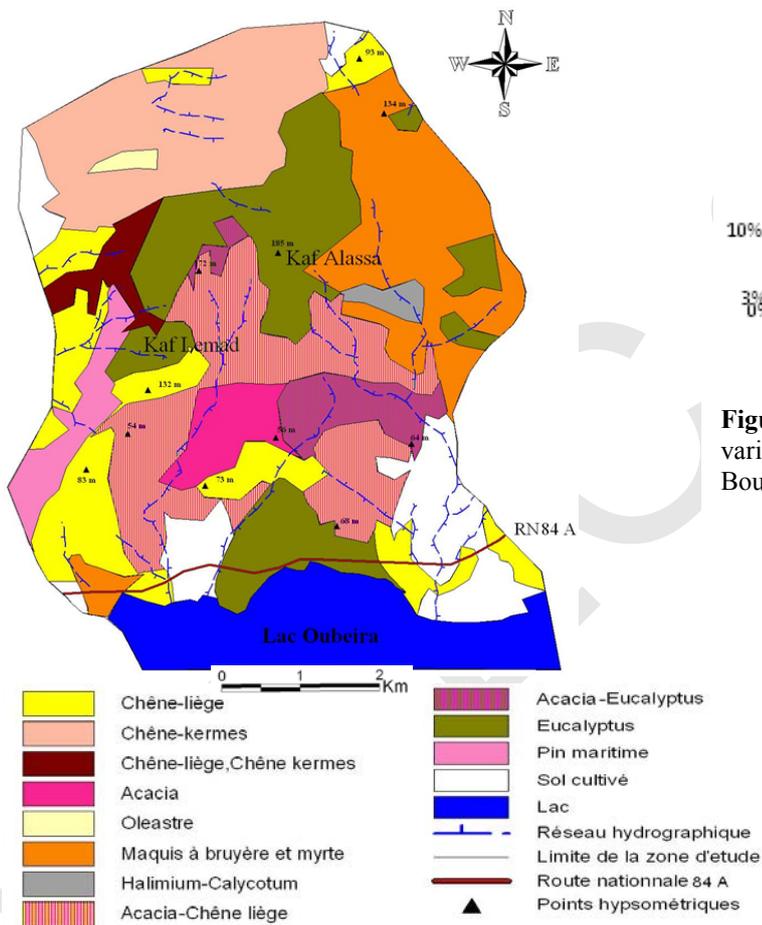


Figure 2. Map of soil occupation in Boumalek station

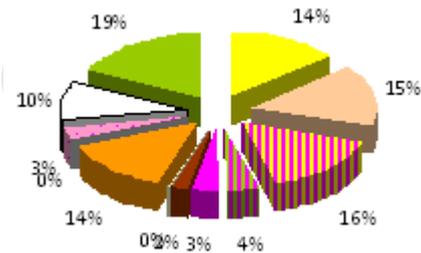
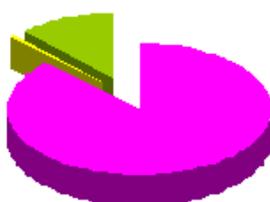
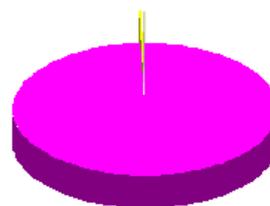


Figure 3. Surface proportion of the various formations in the station of Boumalek



(a)



(b)

Figure 4: *Acacia decurrens* density in the plot located at Northern Oubeira bank (a) and in the plot located at the center of the Boumalek station (b).

Acacia  Eucalyptus  Cork oak 

**- Effect of soil collected under *Acacia decurrens* and *Eucalyptus camaldulensis* on early *Quercus suber* growth and ectomycorrhizal status**

Seedlings raised on the oak cork substrate presented a very fast and quite higher growth compared to that of the seedlings raised on the natural or sterile soil collected under Acacia like those high on the soil collected under eucalyptus (Table 1). The cork oak seedlings growth is reduced to more than 50% in the acacia soil. When microflora effect by soil sterilization is removed, growth of cork oak seedlings is even weaker in this substrate. In the same way ectomycorrhizal colonization as well as ectomycorrhizal morphotypes number on the cork oak roots were significantly reduced in the substrates of Acacia and Eucalyptus.

**Table 1:** Growth of six months old cork oaks seedlings on a natural or sterilised soil collected under Acacia, Eucalyptus or Cork oak and their ectomycorrhizal status

| Origin of the soil culture | Natural Soil |                                   |  | Sterilised soil |
|----------------------------|--------------|-----------------------------------|--|-----------------|
|                            | Height (cm)  | % of ectomycorrhizal colonisation | Numbers of ectomycorrhizal morphotypes | Height (cm)     |
| Soil under Acacia          | 16.7         | 0                                 | 0                                      | 13.16           |
| Soil under eucalyptus      | 35.14        | 1, 33 ± 1,41                      | 3                                      | 22.31           |
| Soil under cork oak        | 42.6         | 19,07 ± 9,83                      | 10                                     | 35.15           |

## Discussion

Although the two stations of studies (Brabtia and Boumalek) were subjected to the same ecological conditions, the results reflect a remarkable difference in their plant specific diversity. In the Boumalek station, more than 1/3 of the species are eliminated and those which are able to be maintained are confined with the periphery with a very low abundance. Boumalek station, in the beginning, was a cork oak forest whose clearings were planted by eucalyptus in mixture with the acacia. Actually it is currently marked by the predominance of the acacia which modified the structure of the forest ecosystem. Acacia occupies 452,6 ha approximately surface on a total of 1930ha, it proliferates quickly at the detriment of the eucalyptus and the cork oak. The only few research on cartography available on the area (Saidi, 1999), does not point out the presence of Acacia and refers only to Eucalyptus, whereas the acacia phenomenon invasion started to appear about the year 1995. Very expensive measures of cuts, incineration and avoid-fires installation were led by the forest services in order to stop the propagation of this species into 2008. This showed failures because of acacia multiplied soon its invasive character by rejecting stock vigorously, by forming suckers and reproducing by sowing. This last reproduction mode is much facilitated by fires (Beddiar *et al.*, 2012). It is imperative to seek other solutions for stopping this phenomenon. In addition, the experiment of the cork oak seedlings breeding on the acacia soil or eucalyptus soil showed that the latter had a depressive effect on the early growth of the cork oak but also on abundance and diversity of the symbiotic microflora which is associated with it. According to Grayston *et al.* (2001), the structure and the functional diversity of the soil microbial communities is closely related to the plant species specific composition, showing thus very narrow interactions in the functioning of the epigeous and hypogenous compartments. Kourtev *et al.* (2003) also has established as quite distinct microbial communities, as well in their structure as in their functions, developed under different plant species. The transformations of the soil microbial communities are quoted more and more like major causes supporting the expansion of the invasive plants (Stinson *et al.*, 2006). The invasive plants affect mainly the telluric micro-organisms through the modifications in the quantity, quality, the periods of contribution of the roots exudates and the litter, thus modifying the contribution of nutriment on the soil (Wolfe & Klironomos, 2005). Wolfe & Klironomos (2005) argued the assumption that the modifications created in the soil, in particular on the biotic component, by the invasive plant, gives a favourable environment for its

development and this would explain mainly the potential of colonization of certain exotic plants in their introduction medium, becoming thus invasive plants.

## Conclusion

*Acacia decurrens* is equipped with a strong reproductive potential by sexual and vegetative way, develops very quickly and invades the Boumalek station. It is a true invading plant involving a reduction of this area biodiversity. It contributes not only to the deterioration of the ectomycorrhizal fungus communities associated with cork oak but also to the modifications of soil chemical characteristics because of the quality of its litter. It is imperative to continue this study by exploring all the possible ways leading to the comprehension of the invasion phenomenon in El-Kala area. It is necessary to recall the evolution of the acacia propagation during these last decades (mapping since its introduction in 1970 up to day), to try to determine environmental factors likely to be correlated with the propagation of this species, by various thematic maps (in correlation with the climate, the soil, the hydrographic system), to extend this study to other stations where the phenomenon was announced in order to define the factors to be taken into account to develop the cork oak, to slow down the colonization of the area by the acacias and to seek the means to implement to control the process of invasion.

## Acknowledgements

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# ACTIVE VIBRATION CONTROL OF A BEAM WITH PIEZOELECTRIC ACTUATORS

Semih Sezer<sup>(a)</sup>, Oktay Aydos, Celalettin Ergun<sup>(b)</sup>

<sup>(a)</sup>Mechanical Engineering Department Yıldız Technical University, TURKEY, sezer@yildiz.edu.tr

<sup>(b)</sup>Mechanical Engineering Department Istanbul Technical University, TURKEY, erguncela@itu.edu.tr

**Abstract:** This paper is about the active vibration control of a cantilever beam by piezoelectric materials, which called smart beam. Within this paper one may find a brief history of the smart structures, the piezoelectricity concept and some examples of piezoelectric materials. But the main goal of the paper is to show the relevance between the ANSYS model and experimental model of a smart beam. For that goal, APC 856 type piezoelectric patches prepared for the application, experiment set up and the ANSYS model of this experiment has been made accordingly. The results of the experiment and the computer model showed notable similarity.

**Key words:** Smart beam, piezoelectric, PZT, finite element analysis.

## Introduction

Smart structures and systems have become a new interdisciplinary research field in recent years. Fields related to this subject are mechanical engineering, electrical engineering, material science and computer science.

It has been more than 132 years since the piezoelectricity phenomenon discovered by Jacques and Pierre Curie at 1880. More and more piezoelectricity theory has been introduced and they used in different kinds of engineering applications as the years passed. In recent years, active control of flexible structures using piezoelectric elements studied by a lot of researchers. Plumb, J. M., Hubbard Jr., J.E., & Bailey, T. (1987) have used nonlinear control with piezofilm for controlling a flexible connection. Piezoelectric transducers experimented by Yousefi-Koma, A., Sasiadek, J.Z., & Vukovich, G., (1994a) in active control system of a flexible connection. Beside this, they used LQG controller with piezoelements for controlling flexible structures (1994b). Piezoactuators were used as an optimum controller for flexible structures by Luis and Crawley (1990).

An efficient active control system is depends on actuator and sensor size and placements. One of the most important questions in an active control system is to optimize the system by sizing and placing sensors/actuators. Kondoh, S., Yatomi, C., & Inoue, K. (1990) introduced a method for finding the optimal positions of the sensors/actuators. When they used this method for a flexible beam, they found the system is more sensible for the placement of the actuators than the sensors. There are more researches on the optimal positioning of point actuator and sensors at the active control of flexible structures (Lindberg and Longman, 1984; Sepulveda and Schmit, 1990; Smith and Clark, 1997).

Piezoelectric property, which describes the relevance between stress/deformation of the materials and the electric field, can be seen in only 21 of the total 32 crystal classes. 10 of these have dipole in their crystal structure that even the thermal stretch and contraction can be enough for electric potential to occur on their surface. These materials called as pyroelectric material. All pyroelectric materials are piezoelectric, but not all of the piezoelectric materials are pyroelectric (Tressler, J. F., Alkoy, S., Newham, R. E., 1995; Ergun C., Yilmaz S., Ozdemir E., Gul O. and Kalenderli O., 2006).

Solid materials that are not in an electrical field have equal positive and negative loads in their structure. In other words, these materials are neutral in electrical load. In theory, this balance should be disturbed by the disturbance in the material's shape or dimension. Crystal symmetry is the most important property that allows this electrical load to occur. The response of the piezoelectric material to the mechanical effect is depends on the angle between crystal orientation, which defined as the arrangement of the atoms in the crystal structure, and the direction of the elongation by the mechanical stress. In other words, mechanical elongations are tensorial and doesn't show any differences in opposite directions (i.e.  $\epsilon_{12} = \epsilon_{12}$ ). Electrical polarization and electrical field that occurs in the piezoelectric materials are vectorial, and they depend on the characteristic of the material defined by the crystal structure. Thus, the electrical polarization a mechanical stress can make on the material depends on the material itself, and it would have a characteristic value according to the crystal structure in every other piezoelectric material (Tressler, J. F., Alkoy, S., Newham, R. E., 1995; Ergun C., Yilmaz S., Ozdemir E., Gul O. and Kalenderli O., 2006).

The ferroelectric property that piezoelectric materials have is the polarization under the high electric field. Normally, ferroelectric ceramics have randomly placed poles as they make their total elastic energy minimum. Because of these randomly placed poles, ferroelectric materials don't show piezoelectric property. But, below the Curie temperature, when they exposed to a static electric field above a threshold value they gain piezoelectric property. During the polarization process, a high electric field (~5kV/cm) attained by applying DC voltage to the electrodes placed on the material. During the polarization process, poles rearrange and bring anisotropy to the structure. This

anisotropy stays after the electric field is removed and piezoelectric property continues after the polarization process (APC International, 2006; Morgan Electro Ceramics, 2007).

Mechanical pressure or tension applied on a piezoelectric material disturbs the dipole momentum of the element and generates voltage. This phenomenon called the generator behavior and has its uses in ignition systems, dry batteries, sensor devices etc. On the contrary, when a voltage applied on the material it stretches or shrinks according to the polarization of the voltage and the material. If an AC voltage applies on the piezoelectric material, it stretches and shrinks according to the frequency of the sinusoidal wave. This phenomenon called motor behavior and has its uses in piezoelectric motors, sound or ultrasound generator devices and many other products (APC International, 2006).

## Experiment Setup

APC 856 type piezoelectric material of APC International Company is used for the experiment. Manufacturer's data of APC 865 material has shown on Table 1. 856 type piezoelectric mainly has its uses in actuators, flow meters, hydrophones, microphones, pressure sensors and medical screening and diagnosis devices.

Powder APC 856 is sintered under appropriate pressure and temperature to prepare the required material. Then the material is cut to its specific dimensions (20\*5\*2mm) by a precision cutter. In this stage, two surfaces of each piezoelectric patch have covered by silver conductor liquid. After silver conductor liquid dried the patches are polarized under 1200VDC for 60 minutes. After the patches polarized their  $d_{33}$  is measured by a  $d_{33}$  test device. Under the force of  $250 \times 10^{-3}$  the  $d_{33}$  of the material is measured as  $420 \times 10^{-12}$  C/N. Prepared piezoelectric patches are fixed on their positions on the beam by epoxy glue. To achieve a good fix, the parts must be stay clamped under a pressure for a time. After the patches are fixed on the surface of the beam, the cables attached to the piezoelectric patches' open sides by aluminum tape.

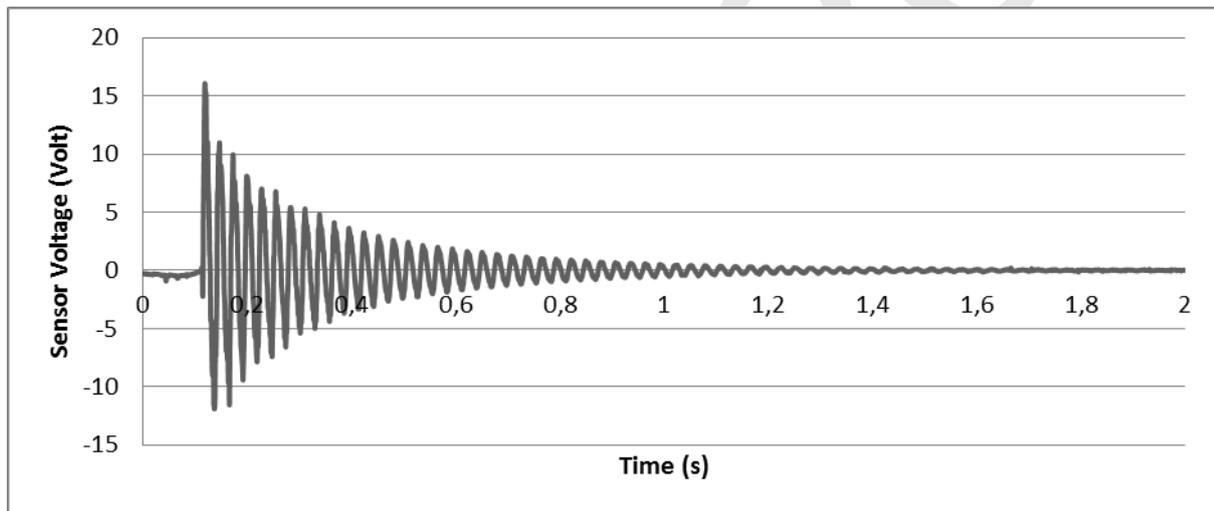


Figure 1: Data acquired from the piezoelectric patch under the free vibration of the beam

Table 1: APC 856 Type piezoelectric material properties.

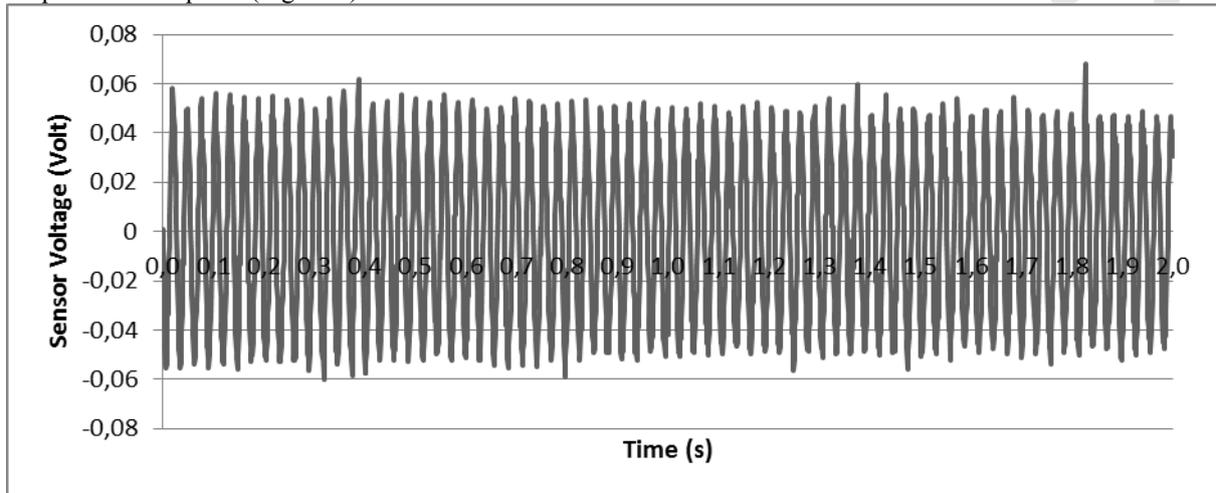
| APC 856   |      |
|---|------|
| Relative Dielectric Constant ( $K^T$ )  | 4100 |
| Dielectric Dissipation Factor (Dielectric Loss(%))*                             | 2.7  |
| Curie Point ( $^{\circ}\text{C}$ )**  | 150  |
| Density ( $\text{g}/\text{cm}^3$ )  | 7.5  |
| Mechanical Quality Factor   | 72   |
| Electromechanical Coupling Factor   |      |
| $k_p$   | 0.65 |
| $k_{33}$  | 0.73 |
| $k_{31}$  | 0.36 |
| $k_{15}$  | 0.65 |
| Piezoelectric Charge Constant ( $10^{-12}$ C/N or $10^{-12}$ m/V)               |      |
| $d_{33}$  | 620  |
| $-d_{31}$   | 260  |
| $d_{15}$  | 710  |
| Piezoelectric Voltage Constant ( $10^{-3}$ Vm/N or $10^{-3}$ m <sup>2</sup> /C) |      |
| $g_{33}$  | 18.5 |
| $-g_{31}$   | 8.1  |
| $g_{15}$  | 25   |

| Young's Modulus ( $10^{10}$ N/m <sup>2</sup> ) |      |
|--|------|
| $Y_{11}^E$                                     | 5.8  |
| $Y_{33}^E$                                     | 4.5  |
| Frequency Constants (Hz*m or m/s)              |      |
| $N_L$ (longitudinal)                           | ---  |
| $N_T$ (thickness)                              | 1980 |
| $N_P$ (planar)                                 | ---  |

\*At 1 kHz, low field.

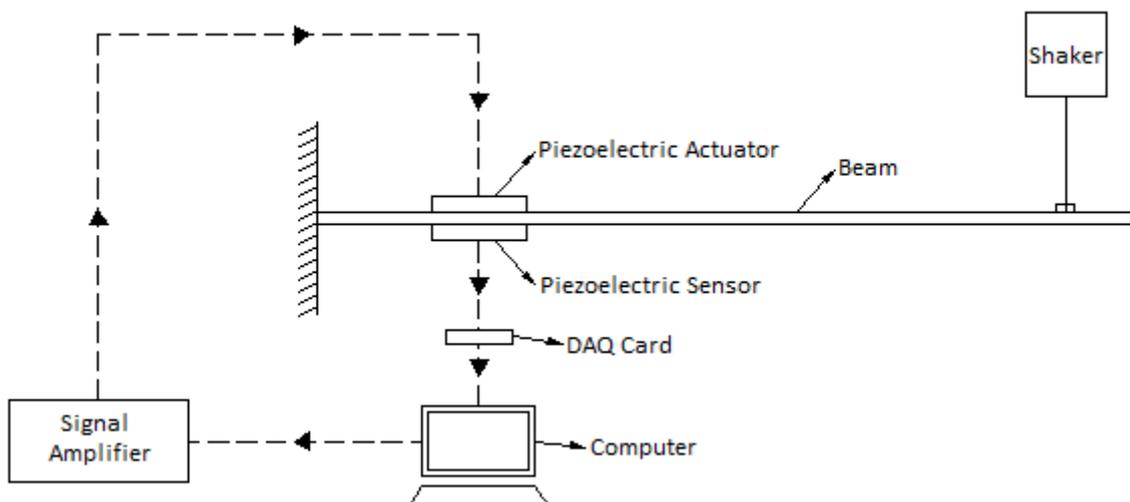
\*\*Maximum operating temperature = Curie point/2.

Fully prepared apparatus are connected to a computer by means of a DAQ card for testing the patches. Data acquired from the piezoelectric patch under the free vibration of the beam is shown in Figure 1. After that 30Hz, 370V is applied to the actuator patches. In that test, the beam is vibrated on its resonance frequency and voltage acquired from the sensor piezoelectric patch (Figure 2).



**Figure 2:** Data acquired from the piezoelectric sensor while 370V applied to the actuators

Actual experiment is setup for forced vibration after testing of the patches and the devices. For this experiment the beam is forced by a shaker at its resonance frequency. The sensor voltage is altered for control by means of Matlab computer program and a signal amplifier device and transmitted to the actuator patches. A scheme of the experiment set up is shown in the Figure 3.



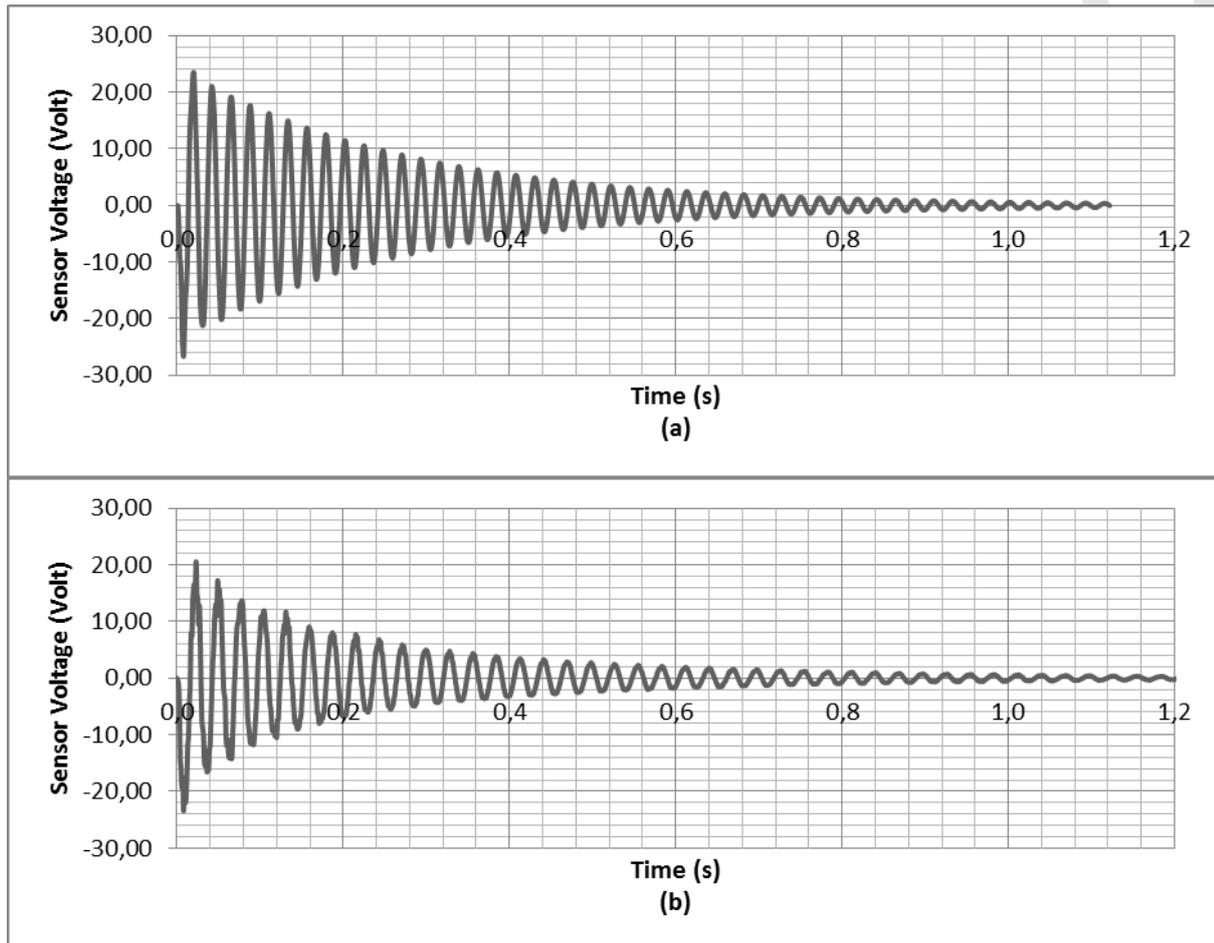
**Figure 3:** Experiment setup scheme for forced vibration control

The experimental setup is also modeled in ANSYS computer program for comparison. While modeling at ANSYS, piezoelectric ceramics and the beam are chosen as SOLID5 and SOLID45 elements respectively. Manufacturer's data of the piezoelectric material cannot be directly used as inputs of ANSYS program. Thus, some transformation was made for these inputs.

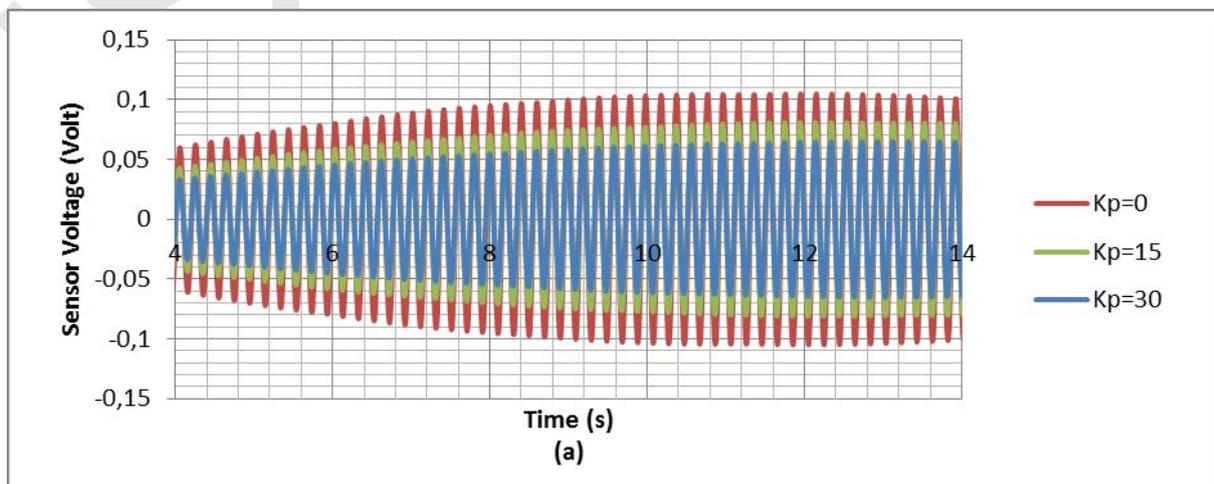
## Results

In this study, a comparison is made between experimental and numerical results. At first, a comparison is made for free vibration of the beam for checking purposes. Resulting graph of this comparison is as the Figure 4.

Results of this test showed that the sensor voltages are quite similar for experiment and computer model. After seeing that result, a new test is made with the same setup under the forced vibration for proportional control. The experimental and numerical (ANSYS) results tested individually to see whether the control works on both systems. The controlled systems decreased the amplitudes of vibration in both situations, and a comparison between the controlled and uncontrolled systems was made. The results of this comparison are shown in Figure 5. Note that  $K_p$  is the control factor and it is the multiplier of the signal that gained from the sensor patch. Thus, a  $K_p$  of 3000 means the signal amplified 3000 times before forwarding to the actuator patch.



**Figure 4:** Sensor responses of the beam under the free vibration (a)ANSYS, (b)Experiment



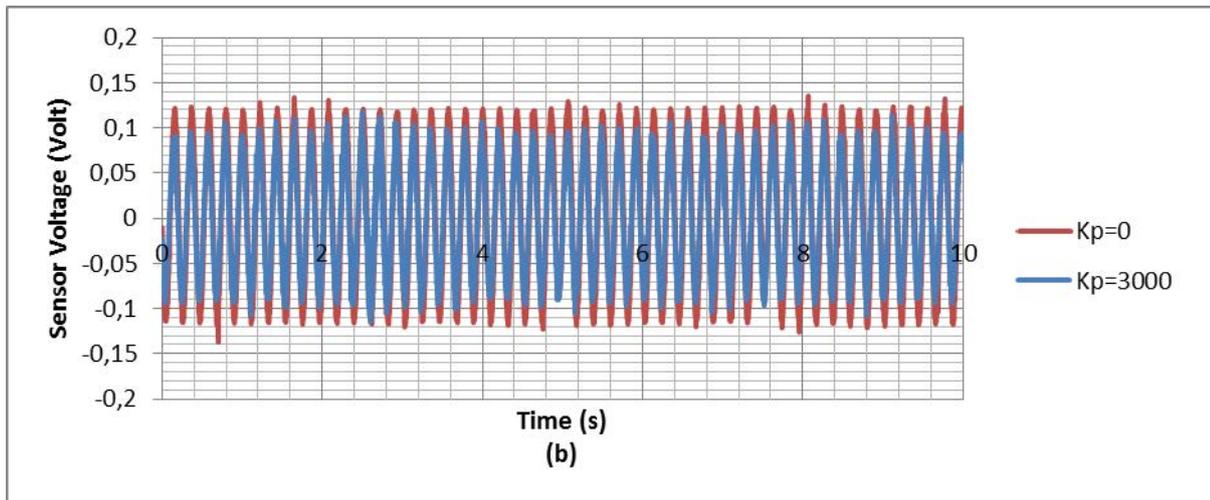


Figure 5: Sensor responses of the beam under forced vibration (a)ANSYS, (b)Experiment

## Conclusions

The comparison of the numerical (ANSYS) and experimental study shows quite similar results. However, control factors of the systems are very different for achieving similar results. Reasons of this difference may be the bonding between the piezoelectric patches and the beam, or a disruption of the manufacturing piezo ceramics procedure.

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## ADVANCED PROGRESS ON THE APPLICATION OF MOLECULAR TOOLS AND TECHNOLOGIES FOR PARASITES IDENTIFICATION\*

Prof. Dr. Sanaa Haroon\* , Prof. Dr. Fatma Hamad, Dr. Mary Zaher  
*Nematology and Biotechnology unit,  
 Fayoum University, Egypt  
 sanaaharoon@hotmail.com*

**Abstract:** Molecular biological and its application have been used as strong tool for many fundamental and applied areas of research, it provides unique and elucidating developmental and understanding of host parasite interaction at molecular level and seeking new means of parasite intervention.

Our researches is focus specifically on recent progress in studying the molecular mechanisms of host parasite relationship with special emphasis to nematode as a serious parasite to human, animal and plants. In our research, we highlighted on nematodes problem in plants.

In Egypt and all over the world, Root Knot Nematode is considered as one of the most important pest, many species has been identified to cause important problems to most field crops, vegetables and fruit trees. Molecular tools was used for nematode identification, Ribosomal DNA for ITS spacer was used to identify different genera of nematode while multiplex test from ITS region was determine the different between species.

The identification of different population and races that exist within root knot population were determine using RAPD technology , Dendrogram was developed to provide analysis from the obtained results to describe the relationship between different populations.

Also, RFLP technology plays an important role for species analysis; different restriction enzymes have been used to identify different species of Root Knot nematode.

SCAR techniques were used to obtain special markers for each species and Multiplex test from ITS region was used for mixed Root Knot population on the same field (population dynamics).

The most advanced technology is the application of laser capture microdissection (LCM) for expression analysis of giant cells that is formed by Root Knot Nematode. Giant cells were collected using (LCM), RNA was extracted and used to make a cDNA library and expressed sequence technology (ESTs) were produced and used for gene ontology analysis , thus (LCM) allowed for the isolation of tissue enriched for giant cell , providing material suitable for a variety of Molecular analysis.

RNAi has also become available research tool, both in cell culture and in living organisms, because giant cell dsRNA introduced into cells can selectively and robustly induce suppression of specific genes of interest. RNAi used for large scale screens that systematically shut down each gene in the cell, which can help identify the components necessary for a particular cellular process or an event such as cell division. The pathway may also use as practical tool in biotechnology and medicine. All previous technology could be applied on most parasites.

**Key words:** Molecular techniques – Root Knot Nematode - host parasites interaction

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### Introduction:

During the past few years, rapid advances in molecular biology have affected our understanding of diseases and revealed many powerful tools that help in many areas of pests control. The new tools include species, race and pathotype identification, population genetics, biological control agents and the design of new pesticides.

Our researches is focus specifically on recent progress in studying the molecular mechanisms of host parasite relationship with special emphasis to nematode as a serious parasite to human, animal and plants. In our research, we highlighted on nematodes problem in plants.

Root- knot nematode is considered as one of the most serious nematode pests of agricultural and horticultural crops in Egypt and most widely distributed group of plant-parasitic nematodes all over the world. An estimated 10% of world crop production is lost due to nematode damage. It causes an estimated \$80 billion in losses worldwide ([http://www.cals.ncsu.edu/pgg/dan\\_webpage/index.htm](http://www.cals.ncsu.edu/pgg/dan_webpage/index.htm)). Root knot nematode (RKN) attacks cotton, soybean, wheat, tomato, potato, pepper and many other important crops, Eissa (1982), reported that losses due to the root-knot nematodes in Egypt measured about 25-40% of the estimated total losses of plant parasitic nematodes.

A few years ago, root-knot nematodes (*Meloidogyne spp.*) were difficult to be identified using traditional morphological characterization, so alternative identification methods that are easily interpreted are desirable. It is now possible to distinguish among root knot nematodes by the use of DNA markers, the big advantage of using DNA that it does not change with environmental conditions during a nematode's lifetime. Consequently, DNA markers are stable and useful when applied to identifying nematode species and populations. Various DNA polymorphisms that allow identification of the major root-knot nematode species have been described, also polymerase chain reaction (PCR) developed technique that has been of particular consequence to molecular genetics, and it allows amplification of specific sequences from minute quantities of DNA. The technique is effective with samples containing little biomass; for example, it has been used to amplify DNA from single human sperm or from blood stains.

Restriction fragment length polymorphisms (RFLPs) generated after PCR amplification of ribosomal DNA can be used for identification of single root-knot nematode 2nd Juvenile (J2). The technique uses PCR and primers to generate DNA fragments that are subsequently subjected to restriction endonuclease digestion, yielding species-specific RFLPs that allow discrimination of different root knot nematode species such as *M. arenaria*, *M. chitwoodi*, *M. incognita*, *M. javanica*, and *M. hapla*.

Random amplification of polymorphic DNA (RAPD) assaying the entire genome for DNA markers is a powerful way to obtain markers linked to characters of interest. The RAPD assay refers to PCR amplification of target DNA with single primers, and hence produces DNA fragments distributed over the entire target DNA pool.

RAPD analysis has been used successfully to distinguish between different species of Root Knot Nematode. Thus it is desirable to clone species-specific RAPD markers, sequence the clones, and then synthesize larger, more stable primers that allow reliable amplification of the diagnostic bands. A distinct dendrogram (UPGMA) will be used to show the phylogenetic relationships between root-knot nematodes.

Genetic variability in nematode populations and their hosts, are just beginning to be documented, because it was not important while nematicides were available and, more importantly, because the tools for assessing genotypic variation have become available only during the past few years. For each nematode species, genetic markers associated with host range or life history characters would be valuable in developing management practices that reduce nematode pathogenicity and fitness by allowing monitoring and selection for specific genotypes.

The next challenge in the application of new technologies is to obtain DNA polymorphisms useful as markers to identify pathotypes, races, and geographic isolates of *Meloidogyne spp.*, and several researchers are looking for such markers.

Molecular techniques can be also used for nematode population dynamics and management, several root-knot nematode species occur in the same field. For example, *M. arenaria*, *M. incognita*, often occur together in most fields around the world. Part of the difficulty lies in defining the species that are present and their relative proportions, before and after rotations. Certain hosts in a rotation series will favor increase of one of the root-knot nematodes, and it is difficult to sample such fields accurately with morphology-based nematode identification. So multiplex test can be used to determine the population dynamics of mixed populations in the same field. This technique becomes widely used in routine diagnostic tests to identify species and to sensitivity differentiate them from each other in field population. It depends on the used of four primers in a single PCR reaction, also this test makes it possible to detect species present in mixtures in proportions as low as 2 to 5%.

In conclusion, there are many exciting research opportunities in applied and basic nematology that utilize the new approaches and tools of molecular biology. The tools will facilitate research on previously intractable questions in nematode biology that have been inaccessible because of technical limitations. Current nematode control options include the use of nematicides, cultural practices, resistant cultivars, and crop rotations. In the future, successful integrated nematode management will depend on combinations of control tactics to reduce nematode numbers. Application of biotechnology to nematode control tactics will influence applied nematology in diverse ways, from nematode identification to the development of resistant cultivars, and will improve effectiveness and increase the number of management options available. Increased communication and cooperation between researchers with expertise in applied science is necessary to enlarge our understanding of nematode biology and ecology. The outcome will enhance development of new nematode management strategies and allow refinement of old techniques.

This research has focused upon the important agricultural root knot nematode to study its distribution all over Egypt. So 5000 samples were collected from landed sectors of different governorates. The new molecular technology will be used to identify different species races and the distribution of different population. This information will be a very helpful tool for IPM program for controlling this destructive pest. we will use cotton plant as important economic crop to implement all the advanced technology to obtain the most recent information concerning this valuable crop, It was found out that the loss estimates of cotton crop as a result of nematode attack are complicated by the occurrence of disease complexes, and the loss caused by each part of the complex is difficult to assess. The root-knot nematode, *Meloidogyne incognita* and the reniform nematode, *Rotylenchulus reniformis* are regarded as the major nematodes attacking cotton in Egypt in both light and heavy soils (Salem, 1970). There is a relationship between *Meloidogyne incognita* and the presence of the fungus *Fusarium oxysporum f. vasinfectum* (Salem, 1980).

Developing cultivars that resist biotic stresses is one of the major goals of breeding programs of cotton. So, molecular markers can help these programs by tagging the important traits, helping in screening the genotypes and selecting them throughout the course of breeding programs.

#### **So the objective of our project is:**

- 1- Accurate identification of genes, species and population of different nematodes as a major pest in field crops, vegetables and fruits in Egypt by using molecular technology.
- 2- Investigate root knot nematode problems in cotton as major and economic crop in Egypt and manipulation of most advanced technology (LCM) to differentiate between resistant and susceptible cotton cultivars for future work (gene silencing technology)

#### **Materials and Methods:**

**Collection of Nematode Samples:** Five thousand samples were collected from agricultural sectors of different governorates in Egypt (The survey includes agronomics crops, vegetables, cut flowers and fruit trees. The most common crops were pea, pepper, potato, strawberry, squash, cucumber and tomato, among the vegetable, and cotton, corn, soybean, peanut and sunflower among other crops also banana, peach and grapevine and ornamentals.

The samples were handled with care and stored at 10-15°C until the analysis in nematology lab (college of agriculture, Fayoum University).

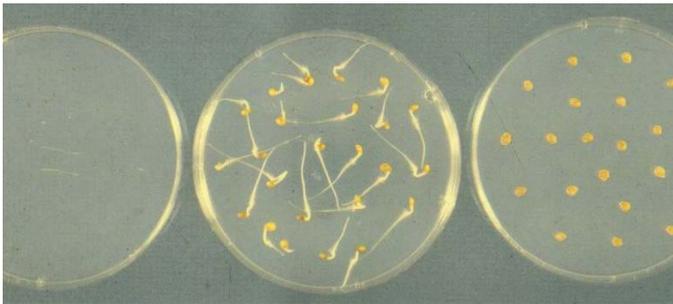
**Nematodes extraction from the soil samples:** Nematode was extracted from the soil sample and was recovered according to centrifugal flotation method (Jenkins, 1964). Extracted nematodes were identified to the generic

level, and counted under microscope using the Hawksley counting slide.

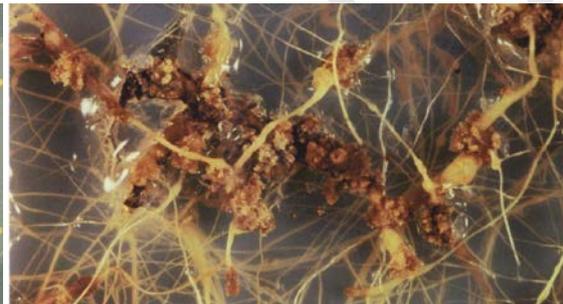
Root samples were carefully washed with tap water and cut into small pieces in a Petri dish with 10 ml water. Roots were then teased with dissecting needles to collect mature females necessary for species identification and tissue culture propagation.

**Preparation of pure culture from root knot nematode samples:** One adult female with one egg mass from each sample were propagated under tissue culture condition to insure the purity of the population for each sample that will be used for DNA extraction.

Preparation of root explant cultures was accomplished according to Haroon et al., (1993). Seeds were sinicated for 3 min. in 95% ethanol followed by a 10-min soak in 0.5% sodium hypochlorite and were transferred to sterile 1.5% water agar plates where they were maintained for 3 days at 25°C. A 5-mm-long root tip was excised from each seed-plate (one root tip per plate) containing Gamborg's B-5 medium (Gibco. Grand Island, N.Y.). Each plate was inoculated with one egg masse that was extracted from one population of each genera of root knot nematode. All the plates were stored in an incubator at 28°C and three months later 25 females from each dish were isolated for DNA extraction. (Fig. 1, 2)



**Fig 1:** Tomato seeds in water agar



**Fig 2:** plates after 3 months of inoculation with RKN

**FIRST: DNA isolation for Root Knot Nematode molecular identification:** DNA isolated from different samples was done using Genomicprep™ Cells and Tissue DNA Isolation kit (Amersham Pharmacia Biotech, ltd, England). **Isolated DNA was measured to determine the purity and quality to be used for further experiments as following:**

**Step 1: Ribosomal DNA amplification (ITS) Primers** 5367 (5' - TIGATI ACGTCCCTGCC CTTT-3') and primer 5368 (5' -TTICTACTCGCCGTIACAGG3') were sequences as described by Vrain et al.,(1992) and Vrain (1993). The DNA fragments containing the ITS regions were amplified by PCR. The reaction mixtue contained 10 mM Tris, pH 9.0; 1.5 mM MgCl<sub>2</sub>; 50mM KCl; 0.01 % (wt/vol) gelatin; 0.1% Trition X-100; 100 uM each of dATP dTP dGTP and dTTP (Boehringer GmbH, Mannheim, Germany); 0.6uM each primer; 0.1 to 10 fig of total DNA or the crude DNA extract from 25 females of each isolate; 0.6 units of Taq DNA polymerase (Sphaero Q. Leiden, the Netherlands); and deionized water to a volume of 50 µl. The amplification was carried out in a thermal cycler (PCR) DNA. Initially PCR amplification conditions were as follows: denaturation at 94°C for 2 min, repeated for 20 cycles. A 5-min incubation period at 72.C° followed the last cycle to complete any partially synthesized strands. The fastest available transition between each temperature was used (Zijlestra et al., 1995).

**Step 2: ITS-RFLP:** Amplified DNA of ITS fragments were digested with Hind I, Hinf I, EcoRI and Dra I restriction enzymes. A master mix was prepared by using 1 µl of selected enzyme, 1.5 µl of matching buffer and 12.5 of DNA template (obtained from ITS test). The mixture for each sample was placed in incubator at 37°C for at least 3 hours or until the second day. The digested DNA was loaded on a 2.5% agarose gel, separated by electrophoresis and detected by ethidium bromide staining.

**Step 3: Species specific (Multiplex) PCR:** For conducting the species specific (multiplex) PCR test, amplifying segments of the ITS region of each isolate was used. This technique was used to identify root knot nematode species by the size of their amplified fragments in a signal PCR reaction. In other words the test was used for direct identification of the four species based on length polymorphism. The reverse primer HCFI-28S is the backward primer as described by Ferris et al. (1993).

The reaction mixture contained 10 mM Tris pH 9.0, 3.5mM MgCl<sub>2</sub>, 50 mM Kcl, 200 uMeach of dATP, dCfP, dGTP, and dTTP, 0.4 uM of each forward primers H-18S (5'-CTTGGAGACfGTTGATC3'),CF-ITS(5'-GATTATACGC ACAATT), and I-ITS (5TGTAGGACTCTTTAATG 3') and 0.4 uM of the reverse primer HCFI-28S. One unit of Taq DNA polymerase (Pharmacia), 3 ng of total DNA or the crude DNA extract from 25 female, was mixed with deionized water to a volume of 50ul. PCR cycle was denaturation at 94C° for 4 min. followed by five cycles at 94C° for 30s, 55C° for 30s, 72.C° for 1 min. with a decrease of 1 C° per cycle for the annealing temperature followed by 25 cycles at 94C° for 30s, 50C° for 30s, and 72C° for 1 min.

## **SECOND: Root Knot Nematode associated with cotton plant:**

**Collection of samples:** A total of 200 soil and roots samples were collected from cotton fields all over Egypt. Each soil sample was composed of three sub-samples obtained from the rhizosphere of the growing plants, by digging the soil to a depth of about 30 cm and placed in labeled polyethylene bags. Root samples were also obtained by lifting the plants carefully with a trowel and samples were directly sent to the laboratory for nematode extraction and identification. The survey included the following cotton cultivars in Giza 45, Giza70, Giza 83, Giza80, Giza 85, Giza 86, Giza 88, Giza 89, Giza 90, Giza 91 and Menoufia.

Nematodes were extracted from soil and root samples and pure tissue culture were prepared for each population as described before. Nematode counts and identification to generic level were based on the morphology of the adult and larval forms, described by **Harrison and Mai, 1985 and Freckman and Baldwin, 1989**.

For each genus, population density / 100 cc soil, percentage of frequency occurrence and prominence value were calculated according to (**Norton, 1978**) as follows: -

**Population Density (P.D.)** = Total numbers of individuals of each genus per 100 cc.

**% Frequency Occurrence (% F.O.)** =  $\frac{\text{Number of samples containing a genus} \times 100}{\text{Total number of collected samples}}$

### **Root Staining and Examination:**

The complete root-system of each seedling of cotton was carefully removed from the soil, washed gently in tap water and stained in 0.05% boiling lactophenol acid fuchisin (Franklin 1949) according to (**Byrd et al, 1983**), and then followed by washing in tap water and keeping in plain lactophenol for further differentiation. The pieces of roots were putted on one drop of glycerin on the glass slide, pressed slowly and covered it to be examined under the microscope to seeing the different stages from the different days post inoculation.

**Different steps were conducted after DNA extraction from each population as following:**

### **Step 1: Fingerprinting of cotton cultivars for Molecular genetic markers in cotton cultivars Randomly Amplified Polymorphic DNA (RAPD) markers:**

PCR reaction was conducted using ten (10 mer) random primers. List of primer names and their nucleotide sequences used in the study as listed in table (1) :

**Table (1):**

| Primer code | Sequence 5 '-3' | Primer code | Sequence 5 '-3' |
|-------------|-----------------|-------------|-----------------|
| OP- A03     | AGTCAG CCAC     | OP- A07     | GAAACGGGTG      |
| OP- A16     | AGCCAGGGAA      | OP- B01     | GTTTCGCTCC      |
| OP- B05     | TGCGCCCTTC      | OP- C19     | GTTGCCAGCC      |
| OP- D05     | TGAGCGGACA      | OP- Z13     | GACTAAGCCC      |
| OP-K02      | GTTTCGCTCC      | OP-K06      | CCCGTCAGCA      |

The amplification process were carried out by using Ready – To – Go RAPD Analysis Beads Kit (Amersham Pharmacia Biotech, ltd, England) for 25 µl PCR mixture.

25µl mixture of 25 pmol of a single RAPD primer, 50 ng template DNA and the volume were completed to 25 µl by distilled water was prepared in 0.5 ml tube. Then the contents of the tube were mixed by gently vortexing. Centrifuge briefly to collect the contents at the bottom of the tube. The mixture was added to 0.2 ml PCR tube containing RAPD analysis bead in the bottom of the tube. So the contents in the above tube were mixed by gently vortexing. Then centrifuge briefly to collect the contents at the bottom of the tube. Finally, the samples were introduced to a Perkin Elmer 480 thermocycler (Norwalk, CT) where the following cycle profile was used: **One cycle:(95C° for 5 min) - 45 cycles each of( 95C° for 1min, 36C° for 1 min, 72C° for 2 min)**

After amplification, the banding pattern of the randomly amplified DNA visualized and analyzed. RAPD analysis done on agarose gel.

**Gel analysis:** Gels were photographed and scanned with Gel Documentation system image analysis software (Bio Rad laboratories, Inc., California, USA).

### **Step 2: Histopathological changes in cotton roots, cv. Giza 83 as influenced by the infection with the root-knot nematode, *M. incognita* race 3:**

Cotton seeds, cultivar Giza 83 were planted in 20 cm diameter plastic pots filled with steam sterilized loamy soil. Two weeks after germination, plants were thinned to one seedling per pot and nematode suspension, containing the known numbers of freshly extracted second stage juveniles (**Hussey and Barker, 1973**), was then pipetted directly around the root system of each seedling. Approximately 0, 100, 500, 1000, 2000, 4000, 8000 and 12000 juveniles per

plant were used as different levels of initial inoculation. Each inoculation level was replicated three times and all pots were arranged on a bench in a greenhouse at temperature degree of  $30 \pm 5^{\circ}\text{C}$ . Sixty days later, plants were harvested and data on plant growth was estimated. Infected roots were washed gently, fixed in F.A.A., stained in boiling acid-fuchsin lactophenol (Byrd *et al.*, 1983) and then examined under a stereoscopic-microscope to count the embedded different developmental stages of the nematode. Soil of each pot was processed for nematode extraction to estimate the number of nematode in soil.

**Step 3: reaction of cotton tissue against the invasion of Root Knot Nematode juveniles to resistant and susceptible cultivars.**

Another test was conducted with Giza 83, Giza 90 as two major commercial cultivates to determine their relationship with root knot nematode (Race 3)

**THIRD: Laser Capture Microdissection (LCM) for Cotton roots**

Samples from the above experiment were taken after 25 days post inoculation (dpi) for both cultivars of cotton from Giza 80 (Resistant) and Giza 90 (susceptible), kept in farmer's solution (FS) composed of 75% ethanol:25% acetic acid (Sass, 1958 and Kerk *et al.*, 2003) the same manner was used for control treatments for preparing of laser capture microdissection.

Fixation were done to stabilize the cell contents and to preserve histological integrity and detail during tissue sectioning, tissue fixation in farmer's solution (FS) composed of 75% ethanol, 25% acetic acid provided superior quality RNA extracted from samples obtained by LCM.

Ethanol and ecetic acid were used to reduce the amount of sample preparation required to collect the relatively large number of LCM samples required to provide sufficient RNA for further analysis.

Root samples were cut into 1cm squares, placed in different solutions (70% Ethanol, 30% DEPC H<sub>2</sub>O (Dep'd H<sub>2</sub>o for 30 min, 95% Ethanol for 15 min), (100% Ethanol for 15 min (3 times) Also placed samples in different solvents for different times (100 proof Ethanol: d-Limonene Hemo-De , 3:1for 30 min, 1:1 for 30 min, 1:3 for 30 min, 100% HemoDe for 3h to o/n, 100% HemoDe for 2-4x 1h).

Following steps was placed in the fume hood which include filling tubes 1/2 way with HemoDe and placed tubes with sample in incubator at 58°C for 1h, after that add 5-10 ml of paraffin each hour with initial mixing at each addition.4-5x. Leaved the tube caps off to allow HemoDe to evaporate, poured off all solution and added pure melted paraffin (5 xs at h intervals). Pouring molds was done on silver gradient heat tray placed with aluminum foil and allowed to cool at 4°C.

Sectioning was done while using paint brush to hold section away from microtome (Fig.3). Add Deped H<sub>2</sub>O to baked, RNase-free slides. Float 1 inch section trail on slide, allow section to spread, with Kim Wipe and tipping slide, remove excess H<sub>2</sub>O, and let sections to dry well the slide that used is LCM slides: Lecia: No. 11505158 Membrane Slides: PEN-Membrane 2.0 um, 50 pieces.

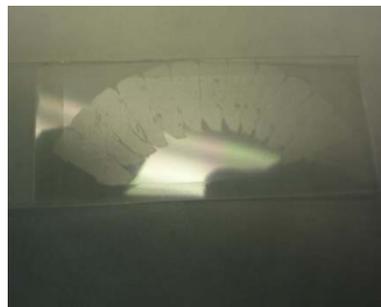
The special LCM slides were covered with a transfer film. The film will later transfer the selected cells after tissue acquisition. Prior to sectioning, LCM slides are placed on a 42 degree Celsius slide warmer and are covered with RNase-free water. Small pieces of the sliced ribbon were placed in the water, on top of a glass slide. After drying, the tissue adheres to the film. This step was important for later isolation of selected cells. Excess water was removed by incubating the slide on the slide warmer.

The tissue sections are then incubated in xylene incoplin jars to dissolve and remove the paraffin wax. The slides were placed on top of a paper towel and air dried; this shows a slide with dried tissue, then the slides were ready for examination by LCM system. (Fig. 4)

The system consists of 2 parts, a microscope and a computer for image display. It has a microscope with an ultraviolet laser beam, this ultraviolet laser will be calibrated and the power will be adjusted before capturing the cells of interest (Fig. 5)



**Fig. 3: microtome system**



**Fig 4: LCM slide which contains on ribbon of cotton roots**



**Fig. 5: LCM, microscope with laser and a computer for image display.**

## Results:

Five thousands samples of nematode different populations were collected from agriculture sectors of different governorates that were considered as its important in crop production in Egypt. The survey covers 47 different crops. Results presented show the prominence values of the eleven plant parasitic nematode genera, including *ectoparasitic*, *endoparasitic* and *semiendoparasitic* forms, which were recovered from the soil samples. These genera were *Meloidogyne spp.*, *Pratylenchus*, *Helicotylenchus*, *Hemicycliophora*, *Hoplolaimus*, *Paratylenchus*, *Rotylenchulus*, *Tylenchorhynchus*, *trichadorus*, *longidorus*, *tylenchulus* and *Xiphinema*. The root-knot nematode, *Meloidogyne*; the lesion nematode, *Pratylenchus*; the reniform nematode, *Rotylenchulus*; the stunt nematode, *Tylenchorhynchus* and the lance nematode, *Hoplolaimus* were the major nematodes distributed. Data revealed that *Meloidogyne*, *Pratylenchus* and *Rotylenchulus* were found with relatively higher frequency of occurrence % (F.O. %), population density (P.D.) and prominence values (P.V.). Accordingly, their percentages of occurrence were 24.7, 22.7 and 20.2, of the total collected samples, respectively.

It was very important to identify all the isolated of Root Knot Nematode, to species, races and population as we found out that the majority of crop s is seriously damaged with this group of nematodes, so using this molecular techniques is important to design effective and suitable program of IPM for control this pest. (Fig. 6)



**Strawberry**



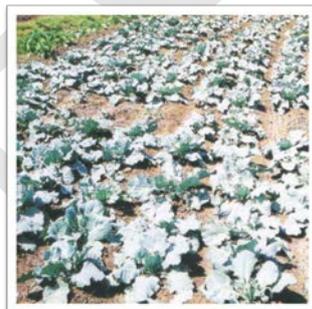
**Carrot**



**Bean**



**Onion**



**Cabbage**



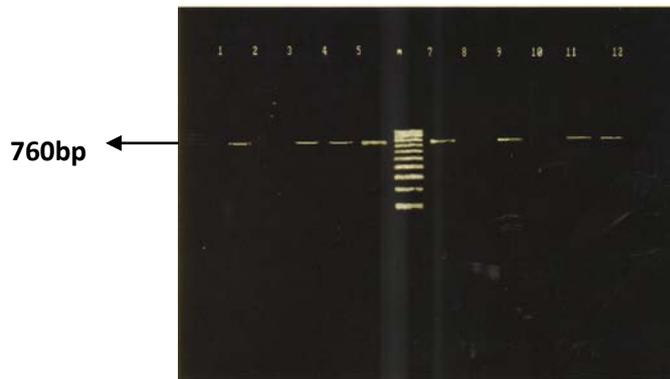
**Turnip**

**Fig. (6) different crops infested with RKN**

## **FIRST: DNA isolation for Root Knot Nematode molecular identification:**

### **Step1: ITS Test:**

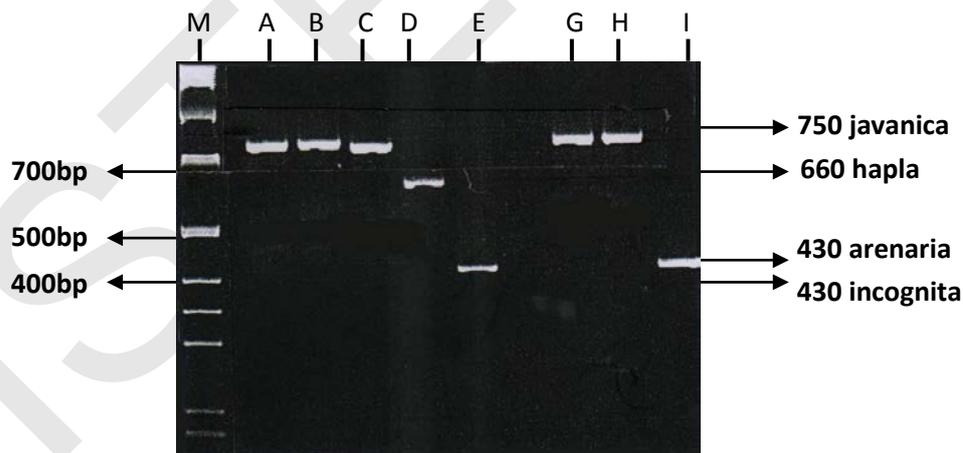
After the measurement of all obtained pure DNA from each isolate of root knot nematode, the first test (ITS) was conducted for each isolate separately to insure that all the DNA is for root knot nematode. So, primer 5368 and 5367 were used for amplification of the ITS region, all the root knot isolates from different governorates and districts gave one main product of approximately 760bp. This 760 bp PCR product obtained from the amplified ITS region of *Meloidogyne* was shorter than the product reported for other nematodes (Vrain et al., 1992; Zijlestra et al., 1997). (Fig. 7)



**Fig (7):** Typical amplification of 760bp polymerase chain reaction – PCR product from template of total DNA extracted from *Meloidogyne* spp. of different isolates from different governorates and districts with internal transcribed spacer (ITS) with primers 5367 and 5368.

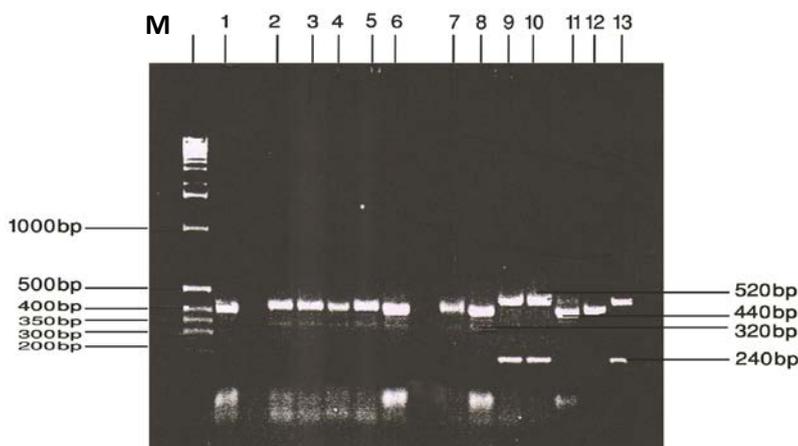
### **Step 2: Multiplex Test:**

Sequencing data reveal that the sizes of the cloned amplified ITS regions of *M. incognita* is 760 bp. First, PCR reactions were performed with HC F I – 285 and one of the three forward primers. The sizes of the fragments obtained after amplification could be estimated from the sequences. The combination of primers H-18S and HCFI - 28S resulted in amplified fragment of 660 bp. this fragment is typical for *M. hapla*. No reaction with any other governorates isolates was shown the amplified fragment of 660bp was recognized. PCR with primers ITS and HCFI - 28S resulted in amplification of a 415 bp fragment when *M. incognita* was used as template. The majority from all governorates isolates react with this combination of the primers. (Fig. 8)



**Fig (8):** Amplification products of multiplex PCR reactions using forward primers H- 18S, I – ITS, EF – ITS and the reverse primer in a single PCR reaction with 3ng of template DNA of root knot nematode population collected from different governorate of Egypt, when ITS primer sets H-18S/HCFI-28C used with *M.hapla* the result was 660bp, when ITS Prime sets I-ITS/HCFI-28S used with *M.incognita* the result was 415bp, and when ITS Prime sets H-18S/CF-ITS/HCFI-28S used with *M.javanica* the result was 750bp and when ITS primer sets ITS / HCF1, 28C used in *arenaria*

ITS regions of all isolates were digested with restriction enzymes. When Hind III was used in RFLP test (Restriction fragment length polymorphisms), the size of the DNA fragment obtained was not clear while 520, 200 bp bands were cleared when EcoRI are used with isolates from *M.incognita* and *M.javanica*, also two bands were recognized at 440 bp and 320bp when Hind I was used with isolates from the same nematodes species. These results were typical for *M. incognita*, and *M.javanica* confirming the previous findings by Zijlstra et al., (1995 and 1997). (Fig. 9)



**Fig (9)** Restriction product OF 760 bp polymerase chain reaction amplified internal transcribed region of *Meloidogyne spp* upon restriction with *Hind I*, *EcoRI*

**SECOND: Root Knot Nematode associated with cotton plant:** It was found out from the simple examination using molecular technique that was described before that *M.inconita* race 3 is the major past in cotton plant also Data indicated that the highest prominence value of *Meloidogyne spp.* was observed with the cv. Giza 90 growing areas; (39.3) followed by the cv. Giza 83; (36.2).

**Step 1: Fingerprinting of cotton cultivars for Molecular genetic markers in cotton cultivars Randomly Amplified Polymorphic DNA (RAPD) markers:**

Randomly amplified polymorphic DNA using PCR (RAPD-PCR) was used to assess the genetic diversity of the six selected cotton cultivars, Ten artificial primers was used to determine the fingerprinting of cotton cultivars, clear results was obtained from four of these primers as in table (2)

**Table 2: Molecular genetic markers for root-knot nematode, *M. incognita* race 3, resistance based on RAPD-PCR with primers OP-C19, OP-A07, OP-A16 and OP-K06.**

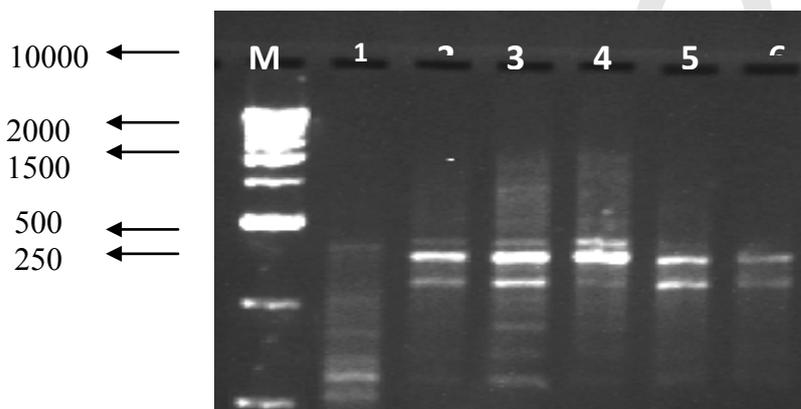
| Primer    | Cultivar      | Molecular Marker                                     |
|-----------|---------------|--|
| 1- OP-C19 | Giza 70(S)    | +396bp and +250bp.                                   |
|           | Giza 83 (S)   | +1500bp, +700bp and +416bp.                          |
|           | Giza 80 ( R ) | +950bp.  |
| 2- OP-A07 | Giza 70(S)    | + 550 bp.  |
|           | Giza 80 ( R ) | +1100bp, +900bp, +800bp and +288bp.                  |
|           | Giza 91 ( R ) | +725bp and +644bp.                                   |
| 3- OP-A16 | Giza 70(S)    | +1000bp, -450 bp and +260bp.                         |
|           | Giza 83 (S)   | +1000bp and -450 bp.                                 |
|           | Giza 90 (S)   | +1412bp, +1000bp, +950bp, +700bp, -450bp and +300bp. |
|           | Giza 80 ( R ) | -1000bp, +450 bp and +250bp.                         |
|           | Giza 86( R )  | -1000bp and +450 bp.                                 |

|                 |               |   |
|-----------------|---------------|---|
|                 | Giza 91 ( R ) | -1000bp and +450 bp.  |
| <b>5-OP-K06</b> | Giza 70(S)    | +1075bp, +751bp, -611bp, +510bp, +413bp, +308bp and +255bp. |
|                 | Giza 83 (S)   | +1075bp.  |
|                 | Giza 90 (S)   | +1075bp   |
|                 | Giza 80 ( R ) | +3000bp, +2500bp and -1075bp.                               |
|                 | Giza 86( R )  | -1075bp.  |
|                 | Giza 91 ( R ) | -1075bp.  |

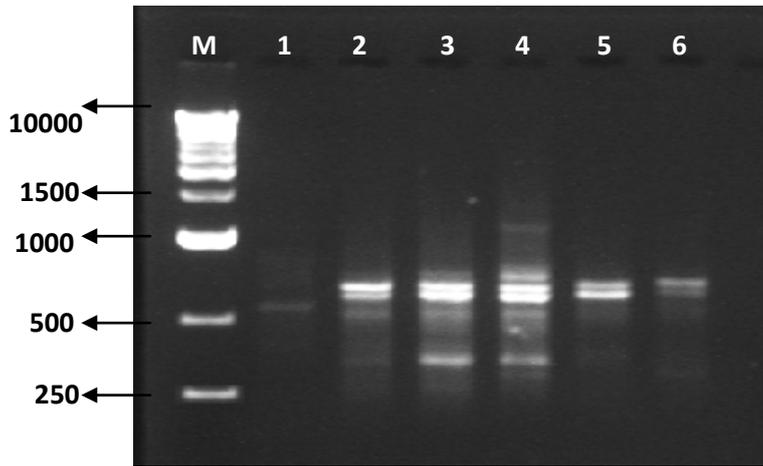
S = Susceptible. R = Resistant. (+) = Band is present, (-) = Band is absent.

Bands generated by each primer varied among genotypes, with a range of 1 to 12 bands. Molecular weight (MW) of these bands ranged from 250 to 3000 bp. These primers could produce specific bands, which can be used to distinguish the six genotypes. For instance, primer OP-A16 gave specific markers with MW of 260 bp for G1(Giza70), 950bp; 700bp and 300bp for G3(Giza 90) and 250bp for G4(Giza 80).

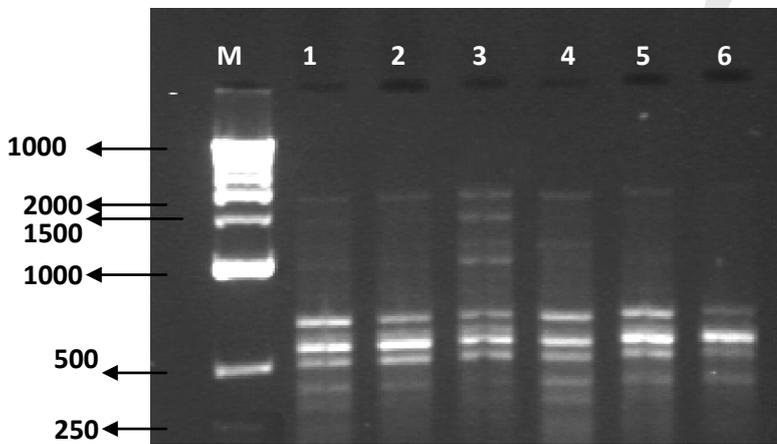
RAPD-PCR showed also some molecular markers related to the root-knot nematode, *M. incognita* race 3, such as the fragments generated by the primer OP-A16, 450bp which was found to be related to root-knot nematode (RKN) resistant and it was absence in the susceptible cultivars and 1000bp which was found to be related to RKN susceptibility and it was absence in the resistant cultivars may be considered as positive and negative molecular markers for the root-knot nematode resistance. **The selected six varsities for all RAPD test were Giza 70, Giza 83, Giza 90, Giza 80, Giza 86, Giza 91 with different primers as indicated in each figures (Fig. 10, 11, 12, 13)**



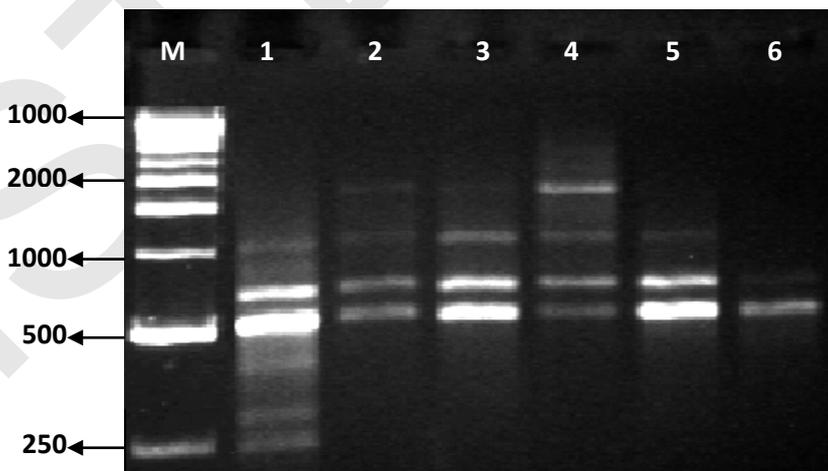
**Fig 10: DNA polymorphism of the six cotton cultivars amplified with primer OP-C19.**



*Fig 11: DNA polymorphism of the six cotton cultivars amplified with primer OP-A07.*



*Fig. 12: DNA polymorphism of the six cotton cultivars amplified with primer OP-A16.*



*Fig. 13: DNA polymorphism of the six cotton cultivars amplified with primer OP-K06 91.*

RAPD-PCR was used to analyze the genetic diversity of the six studied cotton cultivars, and to assess their genetic relationships using similarity index and dendrogram tree. Ten random primers were used to determine RAPD polymorphism of the six-cotton Egyptian cultivars.

Among the 128 amplified fragments across the ten primers, 120 were polymorphic (93.7%). The numbers of amplified and polymorphic fragments generated by each primer and the specific markers for the six cotton cultivars. Data of the amplified fragments using ten-mer chosen primers for the six cotton cultivars revealed that all primers succeeded in amplifying DNA fragments. Polymorphism levels differed from one primer to the other. Primers OP-K02, OP-K06, OP-A07, OP-B01 and OP-Z13 exhibited high polymorphic differences and were useful in cotton cultivar identification.

Cluster analysis (similarity matrix) based on RAPD-PCR analysis using UPGAMA computer analysis was shown. The highest similarity index recorded was 67.6%, which was observed between the two resistant cotton cultivars to the root-knot nematode, *M. incognita*, Giza 86 and Giza 91 and it was 60.6%, which was observed between the two susceptible cotton cultivars to the root-knot nematode, *M. incognita*, Giza 90(S) and Giza 70 (S), while the lowest similarity index recorded was 33.8%, which was observed between the two cultivars Giza 91 (R) and Giza 83 (S), also it was 30.8%, which was observed between the two cultivars Giza 91 (R) and Giza 90 (S).

A Dendrogram for genetic relationships among the six cotton cultivars was carried out. The six cotton cultivars were separated into two clusters; cluster one included two resistant cotton cultivars Giza 86 and Giza 91, cluster two included two sub-clusters; sub- cluster one included resistant cultivar Giza 80 and sub-cluster two included two sub-sub clusters; sub-sub cluster one included susceptible cultivar Giza 83, while second sub-sub cluster contained two susceptible cotton cultivars (Giza 70 and Giza 90). This conclusion is in agreement with **Multani and Lyon, (1995)**, **Tatineni et al., (1996)** and **Abd El- Ghany and Zaki, (2003)**. (Fig. 14, 15)

| Var. |   | G.1   | G.2   | G.3   | G.4   | G.5   | G.6   |
|------|---|-------|-------|-------|-------|-------|-------|
| G.1  | 1 | 100.0 |       |       |       |       |       |
| G.2  | 2 | 60.6  | 100.0 |       |       |       |       |
| G.3  | 3 | 56.2  | 53.2  | 100.0 |       |       |       |
| G.4  | 4 | 53.0  | 55.7  | 47.1  | 100.0 |       |       |
| G.5  | 5 | 44.2  | 30.8  | 33.8  | 42.4  | 100.0 |       |
| G.6  | 6 | 37.2  | 35.2  | 42.3  | 48.5  | 67.6  | 100.0 |

**Fig. 14: Similarity matrix among the six cotton cultivars based on RAPD-PCR analysis.**

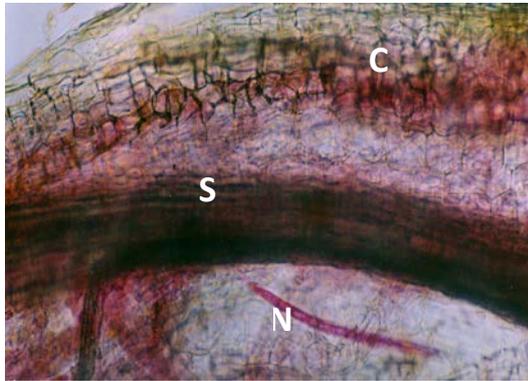
G.1= Giza 70 (S), G.2= Giza 90 (S), G.3= Giza 83 (S), G.4= Giza 80 (R), G.5= Giza 91(R), G.6= Giza 86(R).

**Fig. 15: Dendrogram for the genetic distances between the six cotton cultivars based on RAPD-PCR analysis. (1): G.70 (S) (2): G.83 (S) (3) G. 90 (S) (4)G.80 (R) (5) G. 86 (R) (6) Giza 91 (R)**

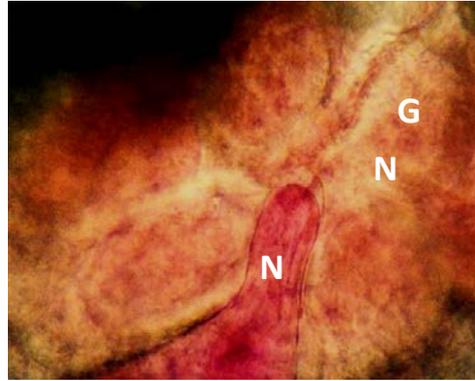
**Step 2: Histopathological changes in cotton roots, cv. Giza 83 as influenced by the infection with the root-knot nematode, *M. incognita* race 3:**

Cotton roots infected with the root-knot nematode, *M. incognita* race 3 exhibited histological responses, typically like those of other hosts infected with such nematode. Microscopic examination of stained sections of the infected roots indicated that, the infective stage had infected both young and old roots. It was clarify that juveniles had penetrated the roots at their tips. Then they migrated in the root cortex and had orientated parallel with the longitudinal root axis and their anterior parts towards the vascular region. The advanced duration after inoculation; the fourth stage juveniles were observed very close to the stelar region. Likewise, the young females were noticed within the cortical

layers, inserting their anterior parts inside a cluster of giant cells. The more advanced stages after inoculation, the egg laying females were found with their egg-masses embedded within the root tissues, causing a great pressure on the cortical layer, endodermis, pericycle and stelar region. Cell walls of giant cells were thickened and darkly stained; each giant cell contained a great number of granulated swollen nuclei, which may be orientated either in a lateral or central position. The crushing effect of the exhaustive giant cells and the developing nematodes resulted in malformation and destroying of the vascular tissues and their neighboring cells. Such abnormalities in the anatomical structure of the roots interfere greatly with the function of the root system. Thus, the water and nutrient absorbing capacity of the root fails to supply the vegetative system with its requirements. **Fig 16, 17** These results are in agreement with the findings of **Ibrahim and Massoud (1974), in Egypt, Finley (1981) and Sosa-Moss *et al.*, (1983).**



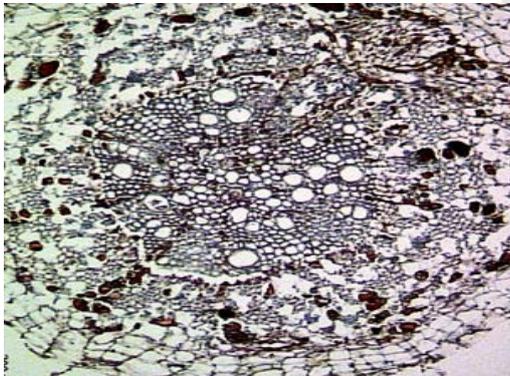
**Fig. 16: Second stage juveniles oriented parallel with the longitudinal root axis**



**Fig. 17: giant cells contained granulated swollen nuclei and dense cytoplasm.**

**Step 3: reaction of cotton tissue against the invasion of Root Knot Nematode juveniles to resistant and susceptible cultivars.**

The results reveal that the difference between two cultivars resistant Giza 80 and susceptible Giza 90 respectively, in the shape of giant cells which formed during the interaction between nematode and root plants. (**Fig.18 a, b**)



(**Fig, 18 a, b**) sections of microdissection of both resistant and susceptible cotton cultivars (**Control**).

### **THIRD: Laser Capture Microdissection (LCM) for Cotton roots**

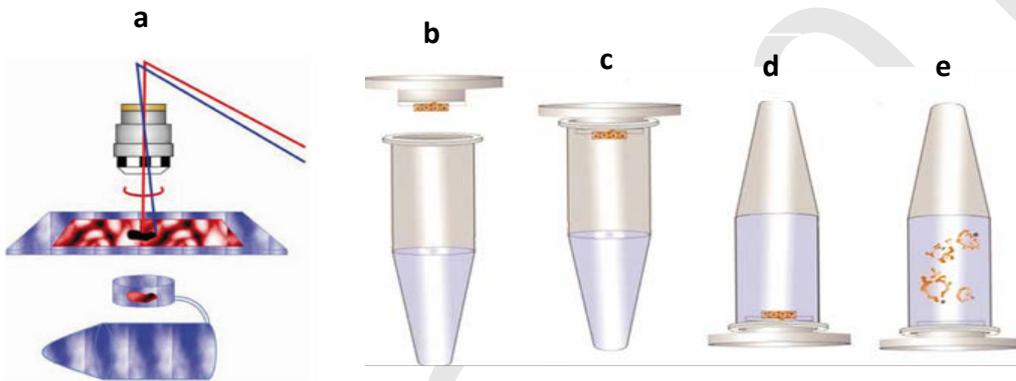
The slides with tissue sections of both two cultivars of cotton plants susceptible and resistant cultivars were examined, a specific software package is used to select the infected cells by moving the cursor, shown by the red line. The laser provides enough energy to cut both the transfer film and the tissue. In this case, nematode infected cells are selected, the selected infected tissue with adherent film sections drop into the cap of a microfuge tube that is located below the tissue sample.

The selected cells can be seen in the microfuge tube that is located under the sample. These cells can be further used for DNA, RNA or protein extraction and analysis. (Fig. ....)

The giant cell undergoes a variety of cytological changes as it differentiates and becomes the feeding site of root-knot nematode. From our observation it was clear that there are ongoing molecular changes occurring within the giant cell as it differentiates. So we can conclude that the molecular change is different if we compare between the giant cells for susceptible plants comparing with the resistant plants, so defiantly the molecular change is different as shown from the isolating tissues enriched from giant cell by laser capture microdissection (LCM). (**Fig. 19, 20, 21**)

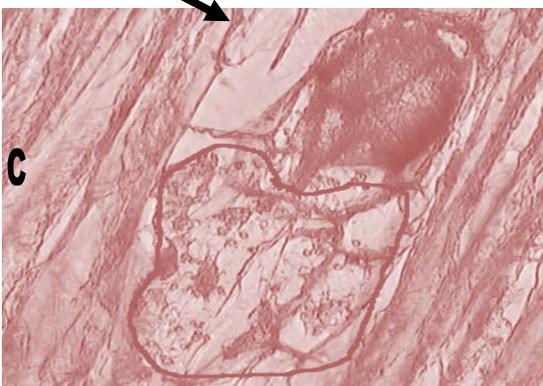
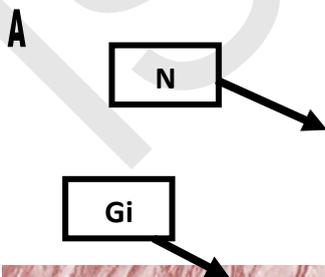
*(Fig, 19) Show the slide with tissues, placed on the slide of microscope.*

*(Fig, 20) Show the cap of a microfuge tube, which is located below the tissue sample*



*(Figure, 21) (a) Cutting selected cells by UV laser in the cap of tube (b) A 0.5 ml Eppendorf microfuge tube is filled with 50 µl of a buffer solution that is specific for either DNA, RNA or protein analysis. (c) The cap is placed snugly into the microfuge tube. (d) The tube is then inverted so that the buffer is in contact with the cells. (e) After incubation, the cells are lysed in the buffer and can be used for molecular analysis.*

The sections after microdissection of both susceptible and resistant cotton cultivars (Control) show that the form of sections without any infection by root-knot nematode. These results obtained from the laser capture microdissection technique indicated that the dissection of these cells of interest (giant cells) can be used in the future for studies and analysis on DNA, RNA or protein from defined cell populations. (Fig. 22 a- b- c-d)

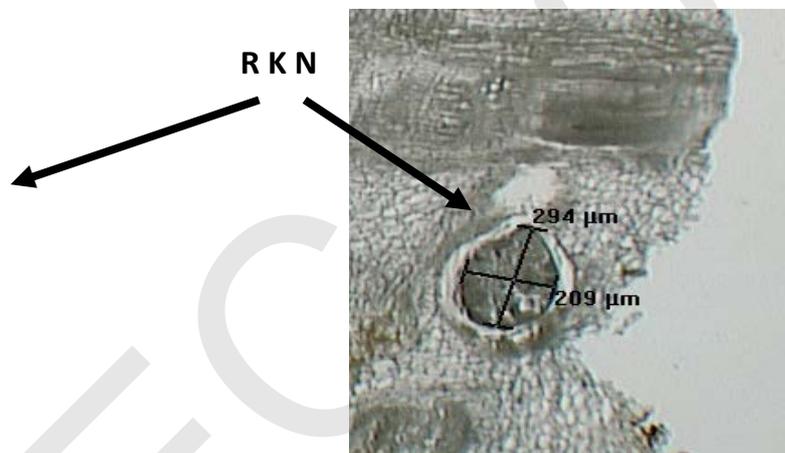


**D**

ptible plant  
(arrowhead)  
dislodgment

After 25 days post inoculation in susceptible Giza 90, it is shown several giant cells contain the large number of nucleus, also the other section shown that the measurement of adult females in the width and the length at which, the width of female were 449 $\mu$ m and the length of female were 512 $\mu$ m.

On the other hand; the resistant Giza 80, after 25 days post inoculation shows a few number of giant cells comparing to giant cells which formed in susceptible cotton plants, also the other section shown that the measurement of adult females in the width and the length at which, the width of females were 209 $\mu$ m and the length of females were 294 $\mu$ m. (Fig. 23 a, b)



## Discussion

(Fig.23 a) Laser capture microdissection from cotton roots sections for susceptible plant Giza 90.

(Fig.23 b) Laser capture microdissection from cotton roots sections for resistant plant Giza 80.

This research confirms that root-knot nematode (*Meloidogyne* spp.) is the major pest in Egypt, causing yield losses to many economic crops. There are many research opportunities in basic nematology that utilize the new approaches and tools of molecular biology. The tools will facilitate research on previously intractable questions in nematode biology, also current nematode control options include the use of nematicides, cultural practices, resistant cultivars, and crop rotations. In the future, successful integrated nematode management will depend on combinations of control tactics to reduce nematode numbers. Application of biotechnology to nematode control tactics will influence applied nematology in diverse ways, from nematode identification to the development of resistant cultivars, and will improve effectiveness and increase the number of management options available. Increased communication and cooperation between researchers with expertise in applied science is necessary to enlarge our understanding of nematode biology and ecology. The outcome will enhance development of new nematode management strategies and allow refinement of old technique.

Concerning to the prominence values (P.V.) calculated for the presence of different genera and nematodes population, we could conclude that *Meloidogyne* was found with relatively high value (36.8) than both *Pratylenchus* and *Rotylenchulus*, which were found in moderate values; 23.1 and 22.9, respectively. The distribution of these different nematode genera, among the surveyed districts was not uniform. It was observed that most of these nematodes did not exist in some surveyed localities. However, *Meloidogyne*, *Pratylenchus*, *Tylenchorhynchus* and *Hoplolaimus* were the only four nematode genera encountered in all surveyed districts with relatively higher frequency of occurrence. The root-knot nematode, *Meloidogyne* spp. exhibited the highest occurrence of the endoparasitic nematodes existing in the collected samples. Therefore, it was concluded that the root-knot nematodes, *Meloidogyne* represented, the major nematode pest attacking cotton plants. The highest values of prominence of *Meloidogyne* spp. amongst Fayoum Governorate were recorded in the districts Youssef El-Siddique, El-Fayoum and Abshawai; 46.4, 43.8 and 41.5, respectively. While, the lowest values were recorded in the districts, Sennores and Tamia; 25.9 and 29.0, respectively. These results are in agreement with those reported by Oteifa (1962), in Egypt, Hillocks and Bridge (1992), in Tanzania and Wrather *et al.*, (1992), in Columbia.

DNA-based molecular markers have been recently integrated in the improvement of several plant systems and are expected to play a very important role in the future of plant breeding programs. The revolution of polymerase chain reaction (PCR) technique has been initiated as a novel genetic assay based on selective DNA amplification (Saiki et al., 1983). Randomly amplified polymorphic DNA (RAPD) has been the most widespread DNA analysis during the last decade. This analysis is more amenable to automation than conventional analysis. It is simple to perform and preferable in experiments when large number of individuals are determined in a few genetic loci. It requires only a small amount of DNA and provides a quick method for developing genetic maps. Targeting genetic markers has been explored in genus *Gossypium* mainly at the inter-specific level (Van de ven et al., 1993).

Molecular genetic markers for root-knot nematode tolerance based on RAPD-PCR are grouped which confirmed the importance of these markers to select the tolerant cultivars instead of long breeding programs. These results are in agreement with Van de ven *et al.*, (1993), Bai *et al.*, (1998); Filho *et al.*, (1999) and El-Badawy (2000). **RAPD-PCR has been used for obtaining molecular markers linked to improved agronomic traits and study plant genetic diversity by, Williams *et al.*, (1990); Peterson *et al.*, (1991); Tao *et al.*, (1993); Pammi *et al.*, (1994); Abd-El-Tawab *et al.*, (1997); Chen *et al.*, (2000) and Hash and Bramel-Cox (2000).**

Using the obtained data from RAPD-PCR, the genetic relationship among the genotypes under investigation was summarized in a dendrogram. It has been noticed that, the two resistant genotype G5 (Giza 86) with G6 (Giza 91) had 67.6% similarity. While, the two susceptible genotypes G1(Giza 70) with G3 (Giza 90) showed 60.6% similarity.

In general, the eventual incorporation of yield-related traits, and the molecular genetic studies of the six cotton cultivars and their genetic diversity are efficient tools for identification and evaluation of these cultivars under the root-knot nematode stress, which could be used as in marker-assisted selection (MAS) in cotton breeding programs.

**Future Work:**

All giant cells that was collected using laser capture microdissection (LCM) technique can be used in the future for studies and analysis on DNA, RNA or protein from defined cell populations.

Genes will be identified that are expressed in giant cells. Genes expressed in common with syncytial cells during nematode infection of soybean roots will be identified. Cell morphology and biochemistry of the giant cells are different from syncytial cells and certainly from uninfected root cells, therefore we expect that several genes expressed in giant cells will not be expressed in syncytial cells or will be expressed at different levels. Promoters of some of these genes may allow targeting of agents to block giant cell and syncytial cell maintenance, thus starving the nematode.

Our future work will be concentrated in isolating the RNA from LCM derived tissues enriched for giant cell to create a cDNA library for cloning and to study gene expression to find out the gene that is formed in resistant cultivars for cloning and work future.

Further study will include the use of RNA interference (RNAi) as a powerful gene silencing tool to investigate genes function, genes expressed in a range of cell types are silenced when preparasitic juvenile of root knot nematode take up double strands (ds) RNA that elicits systemic RNAi response, a resistance effect is observed paving the way for the potential use of RNAi technique to control Root Knot nematode.

We propose to make DNA constructs from orthologs of genes proven to be lethal or stop development of the free-living nematode, *Caenorhabditis elegans*. The orthologs will be from RKN. Several genes known to be associated in a pathway or complex will be targeted. The constructs will contain DNA fragments of target genes oriented in opposite directions, so when it is transcribed, a dsRNA with hairpin is formed. Initially, constructs will be screened. RKN orthologs of target genes that decrease the development of mature females 80% or more will be used and tested in transformed grab and tomato plants. Plants will be transformed with *Agrobacterium tumefaciens*. The transformed roots will be challenged with the appropriate nematode and mature females or galls will be counted and compared to untransformed control roots. DNA constructs that prevent or reduce production of mature females will be used to generate multiplexed constructs containing multiple gene targets. The results of these experiments may lead to a general method for producing broad resistance of crop plants to nematodes.

So our main objective for the future work is to broaden resistance of plants to nematodes using gene silencing with RNAi. We propose to make DNA constructs targeted to silence RKN genes, transform plant roots and determine if the transformed roots develop fewer or no galls. Each DNA construct will be designed against one or multiple gene targets of the cyst and RKN to slow or halt the development of the nematode. Plants used in this study represent important crops in Egypt and the US and include soybean, tomato, and maize

So the future work will include: (1) use of gene targets not tried previously; (2) multiplexing targets in the gene silencing vector or targeting more than one gene for silencing; (3) targeting more than one gene encoding proteins that are involved in a common biochemical pathway or process; (5) for the first time introduces and initiates RNAi gene silencing technology for controlling nematodes (6) allowing the application of this same technology toward solving other agricultural pest and pathogen problems in Egypt.

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# AN AGENT BASED APPROACH FOR PROJECT MANAGEMENT IN CONSTRUCTION

Safiye Sencer

Department of Management Information Systems  
Sakarya University  
TURKEY

safiyesencer@yahoo.com, sencer@sakarya.edu.tr

Tahsin Turgay

Department of Architecture  
Abant Izzet Baysal University  
TURKEY

tahsinturgay@gmail.com,  
turgay@ibu.edu.tr

**Abstract:** Project management has an important role in terms of time, cost and flexibility. An agent-based architecture provides additional robustness, scalability, flexibility that is particularly appropriate for problems with a dynamic and distributed nature. Integrated agent based project management covers design and construction planning. It is combined with plan execution, tolerating both the design and plan, which may be changed as necessary. In this reason, the decision making process requires that the right effects of change need to be propagated through the plan and design in dynamic environment. It is difficult to estimate the operation times and costs exactly. A numerical simulation is presented at the end of this paper to illustrate the procedures of the proposed model.

**Key words:** Agent systems, construction activities, project management

## Introduction

Agent based project management system includes a design agent, planning agent, knowledge agent, cost estimation agent and project manager agent. Agent based system consists of system analysis, program development, testing, installation, and user training skills. Main activities of the suggested system include the control and information flow which are assisting the whole system in every time.

Control activity means by which management control operations. In a project management system, control includes procedures specified for specific tasks, milestones to mark completion of project phases, and the expertise available within the project team to solve problems when they are encountered. Giving information activity provides management with measures of how the system is accomplishing its objectives. Project information systems need to record the current status of activities and list responsibilities, planned and actual durations of activities, and cost expenditures.

We use multi-agent systems as a technique to support project management in a distributed environment. All information relevant to the project as a whole should be passed to the project manager. Information of interest for other team members is often transferred via the project manager as well, even if it is not crucial from the project's point of view. Project Manager agent have been taken on coordinator role. It implements the distribution of the task among the Design Agent, Planning Agent, Knowledge Agent and Cost Estimate Agent.

The next section includes building of model structure in construction activities; then the simulation of the agent based project management in random PERT method presented. The last section reviews the conclusion and results.

## Building of Model Structure

The project management is the organizational structure used by the project manager to get things done. The project management system includes the information system to provide project team members with necessary information, because coordination between groups is critical to integrate activities. Organizational structure involves procedures to endure accurate communication and completeness of activities.

Elonen and Artto reviews the problem areas in project management in detail. Love and Irani assessment the quality cost information mechanism in project management. Ugwu et al.(2004) design processes the procurement route selection and effective communication of design parameters between the stakeholders. They reviewed the steel frame structures of the project management. Tserng and Ling are developed an activity based knowledge management system for contractors. They addressed the application of knowledge management the construction phase with IDEF (Integrated DEFINITION function modeling). Sadeghpour at al. modeled the CAD-based construction sites. They defined the tasks and activities in

detail. Kasvi et al. defined the managing knowledge competences in project organizations. They determined the several potential outputs. They grouped the knowledge management in four different cases such as knowledge creation, administration, dissemination and utilization. Mahaney&Lederer reviews the information systems of the project management in agency approach. They determined the goal conflicting in the system and task programming type.

Multi agent systems are branch of the Distributed Artificial Intelligence. The term of agent represents a hardware or more usually software-based computer system that has properties of autonomy, social ability, reactivity, and pro-activeness. A stronger notion of the agent adopts mentalistic notions, such as knowledge, belief, intention, and obligation (Wooldridge and Jennings, 1995)

Wu et al. suggested public investment project in China with quality self-control and co-supervision mechanism. Udeaja et al. (2008) described a web-based prototype (CAPRI.NET) that was developed to facilitate the live capture and reuse of project knowledge. Xue et al. (2008) suggested the framework, which integrates the construction organizations in construction supply chain and multi-attribute negotiation model into a multi-agent system (MAS), provides a solution for supply chain coordination in construction through multi-attribute negotiation mechanism on the Internet. Kim and Kim (2010) focused on to develop a multi-agent-based simulation system to evaluate the traffic flow of construction equipment in construction site. Adhau et al., proposed A multi-agent system for distributed multi-project scheduling which can solve complex large-sized multi-project instances without any limiting assumptions regarding the number of activities, shared resources or the number of projects. Additionally our approach further allows to random project release-time of projects which arrives dynamically over the planning horizon. Hadikusumo et al. used the e-portal system for the construction material procurement .They proposed the decentralized database system equipped with electronic agents for material procurement.

We represented the multi agent system that is an implementation of a distributed project management tool. Activities, resources, and important functions are represented in a agent's task ability. System contains five main agents. Among of the agent relations are modeled and evaluated in random PERT method.

Project level activities, and applied of the methods, commitment, unclear roles and responsibilities are modeled in agent based structure. Process of project information in construction is reviewed in probability PERT mechanism. Summary of construction activities in MAS system in Table 1, analyzed of the probability PERT approach then obtained the project finish time .This procedure repeated in 100 times, and data are evaluated and system decision mechanism obtained the average project completion time. Suggested system provides the managing of the project scheduling mechanism.

Construction projects are complex and time-consuming, which have usually been characterized by their complexity, diversity and the non-standard nature of the production. Whatever successful and unsuccessful projects have been executed by the general contractors, a valuable record of each one should be kept to identify best and worst company practices. During the construction phase of projects, an effective means of improving construction management is to share experiences among engineers, which helps to prevent mistakes that have already been encountered in past projects. Drawing on experience knowledge, activity-related information or knowledge normally includes specifications/contracts, reports, drawings, change orders and data.

MAS system architecture influences information exchanging patterns and relationships between individual agents. One of the advantages of MAS comes from the cooperation among agents. We adopt multi agent system as information infrastructure to support project management in a highly distributed environment. The project management agent takes the functions of coordinator. Agent-based systems have the advantage of being more robust, flexible and fault tolerant than traditional system. Furthermore, the simple patterns of agent behavior are easier to program. In addition, this approach often provides a means to solve problems that have previously been unsolvable and to address problems in way that is more natural, easy and efficient.

The information and knowledge that relates to the whole project and can be clearly classified into activity units can save the category of the project. Inferred knowledge may include process records, problems faced, problems solved, expert suggestions, know-how, innovations and notes on experience. Information and knowledge is better saved in activity-based units to facilitate classification and searching by the system. Moreover, users may search and refer to related information and knowledge from related activities in past projects.

System decision mechanism are effected the some function as follows;

- Goals, expected results, scope of project.
- Plans and schedules: start date, end date, major milestone activities, data items and reports.
- Management organization: the customer's organization, their key players, their evaluators, and the decision- makers involved in awarding a contract.
- Operational systems: the procedures of selection of the contractors, what is to be done, when it is to be done, who will do it, and how it will be done.
- Technical approach: technical standards and specifications, new technology added and the necessary skills for key persons.
- Related and future work: the importance of the project to the customer, future work and the customer's future capital expenditure.
- Competition for the project: who are the competitors and do they have any special advantages? Customer has biased toward a particular competitor.

Agent based project management includes the processes, tasks and issues to consider in planning and designing for construction of building domain, and formulating the knowledge structures and framework for automated knowledge acquisition, and learning for constructability assessment in infrastructure design and construction. It describes the use of interviewing techniques to understand problem solving and the development of knowledge models for automated constructability assessment.

Constructability assessment is critical to achieving project goals. Consequently, it is often undertaken as part of value engineering exercise. The broad goal of a constructability assessment program is to proactively identify potential sources of problems especially during the construction and/or installation of a designed facility, and to identify measures that would mitigate or minimize the problems and their effects on achieving the project goals. Thus adequate assessment and planning for identify some of these issues.

Upon receiving an order, the project management agent is stimulated, and it activates the system decision mechanism. Within this system, there are choices of building like factories, schools, bridges, houses, blocks, malls, etc. Project management in cooperation with the other agents supervises the working of the system. When it comes to the application, one of the choices is taken as a base model, and the simulation process is run with Random PERT. This way, we obtain information as to when the project is likely to end.

## **Simulation for Agent Based Project Management**

Construction projects are full of the uncertainties, including weather, labor skills, site conditions, and management quality. Therefore many probabilistic scheduling models, including program evaluation and review technique (PERT) have been proposed in a construction project as uncertain in multi-agent system. Simulation is a very valuable tool for analyzing models involving elements described by probability durations. Projects involve interrelated activities, many of which are probabilistic. Agent based project management activities are modeled on spreadsheets in Excel.

Model scheduled earlier involved five agent activities. A through E. Assume that the all activities involve some uncertainty. The best way to proceed is to gather statistics on past agent activities (if possible) so that sound data can be used to estimate the expected durations and probability distribution for specific activities. Uncertain activities are generated using random numbers.

The PERT method is also based on independence of activity durations. However, this is not true in projects. If one activity is late, there is a tendency for management to rush following activities to compensate. This would result in a case of negative correlation between durations. There also can be similar underlying causes of lateness that might be positively correlated, such as skill shortages.

PERT addresses the widely recognized uncertainty involved in project management activities, but it makes a rigid assumption about the distribution of durations, and the calculation of probability of completion by a specified time disregards no critical activities, simulation provides a flexible means of evaluation probability of projects being completed by specific time. Any distribution of duration can be assumed. The distribution used should be based on empirical data if possible. All activity paths are considered in the simple spreadsheet network. For instance, observed data may not be symmetric. The triangular distribution might provide a better fit to such data than does the normal distribution.

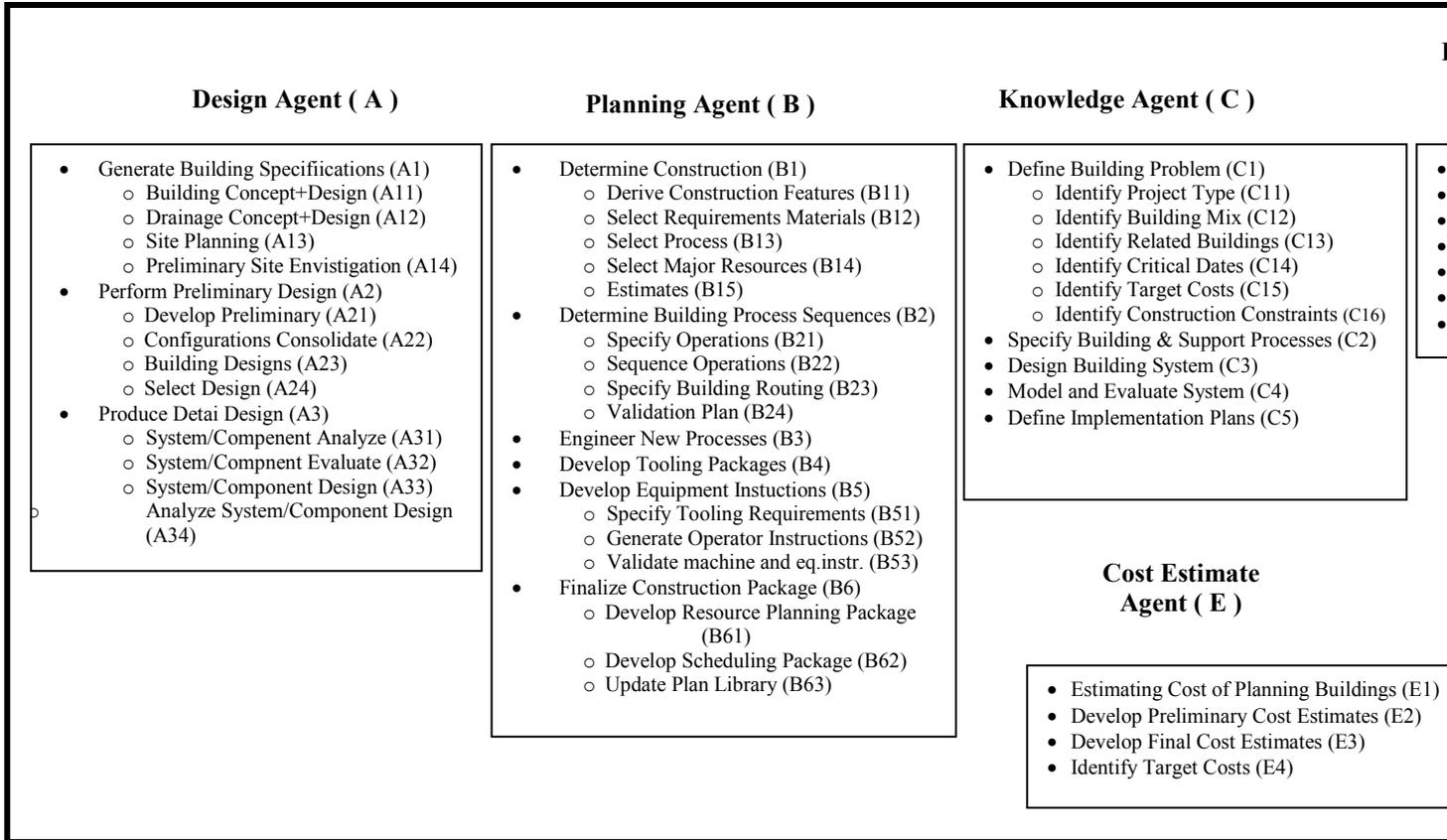


Figure 1. Agent Based Construction Project Management Activities

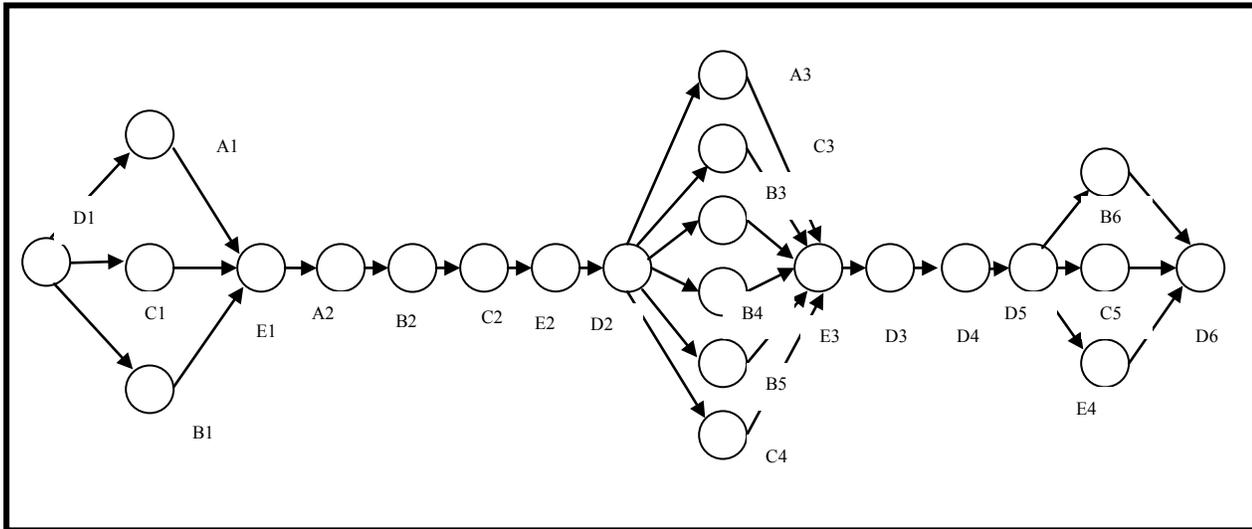


Table 1. Standart building's project process and considering time values.

| Task   | Min | Mode | Max | Random | Duration | Start  | Finish |
|--|-----|------|-----|--------|----------|--------|--------|
| <input type="checkbox"/> Develop Building Plan (D1)                                  | 9   | 8    | 15  | 0,4808 | 10,3303  | 0      | 10,33  |
| * Generate Building Specifications (A1)  |     |      |     |        | 8,49664  | 10,33  | 18,83  |
| o Building Concept+Design (A11)  | 1   | 2    | 3   | 0,7267 | 2,26063  |        |        |
| o Drainage Concept+Design (A12)  | 1   | 1    | 2   | 0,8096 | 1,56368  |        |        |
| o Site Planning (A13)  | 1   | 3    | 4   | 0,4957 | 2,7245   |        |        |
| o Preliminary Site Envistigation (A14)   | 1   | 1    | 2   | 0,9973 | 1,94783  |        |        |
| <input type="checkbox"/> Define Building Problem (C1)                                |     |      |     |        | 12,5656  | 10,33  | 22,9   |
| o Identify Project Type (C11)  | 1   | 1    | 2   | 0,1521 | 1,07918  |        |        |
| o Identify Building Mix (C12)  | 1   | 3    | 3   | 0,9059 | 2,90356  |        |        |
| o Identify Related Buildings (C13)   | 1   | 2    | 3   | 0,8802 | 2,51045  |        |        |
| o Identify Critical Dates (C14)  | 1   | 1    | 2   | 0,3568 | 1,19803  |        |        |
| o Identify Target Costs (C15)  | 1   | 3    | 4   | 0,7688 | 3,16711  |        |        |
| O Identify Construction Constraints (C16)  | 1   | 2    | 3   | 0,2501 | 1,70727  |        |        |
| <input type="checkbox"/> Determine Construction (B1)                                 |     |      |     |        | 9,36559  | 10,33  | 19,7   |
| o Derive Construction Features (B11)   | 1   | 1    | 2   | 0,6111 | 1,37638  |        |        |
| o Select Requirements Materials (B12)  | 1   | 2    | 3   | 0,792  | 2,35508  |        |        |
| o Select Process (B13)   | 1   | 1    | 2   | 0,8057 | 1,55926  |        |        |
| o Select Major Resources (B14)   | 1   | 3    | 4   | 0,4571 | 2,65602  |        |        |
| o Estimates (B15)  | 1   | 2    | 3   | 0,0877 | 1,41885  |        |        |
| <input type="checkbox"/> Estimating Cost of Planning Buildings (E1)                  | 2   | 3    | 4   | 0,2675 | 2,73149  | 22,896 | 25,63  |
| <input type="checkbox"/> Perform Preliminary Design (A2)                             |     |      |     |        | 8,8183   | 25,627 | 34,45  |
| o Develop Preliminary (A21)  | 1   | 1    | 2   | 0,8857 | 1,66188  |        |        |
| o Configurations Consolidate (A22)   | 1   | 3    | 4   | 0,4314 | 2,60881  |        |        |
| o Building Designs (A23)   | 2   | 3    | 4   | 0,7617 | 3,30957  |        |        |
| o Select Design (A24)  | 1   | 1    | 2   | 0,4194 | 1,23804  |        |        |
| <input type="checkbox"/> Determine Building Process Sequences (B2)                   |     |      |     |        | 9,28968  | 34,446 | 43,74  |
| o Specify Operations (B21)   | 1   | 2    | 2   | 0,5826 | 1,76325  |        |        |
| Table 1. Standart building's project process and considering time values (continue). |     |      |     |        |          |        |        |
| o Sequence Operations (B22)  | 1   | 3    | 4   | 0,4607 | 2,66266  |        |        |
| o Specify Building Routing (B23)   | 1   | 2    | 3   | 0,1229 | 1,49571  |        |        |
| o Validation Plan (B24)  | 1   | 3    | 4   | 0,8669 | 3,36806  |        |        |

|  |   |   |   |        |         |        |       |
|--|---|---|---|--------|---------|--------|-------|
| <input type="checkbox"/> Specify Building & Support Processes (C2) | 2 | 3 | 5 | 0,7191 | 3,70179 | 43,735 | 47,44 |
| <input type="checkbox"/> Develop Preliminary Cost Estimates (E2)   | 3 | 5 | 6 | 0,8299 | 5,28566 | 47,437 | 52,72 |
| <input type="checkbox"/> Define Building Jobs (D2)                 | 2 | 3 | 4 | 0,9798 | 3,799   | 52,723 | 56,52 |
| <input type="checkbox"/> Produce Detai Design (A3)                 |   |   |   |        | 8,73297 | 56,522 | 65,25 |
| o System/Compenent Analyze (A31)                                   | 1 | 2 | 3 | 0,6957 | 2,21992 |        |       |
| o System/Compenent Evaluate (A32)                                  | 1 | 1 | 2 | 0,016  | 1,00801 |        |       |
| o System/Component Design (A33)                                    | 1 | 2 | 3 | 0,9968 | 2,92017 |        |       |
| o Analyze System/Component Design (A34)                            | 1 | 2 | 3 | 0,9138 | 2,58487 |        |       |
| <input type="checkbox"/> Design Building System (C3)               | 3 | 4 | 5 | 0,7062 | 4,23339 | 56,522 | 60,76 |
| <input type="checkbox"/> Engineer New Processes (B3)               | 3 | 5 | 6 | 0,3623 | 4,47442 | 56,522 | 61    |
| <input type="checkbox"/> Develop Tooling Packages (B4)             | 5 | 6 | 7 | 0,5396 | 6,04038 | 56,522 | 62,56 |
| <input type="checkbox"/> Develop Equipment Instuctions (B5)        |   |   |   |        | 9,808   | 56,522 | 66,33 |
| o Specify Tooling Requirements (B51)                               | 1 | 2 | 3 | 0,2297 | 1,67774 |        |       |
| o Generate Operator Instructions (B52)                             | 1 | 1 | 2 | 0,7296 | 1,48003 |        |       |
| o Validate machine and eq.instr. (B53)                             | 1 | 3 | 4 | 0,8785 | 3,3962  |        |       |
| <input type="checkbox"/> Model and Evaluate System (C4)            | 2 | 3 | 4 | 0,7218 | 3,25404 | 56,522 | 59,78 |
| <input type="checkbox"/> Develop Final Cost Estimates (E3)         | 3 | 5 | 6 | 0,175  | 4,02464 | 66,33  | 70,35 |
| <input type="checkbox"/> Manage Tooling & Materials (D3)           | 2 | 3 | 4 | 0,5113 | 3,01141 | 70,354 | 73,37 |
| <input type="checkbox"/> Schedule Jobs (D4)                        | 2 | 3 | 5 | 0,8445 | 4,03423 | 73,366 | 77,4  |
| <input type="checkbox"/> Control of Building (D5)                  | 1 | 2 | 3 | 0,3235 | 1,8043  | 77,4   | 79,2  |
| <input type="checkbox"/> Finalize Construction Package (B6)        |   |   |   |        | 3,37634 | 79,204 | 82,58 |
| o Develop Resource Planning Package (B61)                          | 1 | 1 | 2 | 0,3101 | 1,16942 |        |       |
| o Develop Scheduling Package (B62)                                 | 1 | 3 | 4 | 0,0853 | 1,71521 |        |       |
| o Update Plan Library (B63)  | 1 | 2 | 3 | 0,9468 | 0,49171 |        |       |
| <input type="checkbox"/> Define Implementation Plans (C5)          | 3 | 4 | 6 | 0,4107 | 0,7287  | 79,204 | 79,93 |
| <input type="checkbox"/> Identify Target Costs (E4)                | 2 | 3 | 5 | 0,2041 | 0,81088 | 79,204 | 80,02 |
| <input type="checkbox"/> Manage Building Facilities (D6)           | 2 | 3 | 4 | 0,8365 | 0,83261 | 82,581 | 83,41 |

## Conclusions

The main research contributions include the development of conceptual knowledge structures (i.e. concept maps and task models) for (i) distributed management of constructability knowledge, (ii) developing intelligent agents, (iii) collaborative working, and (iv) a framework for automated knowledge acquisition, teaching and learning, for design and construction of steel frames.

Fig3 represents the standart deviation of the project management finish time. Fig.4 shows the project finish time frequency.

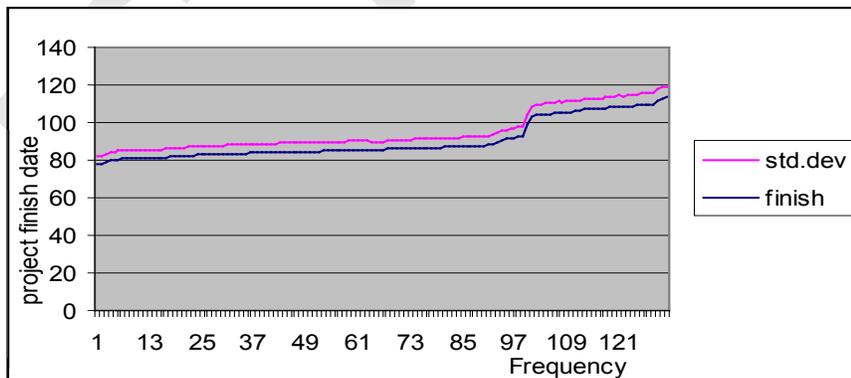


Figure 3. Represents the standart deviation for project finish day.

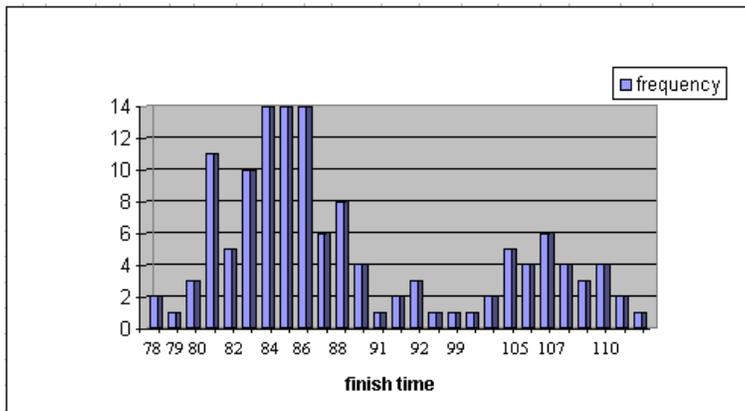


Figure 4. Represents the project finish time.

Agent based project management activities can: (i) minimize travel time; (ii) decrease time and effort spent on material handling; (iii) increase productivity; and (iv) improve safety, and hence decrease construction cost and time. Agent based planning could be a challenging task that requires good knowledge of different aspects of the construction processes involved, as well as related procurement schedules.

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# AN INTEGRATED APPROACH TO SUPPLIER SELECTION USING AHP AND FUZZY PROMETHEE

Gülçin ÇÖL, Servet HASGÜL

Industrial Engineering Department, Eskişehir Osmangazi University, Eskişehir, Turkey

[gcol@ogu.edu.tr](mailto:gcol@ogu.edu.tr), [shasgul@ogu.edu.tr](mailto:shasgul@ogu.edu.tr)

**Abstract:** Supplier selection has become an important decision problem due to today's competitive environment. The company gets a competitive advantage in long-term relationships with the right suppliers. In the evaluation process both quantitative and qualitative multiple conflicting criteria should be utilized. This requires a systematic multi-criteria decision-making approach to evaluation process. Due to uncertainty in the process and verbal assessment of the decision maker's fuzzy sets are used. In this study, supplier selection carried out via the integrated use of the multi criteria decision making methods, AHP and the Fuzzy-PROMETHEE. Thus, the advantages of both methods were used. Criteria, weighted using AHP, and evaluation of suppliers are carried out by using Fuzzy PROMETHEE. The method is implemented in a company producing medical devices in Ankara. As a result, the most suitable supplier identified for the company.

**Key Words:** Supplier Selection, Multi-Criteria Decision Making, AHP, Fuzzy-PROMETHEE

## Introduction

Supplier selection is a process that determines the amount of the purchased materials and the right supplier (Supçiller, Çapraz, 2011). Working with the right supplier affects production cost, amount of inventory, and production quality. Especially competitive environment pushes the companies to benefit from scientific techniques. Supplier selection is a multi-criteria decision making problem. Criteria used in determining the supplier selection may vary from company to company (Kahraman et al., 2003). The most widely used criteria such as quality, delivery, price, production capability, service, management, technology, research and development, finance, flexibility, reputation, relationship, risk, safety and environment (Ho et al., 2010). There are several approaches to the problem of supplier selection in the literature, the cluster analysis, case based reasoning systems, statistical models, decision support systems, DEA, a multi-criteria decision-making techniques, activity based costing, artificial intelligence, mathematical programming (Gencer, Gürpınar, 2007). In the scope of work the studies examined that approaches the problem with MCDD techniques. Kılınccı and Onal examined supplier selection problem in a dishwasher factory with Fuzzy AHP. According to various criteria and sub-criteria evaluations was carried out with the help of excel. Amin and Razmi carried out supplier selection with the help of fuzzy SWOT analysis. In addition, how much purchased from each supplier decided by using fuzzy linear programming model. Gencer and Gürpınar studied the problem of supplier selection in an electronic company with the help of ANP. Lin used fuzzy ANP and fuzzy multi-objective linear programming as an integrated model. The supplier and the amount of the order were determined by using the model. Araz and Özkarahan have proposed a new MCDM based on PROMETHEE. In addition, the applicability of the method was showed. Soner and Önüt used ELECTRE and AHP methods. Criterias weighted by using AHP, and the sorting operation carried out using ELECTREE. Dağdeviren and Eraslan used PROMETHEE method. Özçakar and Demir determined the supplier by fuzzy-topsis.

In this study, supplier selection was carried out using a combination of AHP and fuzzy PROMETHEE methods. Model implemented in a company that produces medical devices. Criterias weighted using AHP and rank of the alternatives determined by Fuzzy-PROMETHEE.

## Methods

### AHP

AHP is one of the multi-criteria decision-making techniques developed by Thomas L. Saaty in 1977. AHP is widely studied especially in the last 20 years, and used in almost all MCDM problems due to effectiveness of it (Kahraman et al., 2003).

AHP is applicable for several areas, such as business strategy formulation, customer complaints analysis, product evaluation, supplier selection, choice of location as well as many business decisions, military defense decisions, individual decisions (Ünal, 2010). The study of Saaty, 1980 can be referenced for more information.

## PROMETHEE, FUZZY- PROMETHEE

Compared with other MCDM methods PROMETHEE method can be expressed with the actual values and applicable when a large number of criteria available (Balli, Karasulu, 2007). For the implementation of the method importance of criteria, the values of alternatives according to the criteria must be known (Albadvi et al., 2007).

PROMETHEE steps are as follows:

1.  $i (i=1,2,\dots, m \text{ and } i \in A)$  alternatives,  $j (j=1,2, \dots, n \text{ and } j \in C)$  the set of criteria and  $g_j (i)$  is the preferred value of alternative  $i$  for the criteria  $j$ . The value of  $g_j (i)$  calculated in the first step, then  $F_j (i,i')= g_j (i)- g_j (i')= x_j$  is determined as one of the six different types of generalized functions. (The study of Tuzkaya et al. (2011) can be referenced for generalized functions.)  $F_j (i,i')$  indicating the degree of the preference function for alternative  $i$  to alternative  $i'$ .

2. After the calculation of the preferred values of each alternative, by using these values combined preference functions are calculated for each alternatives pairs. Then  $\pi (i, i')$  calculated for all criterias,  $\pi (i, i')$  indicated the choice index.

$$\pi (i, i') = \left( \sum_{j=1}^n w_j P(x_j) \right) / \left( \sum_{j=1}^n w_j \right) \quad (3)$$

3. Positive and negative superlative values for each alternative calculated as in equations 4 and 5.

$$\Phi^+ = \frac{1}{n-1} \sum_{\substack{j=1 \\ j \neq i}}^n \pi (i, i') \quad \forall i \in A \quad (4)$$

$$\Phi^- = \frac{1}{n-1} \sum_{\substack{j=1 \\ j \neq i}}^n \pi (i, i') \quad \forall i \in A \quad (5)$$

PROMETHEE I compare the degree of positive and negative superiority values, makes a preliminary ranking of weak and incomparable preferences. Alternative  $i$  superior to alternative  $i'$ , if one of the following equations from 6,7,8, is provided.

$$\Phi^+(i) > \Phi^+(i') \text{ and } \Phi^-(i) < \Phi^-(i') \quad (6)$$

$$\Phi^+(i) > \Phi^+(i') \text{ and } \Phi^-(i) = \Phi^-(i') \quad (7)$$

$$\Phi^+(i) = \Phi^+(i') \text{ and } \Phi^-(i) < \Phi^-(i') \quad (8)$$

If equation-9 is provided, the alternatives are at the same level.

$$\Phi^+(i) = \Phi^+(i') \text{ and } \Phi^-(i) = \Phi^-(i') \quad (9)$$

If the equations- 10 and 11 provided, the comparison cannot be made.

$$\Phi^+(i) > \Phi^+(i') \text{ and } \Phi^-(i) > \Phi^-(i') \quad (10)$$

$$\Phi^+(i) < \Phi^+(i') \text{ and } \Phi^-(i) < \Phi^-(i') \quad (11)$$

From the difference of negative and positive flows, the net flow obtained. For the net flow values;

$$\Phi^{\text{net}}(i) = \Phi^+(i) - \Phi^-(i') \quad (12)$$

The rank of the alternatives can be obtained from the comparison of the net flow values.

PROMETHEE method, was developed by Brans et al. (1986), and Fuzzy- PROMETHEE approach was proposed by Wang et al (2008). Verbal expressions were used by the decision makers for assessing alternatives according to the criterias.

PROMETHEE is suitable to use with AHP. In generally AHP is used the stage of the weighting the criteria.

Comparison of fuzzy numbers in fuzzy- PROMETHEE is necessary. Center of gravity method that represents the membership functions was proposed by Yager (1981) for the comparison of fuzzy numbers. According to Yager index, a triangular fuzzy number size expressed by the formula  $YI = (3*n-a+b)/3$ . The notation  $F(n, a, b)$  is fuzzy triangular number (Tuzkaya et al., 2011).

Evaluation function can be expressed in the following equation for fuzzy- PROMETHEE.

$$\Omega(a, b) = \Omega(b, a) = \begin{cases} 0; & a - b < 0 \\ ((a, b, a) - b) / (a - b); & 0 \leq a - b \leq a + b \\ 1; & a + b > 0 \end{cases} \quad (13)$$

In the equation the values of  $a$  and  $b$  are not fuzzy numbers. The membership functions of fuzzy number  $c$  modified to  $n-a \geq 0$  ve  $n+b \geq 1$ . PROMETHEE approach uses the fuzzy PROMETHEE stages. Fuzzy number operators are used for operations on fuzzy numbers.

## Application

In a medical device company, due to the difficulties in the supply process, company decided to change the supplier. The supplier is to be decided in a systematic way. Criteria weighted by AHP, and the suitable supplier determined using FUZZY- PROMETHEE.

In practice, a decision-making team of engineers in the company was first established. Suppliers with a strong set of references were determined. As a result of investigations the number of suppliers reduced to 4. Criteria, respectively is determined as, the "cost" (C), "Quality" (Q), "delivery" (D), "Technical Support" (T), "Flexibility" (F) .

The decision hierarchy is as in Figure 1. The hierarchy consists of three levels. First level represents the purpose, second level criterias, and the final level is alternatives.

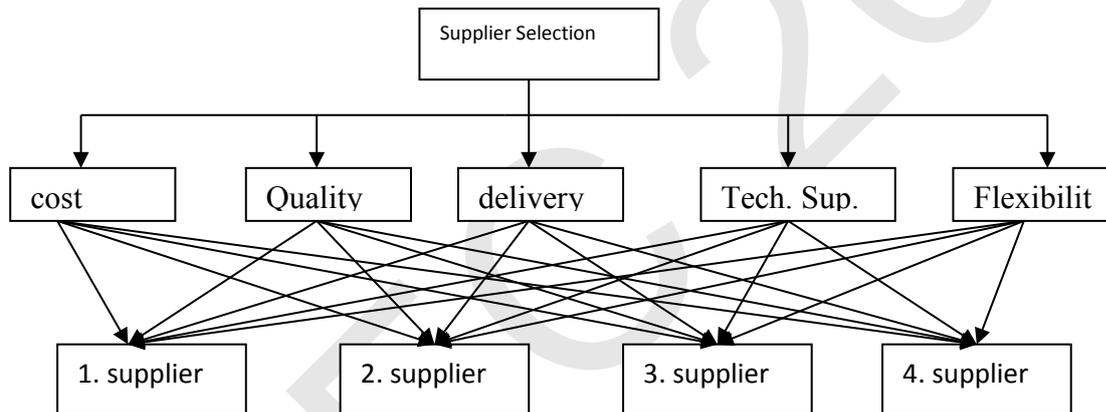


Figure 1: AHP Hierarchy

## AHP Calculations

The weights of the each criteria were determined by AHP. 1-9 scale that is proposed by Saaty and pairwise comparison matrices was used (Saaty, 1980). The geometric average of the comparison matrices determined. Pairwise comparison matrix of the criteria established. Table-1 shows the pairwise comparison matrices. Table-2 shows the results of AHP.

Table 1: Pairwise Comparison Matrice

| Criteria | C    | Q    | D    | T    | F    |
|----------|------|------|------|------|------|
| C        | 1,00 | 0,28 | 0,23 | 0,33 | 0,23 |
| Q        | 3,50 | 1,00 | 3,55 | 4,21 | 3,55 |
| D        | 4,30 | 0,28 | 1,00 | 1,00 | 1,44 |
| T        | 3,03 | 0,23 | 1,00 | 1,00 | 0,33 |
| F        | 4,30 | 0,28 | 0,69 | 3,03 | 1    |

Table 2: Results of AHP

| Criteria | Weights |
|----------|---------|
| C        | 0,09    |
| Q        | 0,44    |
| D        | 0,17    |
| T        | 0,11    |

|   |      |
|---|------|
| F | 0,19 |
|---|------|

The value of  $\lambda$  and CR is respectively 5.5 and 0.08.

### F- PROMETHEE Calculations

After weighting the criteria by AHP, for the selection procedure F-PROMETHEE used. Due to the uncertainty of the verbal assessments fuzzy sets were used. Decision makers evaluated the alternatives using verbal statements. (Table –3)

**Table 3: Evaluation of Alternative Suppliers with Verbal Expressions**

|         | C  | Q  | D  | T  | F  |
|---------|----|----|----|----|----|
| 1. Sup. | SL | L  | VH | E  | VH |
| 2. Sup. | VH | L  | H  | SL | SL |
| 3. Sup. | SH | SL | H  | SL | SL |
| 4. Sup. | VL | VH | H  | VH | VL |

(E: Equal, SL: Slightly Lower, L: Lower, VL: Very Low, SH: Slightly Higher, H: Higher, VH: Very High)

Verbal assessments transformed to triangular fuzzy- numbers. (Table –4)

**Table 4: Verbal Assessments Transformed To Triangular Fuzzy- Numbers**

|         | C        |          |          | Q        |          |          | D        |          |          | T        |          |          | F        |          |          |
|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1. sup  | 0,3<br>0 | 0,1<br>5 | 0,2<br>0 | 0,1<br>5 | 0,1<br>5 | 0,2<br>0 | 1,0<br>0 | 0,2<br>0 | 0,0<br>0 | 0,5<br>0 | 0,2<br>0 | 0,1<br>5 | 1,0<br>0 | 0,2<br>0 | 0,0<br>0 |
| 2. sup  | 1,0<br>0 | 0,2<br>0 | 0,0<br>0 | 0,1<br>5 | 0,1<br>5 | 0,2<br>0 | 0,8<br>0 | 0,1<br>5 | 0,2<br>0 | 0,3<br>0 | 0,1<br>5 | 0,2<br>0 | 0,3<br>0 | 0,1<br>5 | 0,2<br>0 |
| 3. sup. | 0,6<br>5 | 0,1<br>5 | 0,1<br>5 | 0,3<br>0 | 0,1<br>5 | 0,2<br>0 | 0,8<br>0 | 0,1<br>5 | 0,2<br>0 | 0,3<br>0 | 0,1<br>5 | 0,2<br>0 | 0,3<br>0 | 0,1<br>5 | 0,2<br>0 |
| 4. sup  | 0,0<br>0 | 0,0<br>0 | 0,1<br>5 | 1,0<br>0 | 0,2<br>0 | 0,0<br>0 | 0,8<br>0 | 0,1<br>5 | 0,2<br>0 | 1,0<br>0 | 0,2<br>0 | 0,0<br>0 | 0,0<br>0 | 0,0<br>0 | 0,1<br>5 |

The types of preference function determined. There are six type of preference function available. In this study, as a result of interviews with decision makers the third preference function selected. As a result of various experiments function parameters were determined. ( $q = 0$  and  $p = 0.6$ ) Pairwise comparisons of alternatives carried out. In this step, the basic fuzzy operations are used. The results were converted to the comparison values. (Table- 5)

**Table 5: Unweighted Comparison Matrix**

|     | C | Q | D | T | F |
|-----|---|---|---|---|---|
| 1-1 | 0 | 0 | 0 | 0 | 0 |
| 1-2 | 0 | 0 | 0 | 0 | 1 |
| 1-3 | 0 | 0 | 0 | 0 | 1 |
| 1-4 | 1 | 0 | 0 | 0 | 1 |
| 2-1 | 1 | 0 | 0 | 0 | 0 |
| 2-2 | 0 | 0 | 0 | 0 | 0 |
| 2-3 | 0 | 0 | 0 | 0 | 0 |
| 2-4 | 1 | 0 | 0 | 0 | 1 |
| 3-1 | 1 | 0 | 0 | 0 | 0 |
| 3-2 | 0 | 0 | 0 | 0 | 0 |
| 3-3 | 0 | 0 | 0 | 0 | 0 |
| 3-4 | 1 | 0 | 0 | 0 | 1 |
| 4-1 | 0 | 1 | 0 | 1 | 0 |
| 4-2 | 0 | 1 | 0 | 1 | 0 |
| 4-3 | 0 | 1 | 0 | 1 | 0 |
| 4-4 | 0 | 0 | 0 | 0 | 0 |

Matrice, converted to weighted comparison matrice using criteria weights. (Table 6)

**Table 6: Weighted Comparison Matrice**

|     | C    | Q    | D    | T    | F    |
|-----|------|------|------|------|------|
| 1-1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| 1-2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,19 |
| 1-3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,19 |
| 1-4 | 0,09 | 0,00 | 0,00 | 0,00 | 0,19 |
| 2-1 | 0,09 | 0,00 | 0,00 | 0,00 | 0,00 |
| 2-2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| 2-3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| 2-4 | 0,09 | 0,00 | 0,00 | 0,00 | 0,19 |
| 3-1 | 0,09 | 0,00 | 0,00 | 0,00 | 0,00 |
| 3-2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| 3-3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| 3-4 | 0,09 | 0,00 | 0,00 | 0,00 | 0,19 |
| 4-1 | 0,00 | 0,44 | 0,00 | 0,11 | 0,00 |
| 4-2 | 0,00 | 0,44 | 0,00 | 0,11 | 0,00 |
| 4-3 | 0,00 | 0,44 | 0,00 | 0,11 | 0,00 |
| 4-4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |

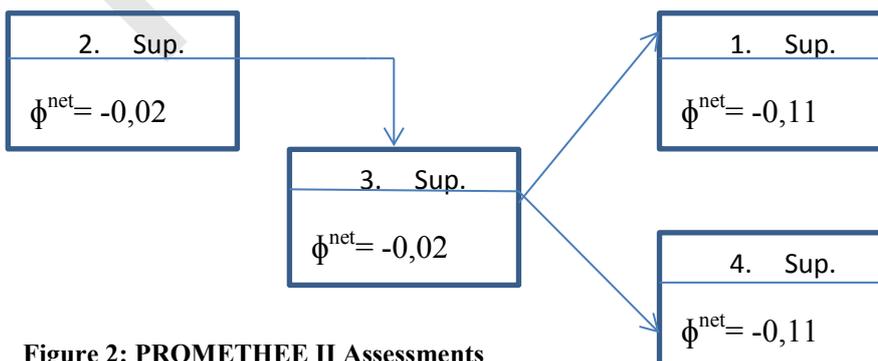
Datas and equation 4 and 5 were used for the calculation of  $\phi^+$  and  $\phi^-$  values. (Table- 7)

**Table 7 :  $\phi^+$  and  $\phi^-$  Values**

|          | 1. Sup. | 2. Sup. | 3. Sup. | 4. Sup. | $\phi^+$ | $\phi^{\text{net}}$ |
|----------|---------|---------|---------|---------|----------|---------------------|
| 1. Sup.  | 0,00    | 0,19    | 0,19    | 0,28    | 0,22     | -0,02               |
| 2. Sup.  | 0,09    | 0,00    | 0,00    | 0,28    | 0,12     | -0,11               |
| 3. Sup.  | 0,09    | 0,00    | 0,00    | 0,28    | 0,12     | -0,11               |
| 4. Sup.  | 0,55    | 0,55    | 0,55    | 0,00    | 0,55     | 0,27                |
| $\phi^-$ | 0,24    | 0,24    | 0,24    | 0,28    |          |                     |

From equations 6-7-8-9-10-11 PROMETHEE I calculations was made. As a result, first supplier is better than the second and the third supplier. There was no difference among second supplier and third supplier. Because  $\phi^+(i) = \phi^+(i')$  and  $\phi^-(i) = \phi^-(i')$ . Any comparison made with the supplier 4. For the supplier 4 the value of  $\phi^-$  is bigger than the others but the value of  $\phi^+$  also bigger than other suppliers' value.

For PROMETHEE II the value of the  $\phi^{\text{net}}$  was calculated. According to the calculations the Supplier 4 is the best, supplier 1 is the second, and the supplier 2 and 3 the last and has a same level.



**Figure 2: PROMETHEE II Assessments**

## Conclusions

If supplier selection is performed correctly, the efficiency of production systems significantly increased. Decline in product quality, insufficient time for orders, increasing inventories, long durations for supply process may be the results of working with the wrong supplier. As a result, there is a loss of customers, increased cost and waste of time. Long-term relationship with the small number of supplier is possible by working with the right supplier. Multiple conflicting criterias are available for the process of supplier selection. This situation necessitates the use of multi-criteria decision making techniques. In addition verbal assessments that are used for evaluation of alternatives leads to uncertainty. Handling with the uncertainty an integrated method that includes AHP and FUZZY PROMETHEE was used. There has been a lot of studies assigned the weights of the criteria intuitively, we used AHP for the weighting criterias. PROMETHEE was used for the selection of supplier. In addition, the model illustrated with an application. The results of the application were taken into consideration by the authorities.

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## AN INTEGRATED COLLABORATIVE ACTIVITY MANAGEMENT MODULE FOR E-LEARNING: SAU ADAMYO APPLICATION MODEL

Uğur Özbek, Tuğrul Taşçı

As technology continues to creep increasingly into our daily lives, education is also impressed more by this process with each passing day. Within this context, Web-based education appears as a method of education which is applied by plenty of educational institutions today for supporting traditional face to face education or particularly aiming at people who want to receive education while they are working. Educational research and reviews point out that collaborative learning activities such as guided studies or group assignments have significant and growing impact on learning. Web-based learning management systems (LMS) in general support collaborative activity management at different levels, but most of those systems are substantially not very efficient. In this paper, an integrated management module for guided studies is presented. The proposed module is part of Sakarya University LMS and has several purposive functions including instructor-topic assignment, students' topic selection, topic-based group creation, calendar-restricted reports submission and supervision, instructor-student group communication, and scoring. The findings obtained from Adapazarı Vocational School application of Sakarya University LMS with the proposed module are demonstrated that such a module adds great value to learning at a distance and also highly facilitates the management of guided studies for hundreds of student groups.

## An Investigation of Involuntary Electromagnetic Exposure from Base Stations in Residential Areas

Suayb Yener

Department of Electrical and Electronics Engineering  
Sakarya University  
Turkey

syener@sakarya.edu.tr

Baha Kanberoğlu

Department of Electrical and Electronics Engineering  
Sakarya University  
Turkey

bkanberoglu@sakarya.edu.tr

Osman Çerezci

Department of Electrical and Electronics Engineering  
Sakarya University  
Turkey

cerezci@sakarya.edu.tr

**Abstract:** In this study the electromagnetic field measurement results of Bursa/Nilüfer district which has a population of over 300,000 are presented. Measurements were focused on base stations and continuous exposure to electromagnetic fields of life has been revealed. In addition, the upward trend recent years in the level of electromagnetic radiation in the life of the city is investigated. Measurements were realized by the Sakarya University Electromagnetic Research Center both the level of a wide range and frequency band levels with advanced hardware devices. When needed, long-term field measurements were carried out with the electromagnetic area monitor. The measurement results were evaluated in terms of both the authorized body in Turkey BTK (Information and Communication Technologies Authority) and the ICNIRP (International Commission on Non-ionizing Radiation Protection) regulations. In addition, the limit values applied in Turkey, compared with the limit values in force in European countries.

**Key Words:** Electromagnetic Radiation, Electromagnetic Pollution, Electromagnetic Radiation Measurements, Electromagnetic Radiation Exposure Limits

### Introduction

In today's world, the electromagnetic pollution in our environment mostly caused by high-voltage power lines, Radio-TV transmitters and base stations. These resources are located close to areas where people live and can be operated in unsuitable conditions. People are affected by these electromagnetic sources without being aware of and without their own choices. Measuring and determining of the emitting levels of these electromagnetic sources is highly important. Thereby, determination of the levels of human exposure and the developing of the control precautions may be possible (Çerezci, 1991, European Commission Report, 2009, WHO Report, 2010).

In this study, the results of electromagnetic field measurement during 2010 and 2011 of Bursa/Nilüfer district are presented (Çerezci, 2012, Nilüfer Municipality 2010). After this introduction section, in the section two electromagnetic safety regulations are given and compared. In the third section, measurement method and devices are presented. Measurements were especially focused on base stations and continuous exposures to electromagnetic fields of life have been revealed. In the following section measurement results are given with graphs. Also, interpretation of the results are given in this section. And finally the important results of the study are given in the conclusions section

## Electromagnetic Safety Regulations

Safety requirements for limiting exposure to time varying electric and magnetic fields are enforced by regulations. At the international level, safety guidelines for EM exposure of workers/general public and controlled/uncontrolled environments have been issued by the International Commission on Non-Ionizing Radiation Protection (ICNIRP Guidelines). American National Standards Institute (ANSI) operates as a part of Institute of Electric and Electronics Engineering (IEEE) for safety standards on EMF exposures. World Health Organization (WHO) and Federal Communication Commission (FCC) are some of the other regularly boards.

There are two regulations for EMF's exposure in Turkey. The first one is belongs to Republic of Turkey Ministry of Forestry and Water Affairs. Electromagnetic field limits in this regulation have been generated with reference to the ICNIRP regulations. The first regulation is related with both ELF and LF frequency band. The second one is published by BTK (Information and Communication Technologies Authority) is the general guidelines that established standard values for telecommunication equipment and total environment. The second regulations applied the standards for RF and MW (GSM) frequency range.

Exposure limits at the ELF&LF frequencies recommended by ICNIRP and adopted by Republic of Turkey Ministry of Forestry and Water Affairs is given in Table 1 and Table 2 respectively (ICNIRP, 1998, Ministry of Forestry and Water Affairs, 2010). The other electromagnetic exposure limits at RF frequencies which presented in BTK guidelines are given in Table 3 (Information and Communication Technologies Authority 2011).

Table 1: Reference levels adopted by ICNIRP for general public exposure to time-varying electric and magnetic fields

| Frequency Range    | Electric Field Strength E (kV/m) | Magnetic Field Strength H (A/m)     | Magnetic Flux Density B(T)           |
|--------------------|----------------------------------|-------------------------------------|--------------------------------------|
| 1 Hz–8 Hz          | 5                                | $3.2 \times 10^4 / f^2$             | $4 \times 10^{-2} / f^2$             |
| 8 Hz–25 Hz         | 5                                | $4 \times 10^3 / f$                 | $5 \times 10^{-3} / f$               |
| <b>25 Hz–50 Hz</b> | <b>5</b>                         | <b><math>1.6 \times 10^2</math></b> | <b><math>2 \times 10^{-4}</math></b> |
| 50 Hz–400 Hz       | $2.5 \times 10^2 / f$            | $1.6 \times 10^2$                   | $2 \times 10^{-4}$                   |
| 400 Hz–3 kHz       | $2.5 \times 10^2 / f$            | $6.4 \times 10^4 / f$               | $8 \times 10^{-2} / f$               |
| 3 kHz–10 MHz       | $8.3 \times 10^{-2}$             | 21                                  | $2.7 \times 10^{-5}$                 |

Note: For calculations, f in Hz

Table 2: Reference levels adopted by Republic of Turkey Ministry of Forestry and Water Affairs for general public exposure to time-varying electric and magnetic fields

| Frequency Range          | Electric Field Strength E (V/m) | Magnetic Field Strength H (A/m) | Magnetic Flux Density B( $\mu$ T) |
|--------------------------|---------------------------------|---------------------------------|-----------------------------------|
| >1Hz                     | -                               | 32000                           | 40000                             |
| 1 Hz–8 Hz                | 10000                           | $32000 / f^2$                   | $40000 / f^2$                     |
| 8 Hz–25 Hz               | 10000                           | $4000 / f$                      | $5000 / f$                        |
| <b>0.025 kHz–0.8 kHz</b> | <b><math>750 / f</math></b>     | <b><math>8 / f</math></b>       | <b><math>10 / f</math></b>        |
| 0.8 kHz–3 kHz            | $250 / f$                       | 5                               | 6.25                              |
| 3 kHz–150 kHz            | 87                              | 5                               | 6.25                              |

A comparison table among the reference level of Turkey, Italy and Switzerland given in Table 4. As can be seen from the table limit levels of Turkey is seven-eight times greater than other two countries'.

Table 3: Reference levels adopted by Information and Communication Technologies Authority for general public exposure to time-varying electric and magnetic fields

| Frequency Range (MHz) | Electric Field Strength E (V/m) |                       | Magnetic Field Strength H (A/m) |                   | Magnetic Flux Density B( $\mu$ T) |                       |
|-----------------------|---------------------------------|-----------------------|---------------------------------|-------------------|-----------------------------------|-----------------------|
|                       | For one equipment               | For total environment | For one equipment               | For one equipment | For one equipment                 | For total environment |
| 0.010 – 0.15          | 22                              | 87                    | 1,3                             | 5                 | 1,5                               | 6,25                  |
| 0.15 – 1              | 22                              | 87                    | 0,18/f                          | 0,73/f            | 0,23/f                            | 0,92/f                |
| 1 – 10                | $22/f^{1/2}$                    | $87/f^{1/2}$          | 0,18/f                          | 0,73/f            | 0,23/f                            | 0,92/f                |
| 10 – 400              | 7                               | 28                    | 0,02                            | 0,073             | 0,023                             | 0,092                 |
| 400 – 2000            | $0.341f^{1/2}$                  | $1.375f^{1/2}$        | $0,0009f^{1/2}$                 | $0,0037f^{1/2}$   | $0,001f^{1/2}$                    | $0,0046f^{1/2}$       |
| 2000 – 60000          | 15                              | 61                    | 0,04                            | 0,16              | 0,05                              | 0,2                   |

Table 4: Comparing the reference levels of Turkey and European Countries

| Country   | GSM Band Electric Field Strength E (V/m) |
|---|--|
| Turkey (Total Environment)                              | 41.25                                    |
| Italy (Total Environment for Sensitive Locations)       | 6  |
| Switzerland (Total Environment for Sensitive Locations) | 5  |

## Measurements and Measurement Method

Survey equipment used during measurements are listed in Table 5.

Table 5: Measurement equipment

| # | Meter/Equipment           | Brand | Model        | Measurement Range |
|---|---------------------------|-------|--------------|-------------------|
| 1 | EMR Area Monitoring       | Narda | AMB 8057     | 10Hz – 3 GHz      |
| 2 | E Field Probe             | Narda | EP-4B-01     | 0.1 – 3000 MHz    |
| 3 | Broadband Field Meter     | Narda | NBM 550      | 100kHz – 60 GHz   |
| 4 | E Field Probe             | Narda | EF0691       | 0.1 – 6000 MHz    |
| 5 | Selective Radiation Meter | Narda | SRM 3006     | 9kHz – 6000 MHz   |
| 6 | E Field Probe             | Narda | E-Field, T-A | 27 MHz – 3 GHz    |
| 7 | E Field Probe             | Narda | E-Field, T-A | 420 MHz – 6 GHz   |
| 8 | E Field Probe             | Narda | E-Field, S-A | 9 kHz – 300 MHz   |

The spot measurements were performed at the typical human height (1.70 m) above from the ground level during over 6 minutes at the indoor environments of the locations. Spot measurements and investigations were performed to reflect the EMR level occurred in the environment vicinity of the base stations.

The electromagnetic fields at RF-MW (GSM) band were measured in frequencies between 100 kHz and 10 GHz. 900MHz, 1800MHz and 2100MHz GSM frequencies were especially focused on. Continuous and frequency level measurement were realized when needed.

The distribution of the measured values, analysis of statistical situation and review in terms of national and international limits were given with the graphs.

## Measurement Results

In this section the measurement results are presented with the graphs. The information contained in graphs is given both in graph titles and figure captions. The measurement values for all measurement locations are given Figure 1 and Figure 2 for 2010 and 2011 respectively. Also limit levels are given both graphs.

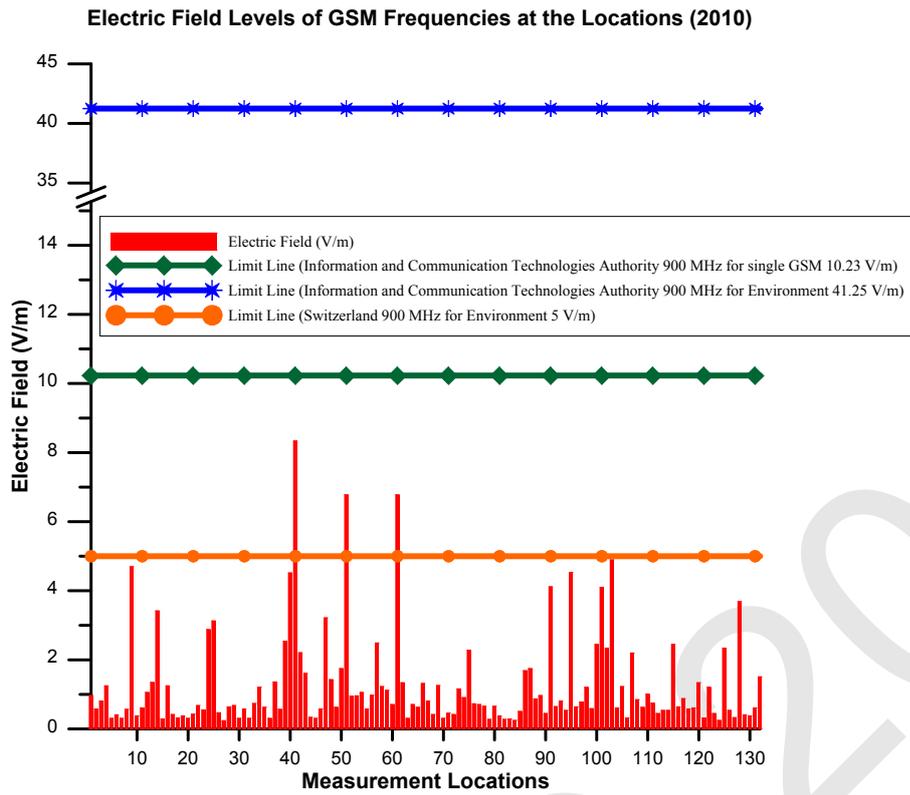


Figure 1: Electric field measurement levels of GSM frequencies at the locations in 2010

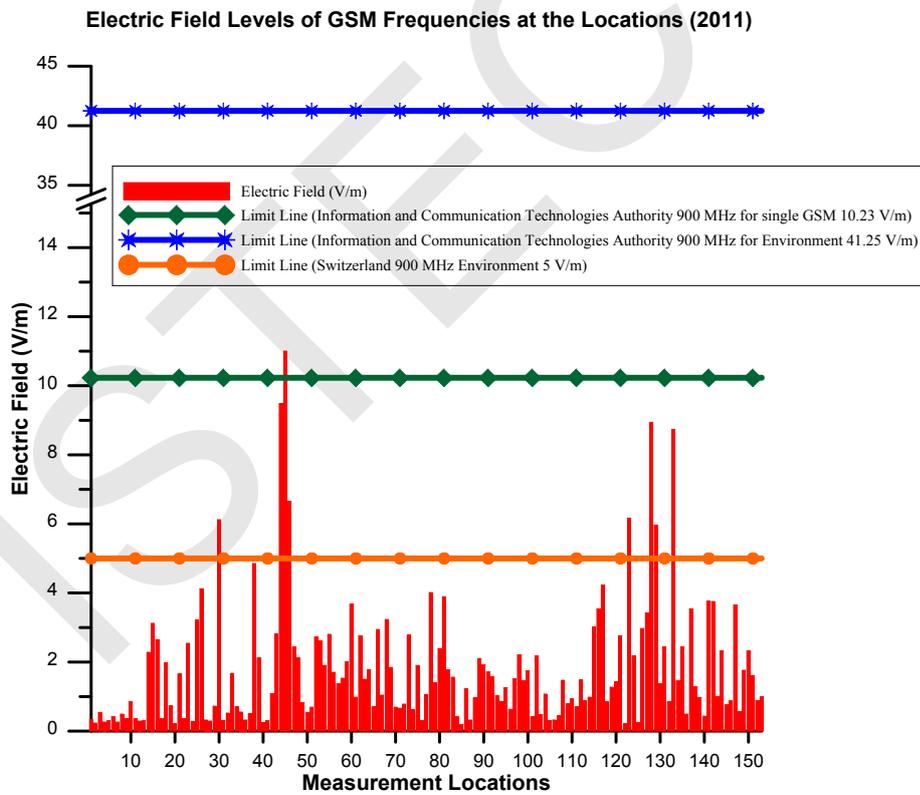


Figure 2: Electric field measurement levels of GSM frequencies at the locations in 2011

By the range of the level volumes and the percentage distributions are given in Figure 3, Figure 4, Figure 5 and Figure 6 for both years.

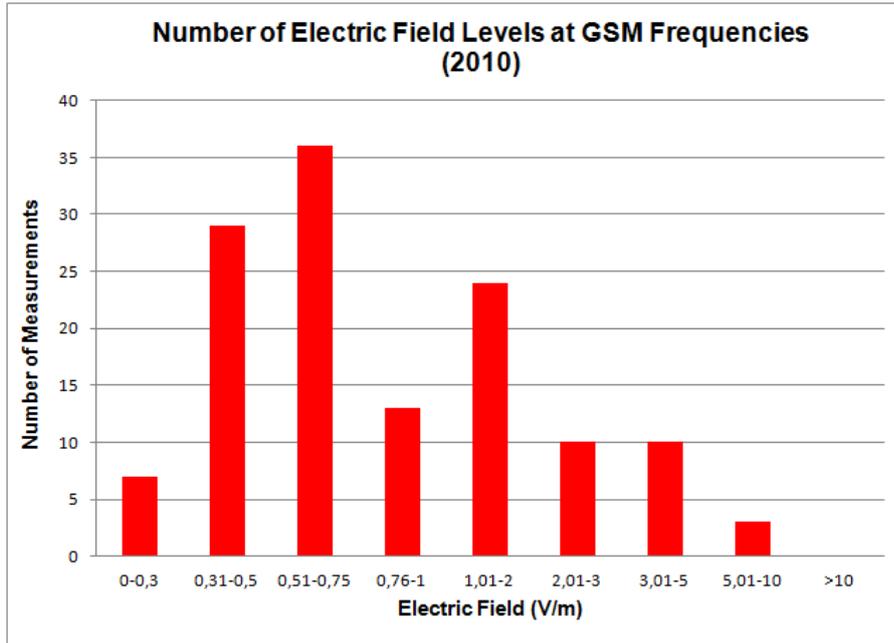


Figure 3: Distribution of electric field levels at GSM frequencies (2010)

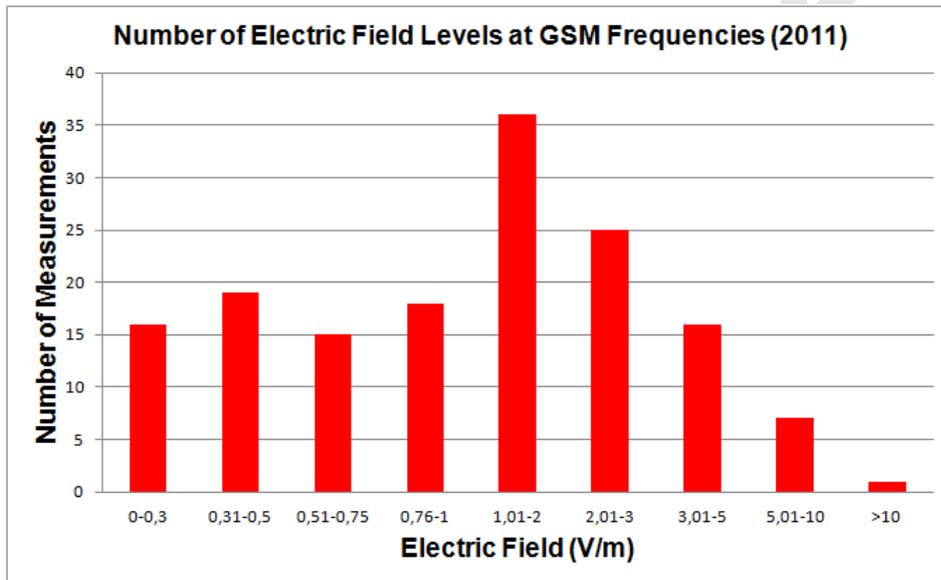


Figure 4: Distribution of electric field levels at GSM frequencies (2011)

**Percentage Distribution of Electric Field Levels at GSM Frequencies (2010)**

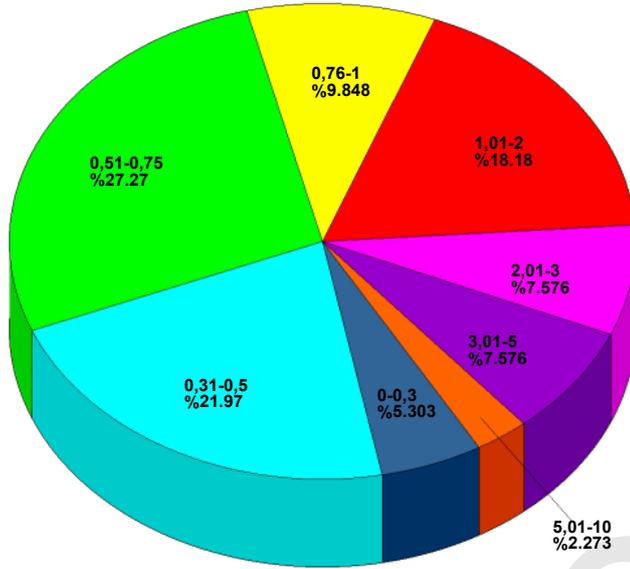


Figure 5: Percentage distribution of electric field levels at GSM frequencies (2010)

**Percentage Distribution of Electric Field Levels at GSM Frequencies (2011)**

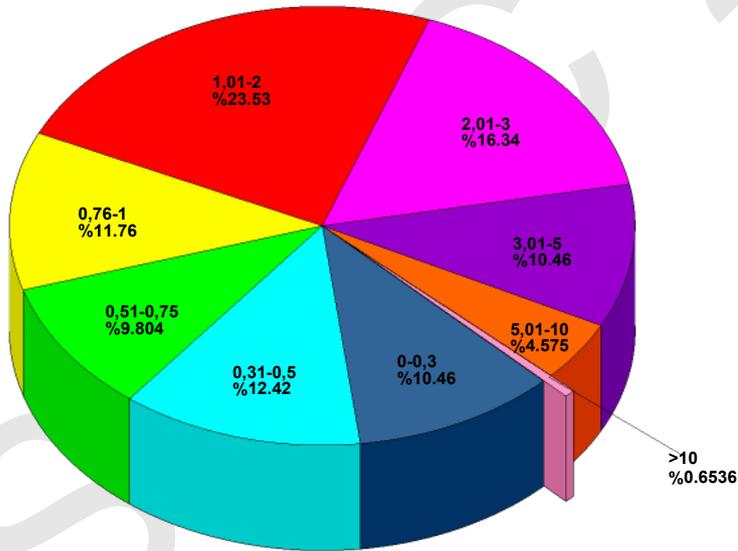


Figure 6: Percentage distribution of electric field levels at GSM frequencies (2011)

Minimum, maximum and average levels of measurements are given in Figure 7 for both two years separately.

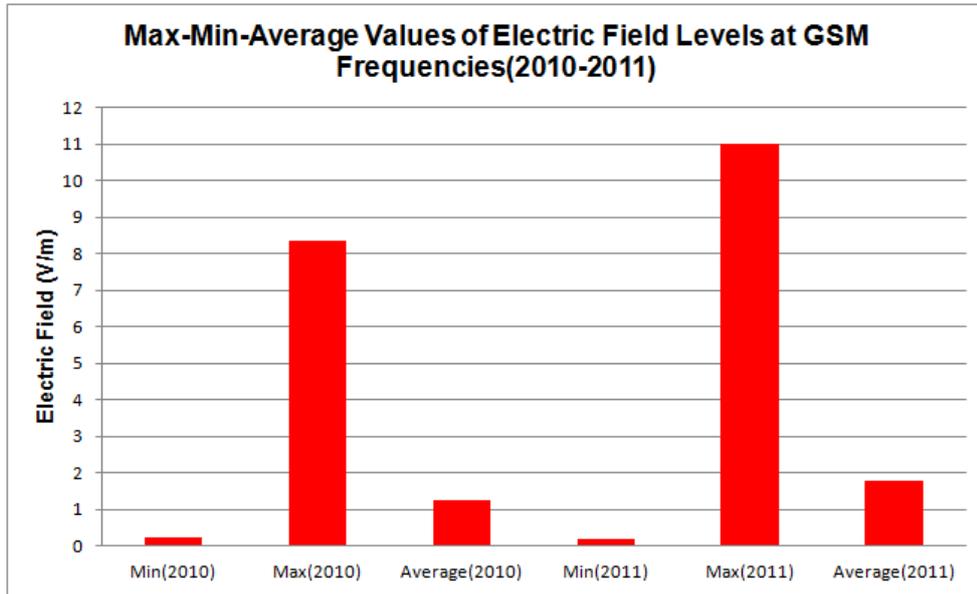


Figure 7: Min-max-average values of electric field levels at GSM frequencies

As can be seen from the Figure 8, 132 and 153 measurements were realized in 2010 and 2011 respectively.

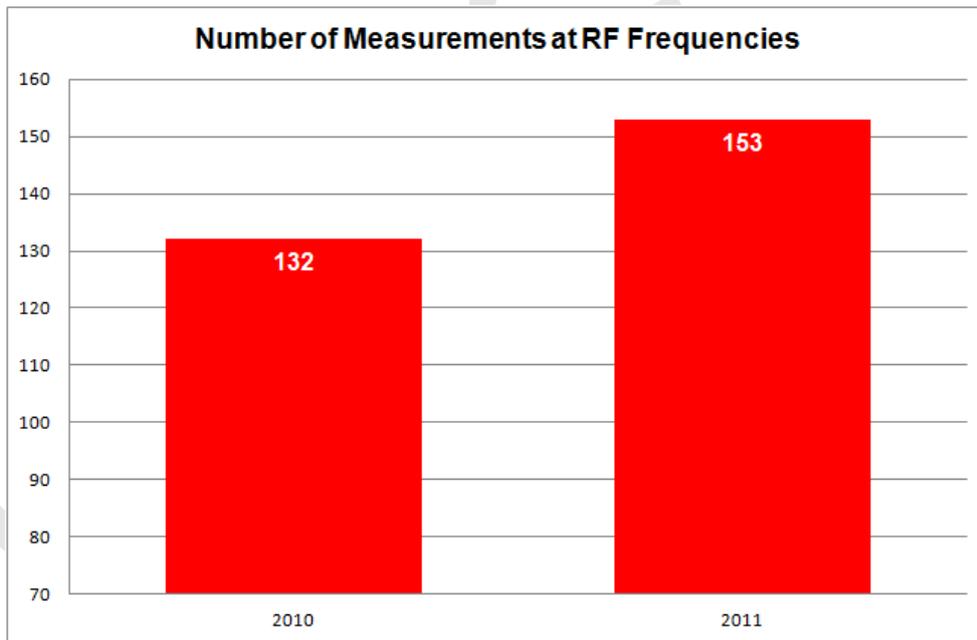


Figure 8. Number of measurements at GSM frequencies

## Discussion and Conclusions

In this study, the electromagnetic field measurement results realized during 2010 and 2011 in Bursa/Nilufer are presented. It is reported 132 and 153 measurements in 2010 and 2011 respectively. The measurement values for all points and levels according to the limits are given graphically. In addition, by the range of the level volumes and the percentage distributions are given study. Minimum, maximum and average levels of measurements are given for 2010 and 2011 separately. Also, the results of the level of change according to the year by year are presented in the study.

With this detailed and long-term work, large number of measurements were realized during two years. Many significant results have been obtained with the analyzing and evaluating of the result of measurements. First of all, it can be easily seen that the limit values is much greater than the real environment results. Almost all measurement values are lower than even single station limit value (10.23V/m). The total environment limit value (41.25V/m) is pointed out an extremely high level. In our opinion, current limit values should be revised and lowered. Because of the lower levels can be obtained already, it will be easy to apply this

Another important result of our work, the amount of the electromagnetic field levels were increased by in 2010 to 2011. According to the experiences and data up to now, also 2012 will confirm this upward trend.

## Acknowledgments

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# AN INVESTIGATION OF THE EFFECT OF PROJECT-BASED LEARNING APPROACH ON CHILDREN'S ACHIEVEMENT AND ATTITUDE IN SCIENCE

Yılmaz ÇAKICI, Nihal TÜRKMEN  
Trakya Üniversitesi, Eğitim Fakültesi, İlköğretim Bölümü  
Edirne-Turkey  
yilmazcakici@trakya.edu.tr

**Abstract:** The aim of this study is to examine the effect of project-based learning activities on the fifth grade children's science achievement and their attitudes towards science course for the unit on 'Sound', and to compare the effectiveness of project-based learning over more traditional teaching methods. The study was carried out with 44 fifth grade students at a public primary school in the Northwestern part of Turkey, during the spring term of the 2011-2012 academic year. Students were divided into two groups as control group (CG, n=22) and experimental group (EG, n=22). Initially, pre-tests (an achievement test and an attitude scale) were applied to both the CG and EG. Following the four weeks, the EG was taught using the project-based practices, while the CG was taught using more traditional teaching practices. Children in the EG carried out three science projects for the science unit on 'sound': *Bite and hear, making music with glass bottles, and designing a house with sound insulation*. Then, the post-tests were carried out in order to determine the effect of a project-based learning approach on children's learning. The research findings revealed that children's science achievement significantly improved with the project-based activities, but their attitudes toward science did not change.

**Key words:** Project-based science, science teaching, sound unit.

## Introduction

In the last two decades, project-based learning has been an important component of science education. Many current curricula emphasized project-based teaching as a favored method for "motivating students and facilitating greater retention of learning" (Barak & Raz, 2000, p.28). A great deal of research revealed that the integration of inquiry based approaches via project-based studies in science courses improves students' deeper understanding of science (Alozie, Moje, & Krajcik, 2010).

Through project-based teaching, students find solutions to real world problems by asking open-ended questions, designing and conducting investigations, researching problem, gathering information, drawing conclusions based on the findings, and reporting results (Schneider, Krajcik, Marx, & Soloway, 2002). Ladewski, Krajcik, and Harvey (1994) pointed out that projects require an authentic real-world problem that drive activities and result in a series of products related to the problem. Projects represent students' emerging understandings and allow students to engage in investigations.

One of the crucial factors in learning science is children's attitude (George, 2006). Koballa and Crawley (1985) emphasized that attitude toward science "fulfills basic psychological needs, such as the need to know and the need to succeed." Therefore, attitudes toward science are considered "to influence future behaviors, such as interest in working on a science project" (p.224). In sum, as Tamir (1998) stated, teaching style affects both students' achievement and attitudes toward science. In this context, this study explored the effect of project-based learning activities on the fifth grade children's science achievement and attitude towards science for the science unit on 'Sound'.

## Materials and Method

### *Research design*

In this study, the pre-test post-test control group of quasi-experimental research design was used (Cohen & Manion, 2000).

### *Participants*

This study was carried out to determine the effect of project-based learning strategies during the spring term of the 2011-2012 academic year. Participants consisted of 44 fifth grade students at a public primary school in the Uzunköprü-Edirne district located in the Northwestern part of Turkey. Students were divided into two groups, a control group (CG, n=22) and experimental group (EG, n=22). The control and experimental groups were regular classrooms.

### *Measures*

In this study, data were collected through the use of two instruments; an attitude scale and an achievement test. Children's science achievement was measured by *the Light and Sound Achievement Test* developed by Salgut (2007). Reliability coefficients of this test were determined by the KR-20 method. The KR-20 coefficient of the test was .92 (Salgut, 2007). Children's attitude was measured by *the Scale for Attitudes towards Science Course* which was developed by Altınok (2006). The Cronbach alpha reliability coefficient of the attitude scale was .92 (Altınok, 2006).

While the class teacher taught in the CG, the courses in the EG were conducted by the researcher. The researcher had participated in science project competitions before, and thus had the experience of the project-based learning approach, and knew how to properly conduct children's project works.

### **The Application of Teaching Activities**

This study continued five weeks. The first week, initially children were given a brief information about the aim of the study and process of conducting a science project. Then, pre-tests consisting of attitude scale and achievement test were applied to both the CG and EG. During the following four weeks, the EG was taught using the project-based activities in science lessons (a total of four hours per week). As for the CG, science courses were carried out through the routine course plans in accordance with Science and Technology course instruction program. The CG followed the activities in the fifth grade Science and Technology textbooks. Three science projects conducted with children are briefly explained below.

The first project work children undertake for the unit sound was "*Making Music with Glass Bottles*". The researcher had requested children to bring identical glass bottles to science course. Using bottles to make music is an interesting science project for children, and thereby, explores how volume and liquid affect sound waves. In this project, children use only seven-eight empty bottles and some water. The bottles must be all the same, such as empty glass soda or fruit juice bottles. At the beginning, children stand eight empty bottles side by side on a table, and then fill the bottles with different amounts of water. Fill the bottle on the left with some water, and add water to the next bottle so that the water level is a bit higher than in the first bottle. Each bottle must have a little bit more water in it than the bottle to its left. There is one variable, which is the amount of water. Initially, using a metal spoon, children tap the each bottle with a metal spoon and compare the pitch of the sounds produced. Later, children blow across the each bottle and compare the pitch of the sounds produced.

The second project was about "*Making Headphone*". In this project work, children learn how sound travels from one matter to other, and how headphones carry the sound from the music player to the ears. Headphones and speakers have a similar design. Children have initially taken apart a headphone and observed the components in the classroom. Materials needed to make a headphone are a coil of copper wire, a magnet, an audio cable and a dry branch.

The third project activity was related to "*Developing Sound Insulation in Homes*". Children tried to answer the question how to reduce sound traveling in a house. Initially, children in groups explored about how to develop sound insulation in a house. Later, they put quartz clock in a box and, using everyday materials such as carpeting, cotton, fabric or cloth, tried to insulate tic tac sound of quartz clock that should not come out. Sound insulation materials act as a sound absorber. The best materials are those that absorb the sound waves effectively: carpeting, cotton, fabrics, cloths, cork board, rock wool and fibreboard. Following the third project activity, the post-tests were administrated to both the EG and CG in order to reveal the effect of project based activities on children's achievement and attitude.

### **Findings**

The independent samples t-test compares the mean scores of two groups on a given variable. At the beginning of the study, independent samples t-test was used to determine whether two groups were equal in terms of their attitudes towards science course and achievement on the 'sound' topic. There was not a significant difference between the two groups' pre-test scores [ $t(42)_{(likeness)}=.749, p>.05$ ;  $t(42)_{(participation)}=.801, p>.05$ ;  $t(42)_{(determination)}=-1.257, p>.05$ ;  $t(42)_{(achievement)}=-.072, p>.05$ ] which indicates two groups were equal in terms of students' attitudes towards science course and achievement in the sound subject.

At the end of the project-based activities, the independent samples t-test was used to determine the differences, if any, between the EG and CG scores. The results are given in Table 2 below.

**Table 2.** Post-test results of the independent samples t-test for students' attitudes towards science course and achievement in the sound topic.

| Post-test     | Groups          | N  | Mean  | Std. Deviation | T      | df | P   |
|---------------|-----------------|----|-------|----------------|--------|----|-----|
| Likeness      | Control G.      | 22 | 50,00 | 4,48           | -,070  | 42 | ,95 |
|               | Experimental G. | 22 | 50,14 | 8,02           |        |    |     |
| Participation | Control G.      | 22 | 70,95 | 8,34           | -,581  | 42 | ,56 |
|               | Experimental G. | 22 | 72,55 | 9,76           |        |    |     |
| Determination | Control G.      | 22 | 6,23  | 1,82           | -1,508 | 42 | ,14 |

|             |                 |    |       |      |        |       |     |
|-------------|-----------------|----|-------|------|--------|-------|-----|
|             | Experimental G. | 22 | 7,18  | 2,34 |        |       |     |
| Achievement | Control G.      | 22 | 13,00 | 4,44 | -8,056 | 33,30 | ,00 |
|             | Experimental G. | 22 | 21,77 | 2,52 |        |       |     |

According to Table 2, there was a significant difference in terms of achievement between the CG and EG [ $t(33.30) = -8.056, p < .001$ ]. However, no significant difference was found between the post-test results of the CG and EG for attitudes towards science course [ $t(42)_{(likeness)} = -.070, p > .05$ ;  $t(42)_{(participation)} = -.581, p > .05$ ;  $t(42)_{(determination)} = -1.508, p > .05$ ]. It is worth noting that although the findings were not significantly higher for attitudes, the mean results for the EG was higher.

## Conclusions

This study revealed that students carrying out project-based activities had significantly higher achievement than those who continued taking routine teaching in science courses. On the other hand, there was not a significant difference between the CG and EG for their attitudes towards science course. This indicates that the use of project-based learning experiences for relatively short term (four weeks) do not lead to a significant increase in students' attitude towards science course. In this study, the researchers realized that children have different levels of interest in different project works. It is widely agreed by the educators that children take greater ownership in their projects when the project is attracting them, interesting for them. Therefore, teachers who adopt a broad scope for science projects can be better able to motivate students whose interests may be in the different topics. This also enables students to build connections between their classroom experiences and their interests (Egenrieder, 2007, p.5).

Given that many studies have found positive relationship between attitude toward science and higher science achievement (Oliver & Simpson, 1988; Freedman 1997), teachers should give particular attention to both students' attitudes and student-centred teaching strategies in science lessons. Teachers have the responsibility of making the curriculum as relevant and as exciting for students as possible (Trumper, 2006). In this context, project-based teaching activities may provide great opportunities to students for effective science learning.

In conclusion, this study supports the view that project-based learning is an effective and motivating strategy for students. Science teachers should be encouraged and supported to practice inquiry-based approaches, especially project-based science teaching to enhance success of reform efforts in the schools (Schneider, Krajcik, Marx, & Soloway, 2002). In this process, teachers' content knowledge and pedagogical skills are necessary and important for successful implementation of new practices and educational reform efforts. However, teachers usually continue to teach in their traditional manner even though they use new textbooks and materials (Tal, Krajcik, & Blumenfeld, 2006).

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## AN OPTIMAL CONTROL PROBLEM BY CONTROLLING HEAT SOURCE OF THE SURFACE OF TISSUE

Rikhiya Dhar

Department of Mathematics, B.P. Poddar Institute of Management and Technology, Kolkata, India  
rikhiya\_dhar@yahoo.com

Ranajit Dhar

Registrar, Vidyasagar University, Midnapur, West Bengal, India.  
rdhar@mail.vidyasagar.ac.in

Piyanka Dhar

Department of Mathematics, Sikkim Manipal Institute of Technology, Majhitar, East Sikkim, India

**Abstract:** A distributed optimal control problem for a system described by bio-heat equation for a homogeneous plane tissue is analytically investigated such that a desired temperature of the tissue at a particular point of location of tumour in hyperthermia can be attained at the end of a total time of operation of the process due to induced microwave on the surface of the tissue which is taken as control. Here the temperature of the tissue along the length of the tissue at different times of operation of the process are numerically calculated which display the rise of the desired temperature of the tumour.

**Keywords:** Bio-heat equation, hyperthermia, optimization, microwave, tumour, control.

### Nomenclature:

|          |   |  |
|----------|---|--|
| $c$      | = | specific heat of tissue, $J/kg\ ^\circ C$  |
| $h$      | = | heat transfer coefficient between the skin and the ambient air, $Wm^{-2}/^\circ C$ |
| $k$      | = | thermal conductivity of tissue, $W m^{-1}/^\circ C$                                |
| $L$      | = | length of the tissue, m  |
| $x_1$    | = | location of the tumour, m  |
| $\chi$   | = | temperature, $^\circ C$  |
| $\chi_a$ | = | arterial temperature, $^\circ C$   |
| $\chi_0$ | = | initial temperature, $^\circ C$  |
| $u(t)$   | = | temperature of the surrounding medium, $^\circ C$                                  |
| $\chi^*$ | = | desired temperature to be attained, $^\circ C$                                     |
| $T$      | = | Total time of the process, s   |
| $t_1$    | = | switching time, s  |
| $Q(t)$   | = | optimal heat generation rate due to volumetric heating, $Wm^{-3}$                  |

|          |   |  |
|----------|---|--|
| $\rho$   | = | density of tissue, $\text{kg m}^{-3}$  |
| $\delta$ | = | dirac – delta function.  |
| $\omega$ | = | product of flow and heat capacity of blood, $\text{W m}^{-3} / ^\circ\text{C}$ |
| $Q_m$    | = | rate of metabolic heat generation, $\text{Wm}^{-3}$                            |

## Introduction

Computer simulation plays a vital role in treating rise of temperature of tumour to its therapeutic value by means of optimal distributions of the applied heat source and surface cooling temperature. In this respect, the consideration of physiological responses of the patient at the time of hyperthermia treatment, the region of the tissue affected by tumour, the anatomical feature of the treated patient and blood flow rates of the tissue should be taken into account with much importance for achieving the temperature of the tumour to its therapeutic value avoiding the damage of healthy tissue due to overheating.

Deng and Liu (2002) investigated analytical solutions described by bio-heat transfer equation due to transient heating on the skin surface with the aid of Green's function. Dhar and Sinha (1989) carried out analytically a distributed optimal control problem in a multilayered tissue to attain desired rise of temperature of the tumour by controlling surface cooling temperature. Wagter (1986) made an important contribution on optimization in plane tissue by multiple electro – magnetic applicators. Butkovsky (1969) had studied the fundamentals of optimal control problems in distributed parameter system. Dhar and Sinha (1988) developed an optimal control problem analytically to attain desired temperature of the tumour by induced heat source at least possible time.

An analytical investigation was developed on computations for optimization problems in hyperthermia by finite difference method (Das et. al., 1999). Kowalski and Jin (2003) carried out analytically on optimization in hyperthermia by electro – magnetic annular phased arrays. In Loulou and Scott (2002) investigated a study on thermal dose optimization in hyperthermia using conjugate gradient method. Bagaria and Johnson (2005) studied analytically optimal control problem in bio-heat equation to achieve ideal hyperthermia condition using explicit finite difference method. An analytical investigation was performed on optimization of radio – immunotherapy interactions with hyperthermia in Kinuya et. al. (2004). In course of investigation on empirical dose construction for oncological hyperthermia Szasz and Vincze (2006) developed Pennes equation by inducing the entire energy balance. Rapoport et. al. (2009) studied on chemotherapeutic intervention on tumours by ultrasound. Liu and Chen (2009) studied analytically the prediction of temperature in tissues described by bio-heat transfer problem in a bi-layered spherical tissue by considering blood perfusion and metabolism. Shih et. al. (2008) investigated the feasibility of heating on tumour by high intensity focussed ultrasound in thermal surgery.

Kuznetsov (2006) investigated optimal control problem to maximize temperature in the tumour at the end of time of the process due to spatial volumetric heat generation by assuming fixed total volumetric heat generation over the duration of the process. With the aid of conjugate gradient method, a distributed optimal control problem for a system described by bioheat equation in a homogeneous plane tissue due to induced microwave was investigated by Dhar and Dhar (2010) and Dhar et. al. (2012).

In this paper, a distributed optimal control problem described by bio-heat equation for a homogeneous tissue is

analytically investigated such that a desired temperature of the tissue at a particular point of location of tumour can be attained at the end of total time of operation of the process by means of controlling induced microwave on the surface of the tissue when the surface cooling temperature is constant. Here the switching time during which the microwave power is operative has been obtained by using conjugate gradient method under calculus of variation.

A numerical temperature distributions of the tissue at different times on various values of total time of operation have been obtained which displays the rise of desired temperature of the tumour.

## Mathematical Analysis

The one dimensional bio-heat equation (Deng 2002, Dhar 1989) can be written as,

$$\rho c \frac{\partial \chi}{\partial t} = k \frac{\partial^2 \chi}{\partial x^2} + \omega(\chi_a - \chi) + Q(t) + Q_m \quad (1)$$

Boundary condition :

$$\begin{aligned} k \frac{\partial \chi}{\partial x} &= h\{\chi - u(t)\} \quad \text{on } x=0 \\ \chi &= \chi_a \quad \text{on } x=L \end{aligned} \quad (2)$$

Initial Condition:

$$\chi(x, 0) = \chi_0 \quad (3)$$

We would like to attain the desired temperature  $\chi^*$  at the point  $x = x_1$ , where the tumour is located at the end of the total time T of the process by controlling optimally Q(t).

Thus the functional (Butkovasky 1969, Loulou 2002)

$$\frac{1}{2} \int_0^L \{\chi^* - \chi(x, T)\}^2 \delta(x - x_1) dx \quad (4)$$

is to be minimized.

The first term designates the square deviation of the temperature  $\chi^*$  from  $\chi(x, t)$  at  $x = x_1$ .

Let us write a functional J, given by (Butkovasky 1969, Loulou 2002)

$$\begin{aligned} J = & -\frac{1}{2} \int_0^L \{\chi^* - \chi(x, T)\}^2 \delta(x - x_1) dx \\ & + \int_0^L \int_0^T \psi(x, t) \left\{ \frac{k}{\rho c} \frac{\partial^2 \chi}{\partial x^2} + \frac{\omega}{\rho c} (\chi_a - \chi) + \frac{1}{\rho c} Q(t) + \frac{Q_m}{\rho c} - \frac{\partial}{\partial t} \chi \right\} dx dt \quad (5) \end{aligned}$$

where  $\psi(x, t)$  is the auxiliary function.

By considering  $Q_m$  as constant, the first variation of the function J can be written as,

$$\begin{aligned}
 \delta J = & \int_0^L \{ \chi^* - \chi(x, T) \} \delta \chi(x, T) dx \\
 & + \frac{k}{\rho c} \int_0^T \psi(L, t) \delta \chi_x(L, t) dt + \frac{1}{\rho c} \int_0^T \left\{ k \frac{\partial \psi}{\partial x}(0, t) - h \psi(0, t) \right\} \delta \chi(0, t) dt \\
 & + \frac{h}{\rho c} \int_0^T \psi(0, t) \delta u(t) dt - \frac{k}{\rho c} \int_0^T \frac{\partial}{\partial x} \psi(L, t) \delta \chi(L, t) dt + \frac{k}{\rho c} \int_0^T \int_0^L \frac{\partial^2}{\partial x^2} \psi(x, t) \delta \chi(x, t) dx dt \\
 & - \frac{\omega}{\rho c} \int_0^L \int_0^T \psi(x, t) \delta \chi(x, t) dx dt + \frac{1}{\rho c} \int_0^T \int_0^L \psi(x, t) \delta Q(t) dx dt \\
 & + \int_0^L \int_0^T \frac{\partial \psi(x, t)}{\partial t} \delta \chi(x, t) dx dt - \int_0^L \psi(x, T) \delta \chi(x, T) dx \\
 & + \int_0^L \psi(x, 0) \delta \chi(x, 0) dx
 \end{aligned} \tag{6}$$

with the help of equations (2) and (3). By assuming  $\delta J$  to vanish for any  $\delta \chi_x(L, t)$ ,  $\delta \chi(x, t)$ ,  $\delta \chi(0, t)$ ,  $\delta \chi(x, T)$ ,  $\delta Q(t)$ ,  $\delta u(t)$  and taking  $\delta \chi(x, 0)$ ,  $\delta \chi(L, t)$  both equal to zero, a system of auxiliary function  $\psi(x, t)$  is obtained as,

$$\frac{\partial \psi}{\partial t} + \frac{k}{\rho c} \frac{\partial^2 \psi}{\partial x^2} = \frac{\omega}{\rho c} \psi. \tag{7}$$

$$k \frac{\partial \psi}{\partial x} = h \psi \quad \text{on } x=0 \tag{8}$$

$$\psi(x, t) = 0 \quad \text{on } x=L$$

$$\psi(x, T) = \{ \chi^* - \chi(x, T) \} \delta(x - x_1) \tag{9}$$

and the optimal values of the controls  $Q(t)$  and  $u(t)$  stand,

$$\begin{aligned}
 Q(t) &= \text{Sign} \frac{1}{\rho c} \int_0^L \psi(x, t) dx \\
 u(t) &= \text{Sign} \psi(0, t),
 \end{aligned} \tag{10}$$

Here the conjugate gradient method with the aid of calculus of variation has been used (Butkovasky 1969, Loulou 2002). Considering  $\chi_1(x, t) = \chi(x, t) - \chi_a$  and expressing  $\chi_1(x, t)$  in Finite Sine Transform, given by,

$$\bar{\chi}_{1n}(t) = \int_0^L \chi_1(x, t) \sin p_n(L - x) dx \tag{11}$$

and

$$\chi_1(x, t) = \sum_{n=1}^{\infty} \bar{\chi}_{1n}(t) \times \frac{2 \sin p_n(L - x)}{L - \frac{\sin 2 p_n L}{2 p_n}} \tag{12}$$

where  $p_n$  are positive, real roots of the equation,

$$p \cot(pL) = \frac{-h}{k} \tag{13}$$

the equation (1) with the help of equations (2), (3) and (13) stands,

$$\frac{d}{dt} \bar{\chi}_{1n}(t) + \alpha_{1n} \bar{\chi}_{1n}(t) = \alpha_{3n} Q(t) + \alpha_{4n} + \alpha_{5n}; \quad n = 1, 2, 3, \dots \quad (14)$$

where,

$$\begin{aligned} \alpha_{1n} &= \frac{1}{\rho c} \{k p_n^2 + \omega\}, \\ \alpha_{4n} &= \frac{h}{\rho c} \{u(t) - \chi_a\} \sin p_n L, \\ \alpha_{3n} &= \frac{1}{\rho c} \left( \frac{1 - \cos p_n L}{p_n} \right) \\ \alpha_{5n} &= \frac{1}{\rho c} \left( \frac{1 - \cos p_n L}{p_n} \right) Q_m \end{aligned} \quad (15)$$

Finally we get,

$$\chi(x, t) = \chi_a + \sum_{n=1}^{\infty} \bar{\chi}_{1n}(t) \times R_n(x) \quad (16)$$

The solution of equation (14) with the help of equation (15) stands,

$$\begin{aligned} \bar{\chi}_{1n}(t) &= [(\chi_o - \chi_a) \left( \frac{1 - \cos p_n L}{p_n} \right) + \frac{h}{\rho c} \sin p_n L \int_0^t \{u(\xi) - \chi_a\} e^{\alpha_{1n} \xi} d\xi \\ &+ \left( \frac{1 - \cos p_n L}{p_n} \right) \frac{1}{\rho c} Q_m \int_0^t e^{\alpha_{1n} \xi} d\xi \\ &+ \frac{(1 - \cos p_n L)}{p_n} \frac{1}{\rho c} \int_0^t Q(\xi) e^{\alpha_{1n} \xi} d\xi] \times e^{-\alpha_{1n} t}; \quad n = 1, 2, 3, \dots \end{aligned} \quad (17)$$

where

$$R_n(x) = \frac{2 \sin p_n (L - x)}{L - \frac{\sin 2 p_n L}{2 p_n}} \quad (18)$$

The corresponding solution of equation (7) with the help of equations (8) and (9) can be written as, with the help of earlier Finite Transform,

$$\psi(x, t) = \sum_{m=1}^{\infty} \bar{\psi}_m(t) R_m(x) \quad (19)$$

where

$$\bar{\psi}_m(t) = \{(\chi^* - \chi_a) - \sum_{n=1}^{\infty} \bar{\chi}_{1n}(T) \times R_n(x_1)\} \sin p_m (L - x_1) \times e^{-\alpha_{1m}(T-t)} \quad (20)$$

for  $p_m$  are roots of the equation (13).

Considering  $u(t)$  as constant, the value of optimal control  $Q(t)$  can be obtained from equation (10) with the help of equations (17), (18), (19) and (20).

Here we have assumed that the time dependent  $Q(t)$  ( $Wm^{-3}$ ) is only controllable input variable which is piecewise

constant function of time that changes value at certain specified discrete instants considered as switching times (Wagter, 1986).

For the sake of simplicity we consider only one specified switching time  $t = t_1$ . Thus, according to equation (10) one can write

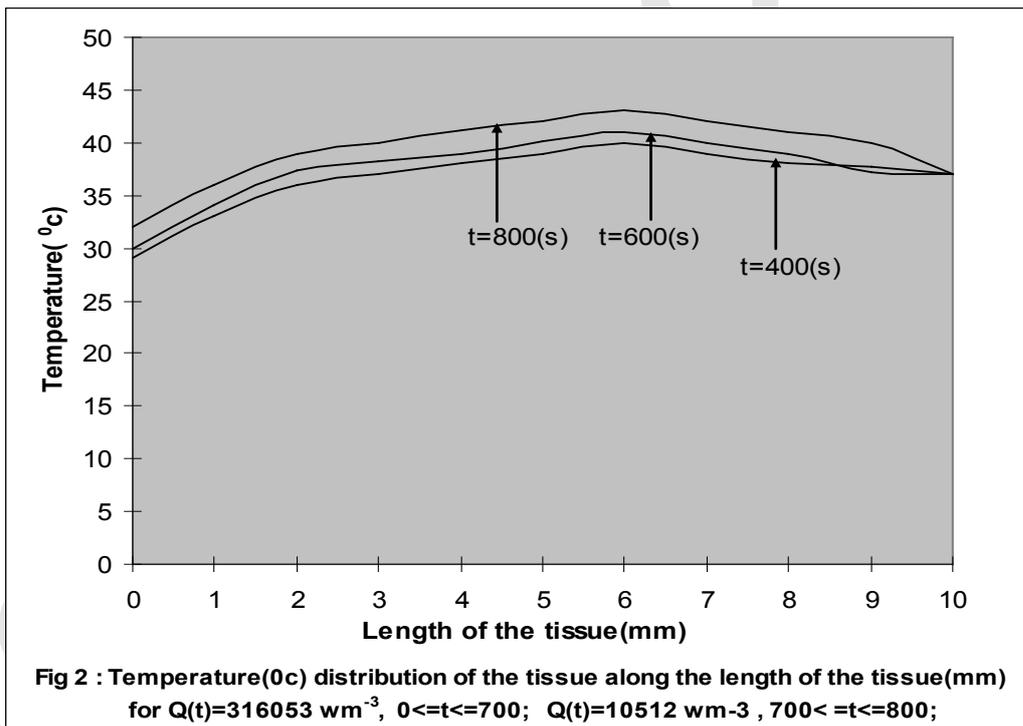
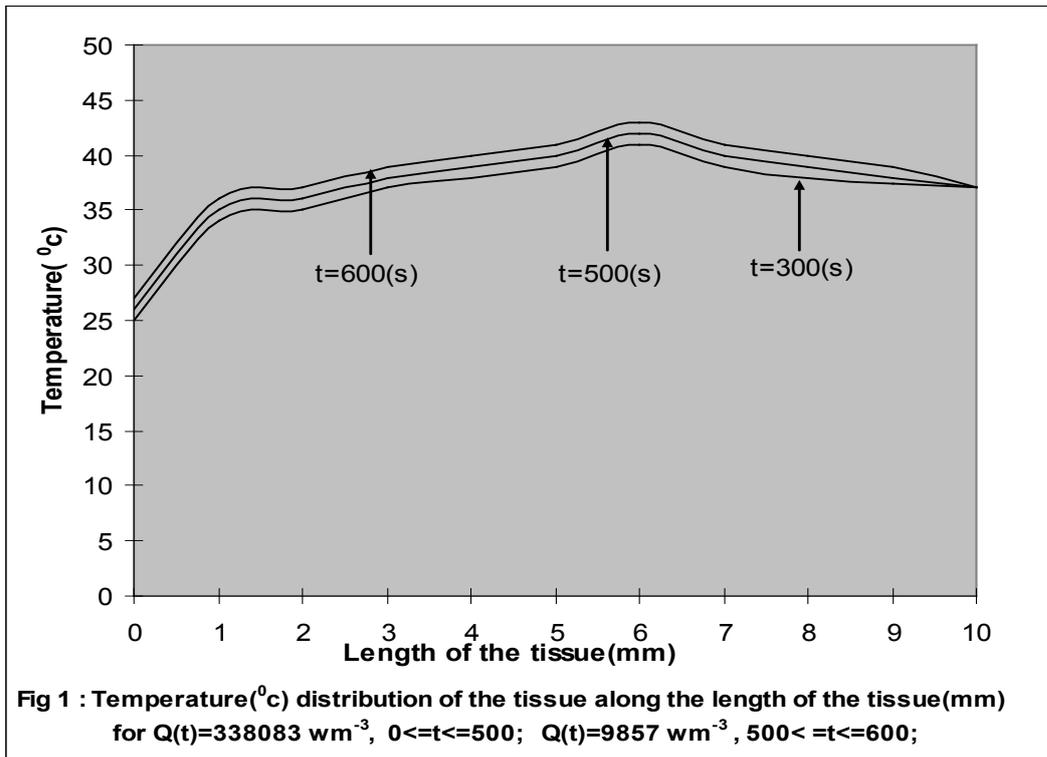
$$Q(t_1) = \int_0^L \psi(x, t_1) dx = 0 \quad (21)$$

where  $Q(t)$  assumes two extreme values in  $(0, t_1)$  and  $(T, t_1)$ , as one considers  $Q(t)$  a singular control, which can be obtained with the help of equations (16) - (21) by means of simulation.

## Results and Discussions

Data used in computation are given as follows :

|          |   |   |
|----------|---|---|
| $c$      | = | $3770 \text{ J kg}^{-1} \text{ } ^\circ\text{C}^{-1}$ |
| $\rho$   | = | $998 \text{ kgm}^{-3}$                                |
| $k$      | = | $.5 \text{ Wm}^{-1} \text{ } ^\circ\text{C}^{-1}$     |
| $h$      | = | $6 \text{ Wm}^{-2} \text{ } ^\circ\text{C}^{-1}$      |
| $\chi_a$ | = | $37^\circ\text{C}$                                    |
| $\chi^*$ | = | $43^\circ\text{C}$                                    |
| $L$      | = | $.01 \text{ m,}$                                      |
| $x_1$    | = | $.006\text{m}$  |
| $\omega$ | = | $3000 \text{ Wm}^{-3} \text{ } ^\circ\text{C}^{-1}$   |
| $Q_m$    | = | $33800 \text{ Wm}^{-3}$                               |
| $\chi_0$ | = | $25^\circ\text{C}$                                    |
| $T$      | = | $600\text{s, } 800\text{s, } 1000\text{s}$            |
| $u(t)$   | = | $20^\circ\text{C}$                                    |



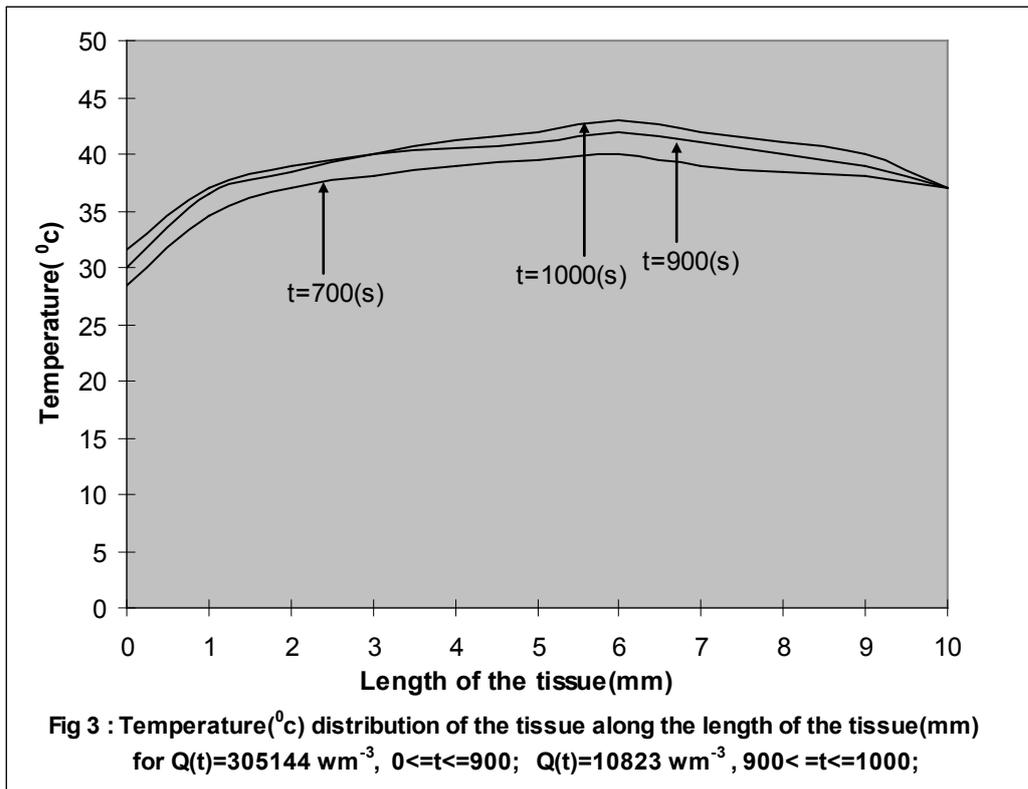


Fig 1 displays the temperature of the tissue along the length of the tissue for  $Q(t) = 338083 \text{ Wm}^{-3}$ ,  $0 \leq t \leq 500$ ;  $Q(t) = 9857 \text{ Wm}^{-3}$ ,  $500 \leq t \leq 600$ . Fig 2 depicts the temperature of the tissue along the length of the tissue subject to  $Q(t) = 316053 \text{ Wm}^{-3}$ ,  $0 \leq t \leq 700$ ;  $Q(t) = 10512 \text{ Wm}^{-3}$ ,  $700 \leq t \leq 800$ . In Fig 3 the temperature of the tissue along its length due to the application of optimal volumetric heat generation rate  $Q(t) = 305144 \text{ Wm}^{-3}$ ,  $0 \leq t \leq 900$ ;  $Q(t) = 10823$ ,  $900 \leq t \leq 1000$ . It is observed that desired temperature  $43^{\circ}\text{C}$  at the particular tumour point  $x_1 = .006\text{m}$  is attained at the end of operation of the process  $T = 600\text{s}$ ,  $800\text{s}$  and  $1000\text{s}$  in Fig 1, Fig 2 and Fig 3 respectively.

Further it requires mentioning that as the total time of operation of the process increases from  $T = 600\text{s}$  to  $1000\text{s}$ , the switching time increases with the decrease of  $Q(t)$  in the first time segment of operation and corresponding increase of  $Q(t)$  in the second time segment of operation. Again the temperature of the tissue on left side of the tumour steadily increases and attains the desired temperature  $43^{\circ}\text{C}$  on the point of tumour at the end of the process. On the right side of the tumour, the temperature rapidly decreases to arterial temperature  $37^{\circ}\text{C}$  till the end of the process as we consider the cases at  $T = 600\text{s}$ ,  $T = 800\text{s}$  and  $T = 1000\text{s}$  displayed in Fig 1, Fig 2 and Fig 3 respectively. Thus the temperature of the healthy tissue is not been overheated above  $43^{\circ}\text{C}$ .

## Conclusion

This analytical study may be extended for further developments considering different times of operation and also different locations of the tumour having various lengths of the tissue.

It is to note that in the paper [Dhar and Dhar, 2010] the desired tumour temperature is attained within the total time of the operation of the process (switching time  $t_1$  (say)). Here, the microwave is switched off during the second time segment ( $t_1, T$ ). But, in this paper the desired temperature of the tumour is attained at the end of operation of the process at time  $T$ . In this case the microwave is not switched off but its intensity is substantially reduced in the second time segment ( $t_1, T$ ).

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# ANALYSIS OF TRIBOLOGICAL DEFECTS OF CONTACT ELEMENTS OUTER LAYERS

Stanisław Pytko<sup>1</sup>, Marek Iwaniec<sup>2</sup>

<sup>2</sup>AGH University of Science and Technology, Faculty of Mechanical Engineering and Robotics, Department of Power Systems and Environmental Protection Facilities, Mickiewicz Alley 30, 30-059 Kraków

<sup>1</sup>s\_pytko@agh.edu.pl, <sup>2</sup>iwaniec@agh.edu.pl

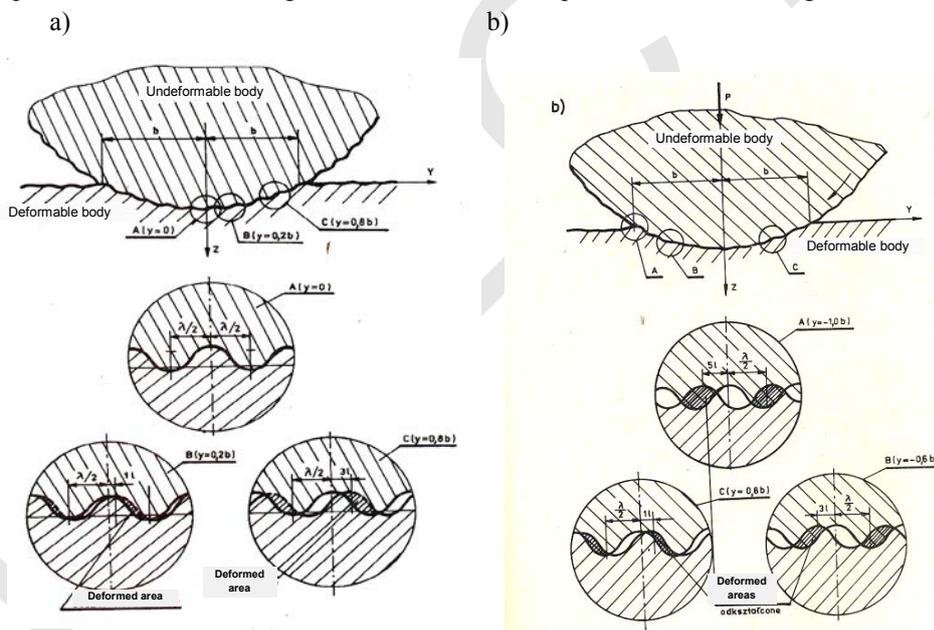
**Abstract:** In the paper, on the examples of damages of the outer layers of rolling bearing elements, gears and bio-mechanical systems there are presented the issues of interactions between contact elements and tribological defects of their outer layers. Rolling bearings and gears are machine elements for which specific friction conditions are observed.

In order to present characteristic defects of contact elements, the authors discussed defects of rolling bearings elements and working surface of the gear teeth with coatings made with the application of the PVD method, lubricated by different oil types. As an example of the biomechanical problem there is presented the model of non linear interactions between stomatological implant and food being chewed and spatial state of stresses and strains in the implant crown.

**Key words:**

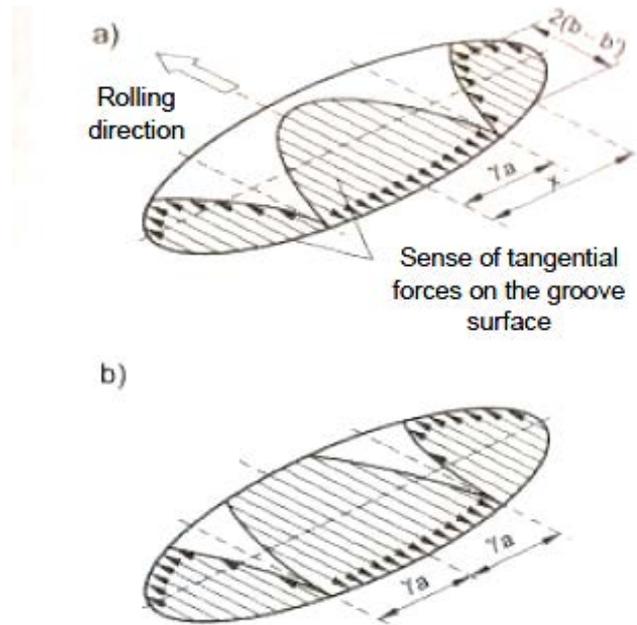
## Deformation in the contact point of the rolling elements and formation of pitting

In fact, the pure rolling of elements does not exist and this is because elastic steel elements deform during contact Fig.1. As a result, the microslips occur, as shown in Fig.1 a) and b). For better understanding of the issue, there were presented the surface irregularities of the roller for pure contact and rolling motion.



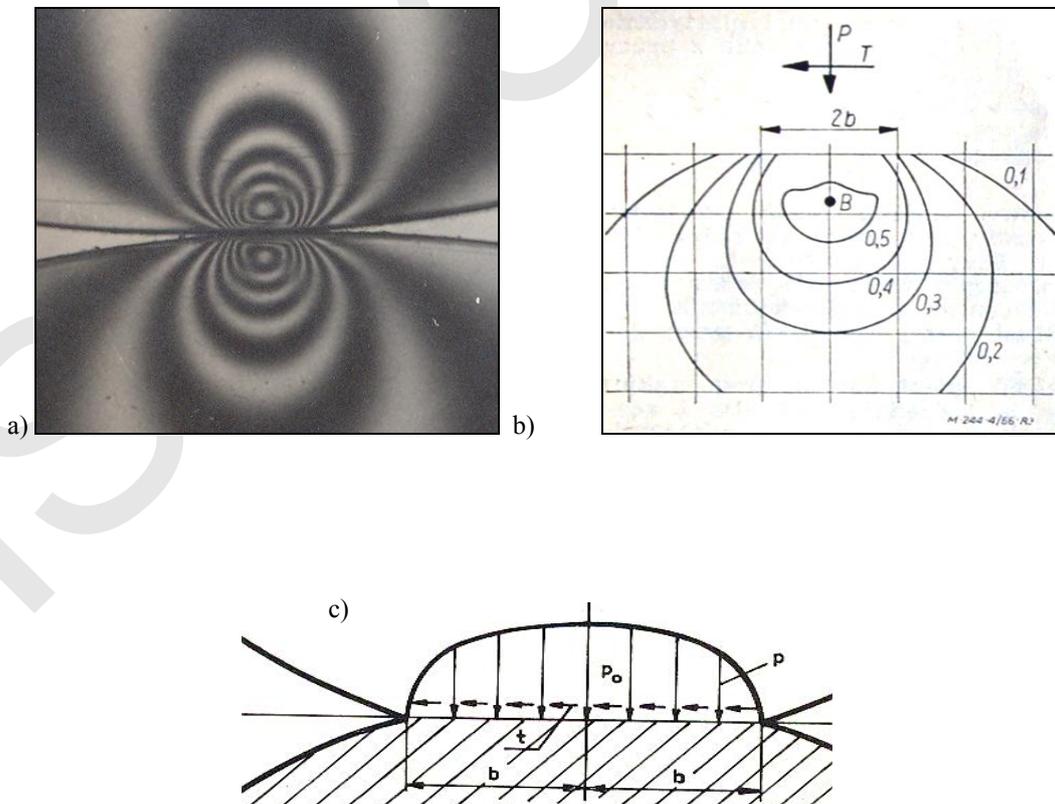
**Figure 1:** Displacement of the layers in the contact area of the cylinder with half-space a) only normal load, b) normal and tangential load

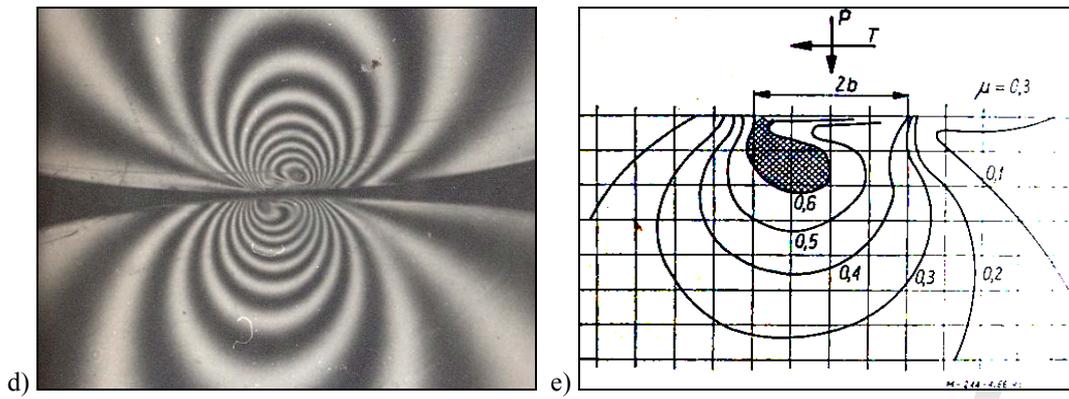
It follows from the Fig.1, showing the model of surface irregularities in contact point of cylinder with the half-space, that along with appearance of tangential force, the value of microslips in the contact point becomes larger, which increases friction wear of the surface layer of the rolling elements, when there is no good lubrication. This situation can occur in case of use of roller bearings but we deal with a completely different situation when a rolling element such as a ball rolls in the groove. In this case, the outer layers in the contact point moves, as shown in Fig.2.



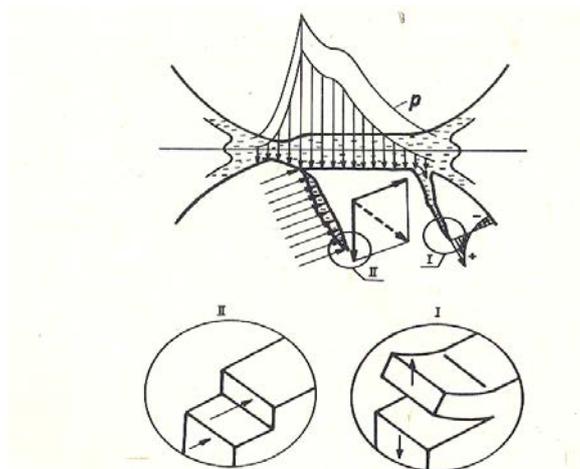
**Figure 2:** Directions of tangential forces of a ball rolling in the groove a) small value of Young's modulus, high coefficient of friction b) large value of Young's modulus and low coefficient of friction

In order to reduce abrasive wear, in certain bearings the surfaces are covered by the hard diamond and graphite nanometer-thick layers. If rolling of an element such as rolling of a ball along the ring lasts a very long time, the outer layer will not only be subjected to abrasive wear, as shown in Fig.1 and Fig.2, but also in the areas of the maximal effort, Fig.3, or in areas of various defects in material the cracks will appear, which spreading will reach the surface and at the time of applying the load, the oil or grease will be pressed into those cracks. The oil, which had earlier a positive impact, now is creating splinters in the material surface and, consequently, the process called "pitting" is taking place, as shown in Fig.4.





**Figure 3:** Isochrones with the area of the maximal effort in contact point of the cylinder-shaped elements: a) and b) when a tangential force  $T = 0$  occurs in the contact point, when  $T \geq 0$  as in c) then the isochrone pattern and the area of a maximal effort looks as shown in d) and e)

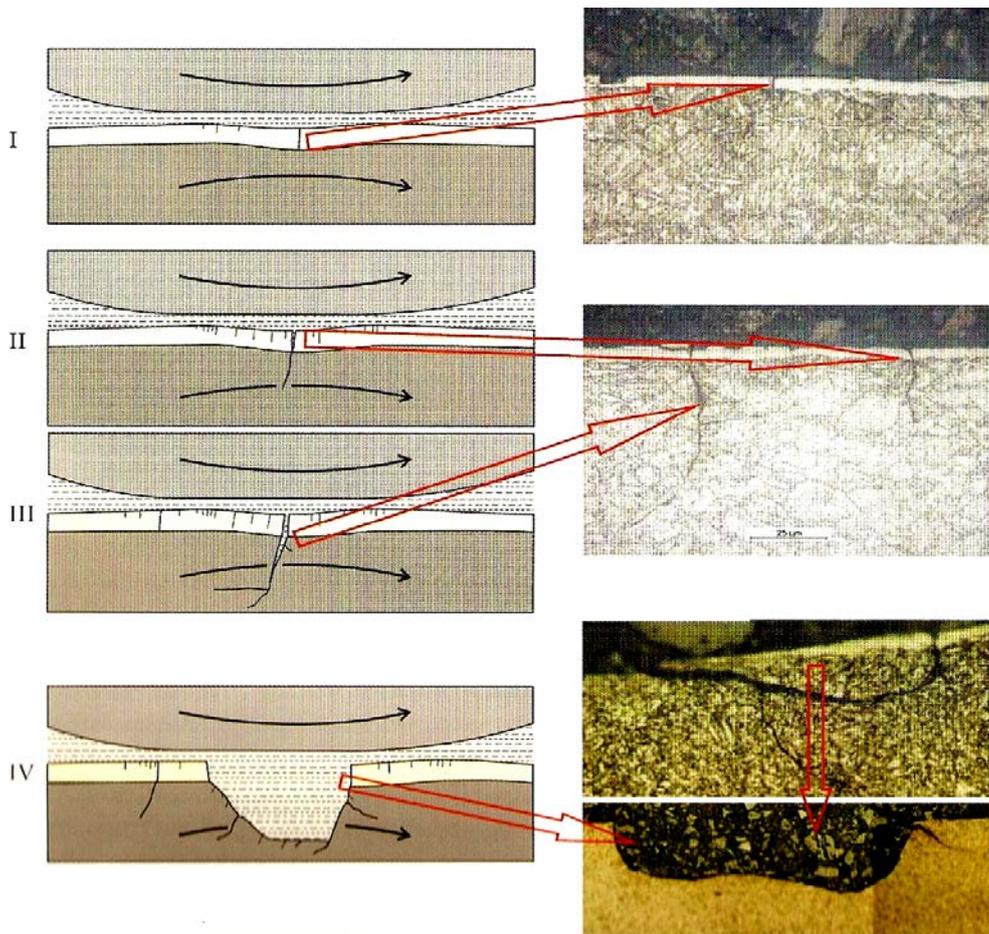


**Figure 4:** Schematic representation of crack propagation (pitting) caused by oil on the rolling element in the contact point

When the working surfaces of the gear teeth are covered with a layer obtained as a result of PVD process, the chipping process at the subsequent stages from I to IV, ie until pitting is illustrated in Fig.5 [12].

**Figure**  
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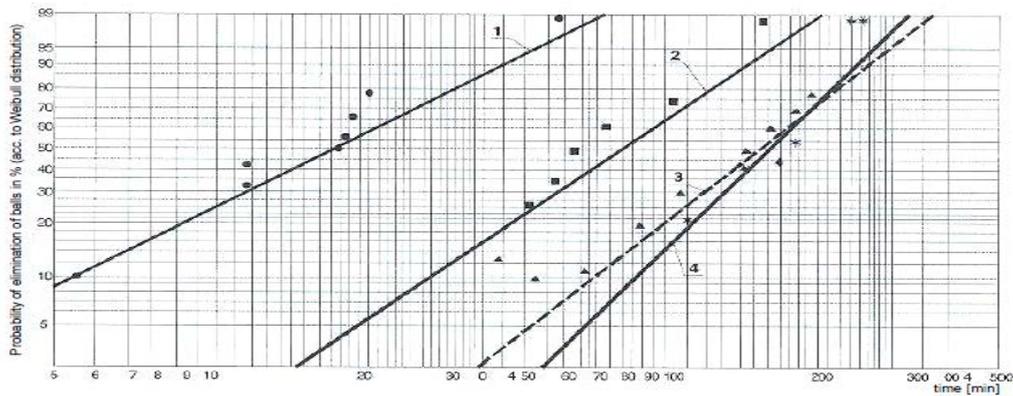
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modified four-ball tester T-02 with a testing node, as shown in Fig.6, designed to test not only the effects of lubricants but also applied coatings and construction materials on the fatigue wear (pitting).



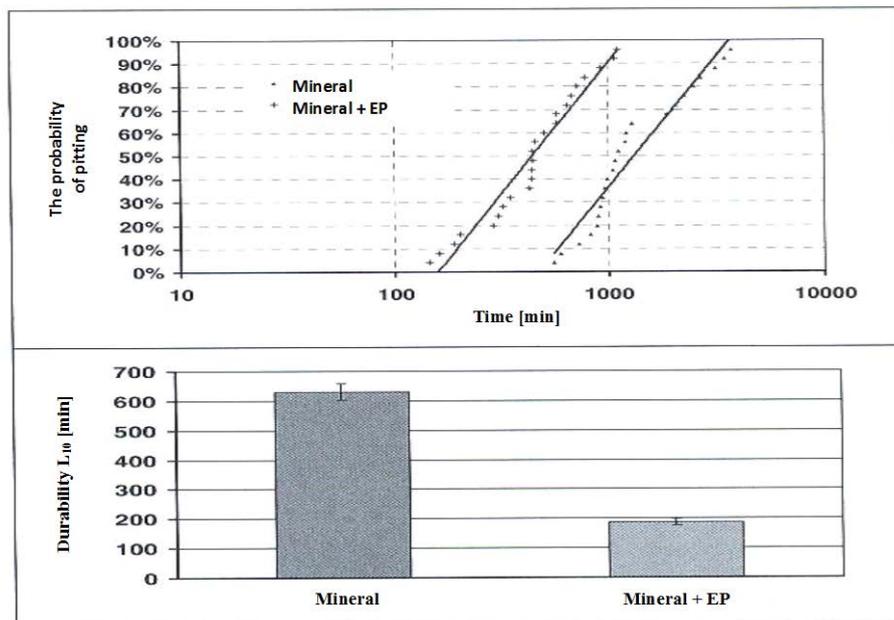
**Figure 6:** Node arrangement of a four-ball tester for testing pitting phenomena a) 1-upper ball, 2 - lower balls, 3 – a cup which allows for ball rolling, b) node photos [5,8]

A very important issue when choosing oil for bearings and gears is to use such EP oil additives (anti-seize additives for extreme pressures to obtain a very high seizure force) that they do not lead to the formation of pitting. It has been found that those EP additives have a significant impact on the formation of pitting. It was confirmed by the results obtained many years ago Fig.7 [2] and by current studies of Institute for Sustainable Technologies - National Research Institute in Radom Fig.8 [12]. The results of these studies indicate that the oils which showed a high seizing forces affect adversely the formation of "pitting". It means that the working time of elements to its formation is shorter, than for the oils without certain additives. According to our knowledge, we believe that they can affect such a condition, causing a change in surface energy. Such changes in surface energy due to the adsorption of chemical compounds is known in the literature as "Rebinder effect" [2].



**Figure 7:** Fatigue curves for four lubricants [2] (until appearance of pitting)

In Fig.7, durability lines of four-ball tester (with rotating bottom balls) were determined by Weibull distribution for different types of oil: 1-oil with glycol, 2-semi-fluid grease, 3-hypoid gear oil, 4-oil for 2-stroke engines.



**Fig.8** The results of pitting described in [15]

Analyzing the results shown in Fig.7 it can be concluded that the best oil of the studied ones, taking into account the "pitting" as a result of the defects, was oil No.4 – without EP additives. Durability of 90% of balls, indicated by the symbol L10, is the time until the chipping appears on the upper ball on the rolling path, when the lubricant agent was: 1 – 5,7 min, 2 – 31,0 min, 3 – 67,7 min, 4 – 87,0 minutes. Similar test results were obtained by W. Piekoszewski in recent years, which were shown in Fig. 8.

### Interpretation of Rebinder effect to explain the pitting

To explain the "Rebinder effect", we consider, what is the relationship between the metal strength and the "surface tension" and "surface energy". As a surface energy we consider the material strength during its tearing, and the surface tension we usually associate with soap bubbles and water column in very thin tubes - capillaries. How, then, can these two properties of metals be associated with each other? It was found that the nature of these two phenomena is very similar. This is a manifestation of the binding forces between atoms or molecules.

The surface tension was clarified in an interesting way by E.M. Rogers [12], who explained how liquids reach their shape on the surface of a solid, ie, how to determine the contact angle (wetting angle) and on what it depends. It turns out that this angle is dependent on the surface tension of the two bodies. Fig.9 shows the shape of a drop of liquid spilled on the plate. As shown in this figure, the adjacent liquid particles pull the extreme particle "C" with a force  $F_1$  along the bisector by the edge. On the other hand, the table attracts extreme particle "C" with a force  $F_2$ , which is perpendicular to the table. The resultant  $R$  of these two forces is directed as shown in Fig.9a. Since the liquid particles attract the liquid particle "C" less than a table, so a small contact angle  $\alpha$  is being formed. It can therefore be simply said

that the table enable liquid to be spilled on it, so wetting is effected with ease. This phenomenon is important in the lubrication technology. However, if the particle "C" is attracted stronger to the liquid particles - Rogers wrote "the countrymen like it more", then the force  $F_1$  is greater than the force  $F_2$  coming from the board particles. Then the contact angle changes completely, which is shown in Fig.9b (left side of the figure). Wettability is then poor. Therefore, in many cases the fibers and materials are covered with impregnating material, so that the force  $F_2$  were small in comparison to  $F_1$ .

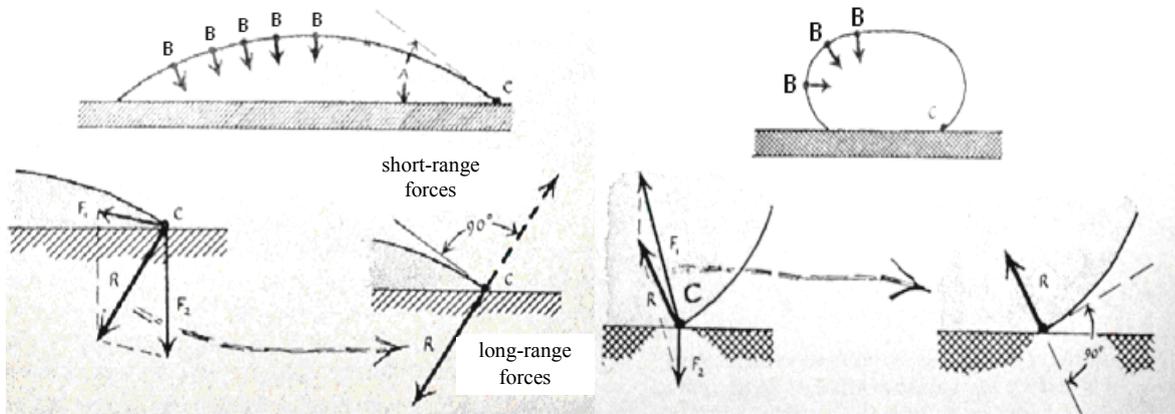


Figure 9: The shape of a drop of liquid of small contact angle  $\alpha$ .

The strength and surface tension (surface energy) are the physical properties, which characterize both solids and liquids. In solids the forces of attraction between atoms ensure adequate metal strength and resistance by the shape change. However, the surface tension is characterized by the tendency to reduction of free surface. For example, a drop of liquid with low viscosity takes with ease the spherical shape, in order to achieve the smallest area for a given volume. For a body with the crystal lattice, for the calculation of the strength  $P$ , ie a force to break an element with cross-section  $1 \text{ cm}^2$ , the value of cohesive forces "f" between adjacent atoms must be multiplied by the number of bonds. So this can be written down in following way:

$$P = fn_1$$

In our case,  $P = 2 \cdot 10^{11} [\text{dyn/cm}^2] = 19,6 \cdot 10^3 [\text{N/mm}^2]$

The strength of real (not perfect crystals) materials is hundreds and often thousands times smaller. The reason for this is an imperfection of real structure of the solid and the presence of various defects in it. These are micro- and ultra-micro-cracks, giving rise to stress concentrations. These cracks appear, inter alia, in areas of the inclusions after repeated load of a solid, for example before "pitting" and through the uneven load of crystal structure and resulting slips give rise to internal stresses.

Therefore, we can say the following:

- strength of the material is equivalent to the atomic bond in macroscopic scale,
- surface tension corresponds, in turn, the macroscopic features of microscopic value of parameter "f", described above.

It must be remembered that the "Rebinder effect" is based on the adsorptive strength reduction, ie a process facilitating deformation and fracture of solids as a result of reducing the surface energy of the body, conditioned by the physical and chemical impact of environment. A nature of adsorptive impact matters, if it takes place simultaneously with tearing of bonds at the time of their formation, ie "in statu nascendi".

## Other forms of damage to bearings and the ways to prevent them

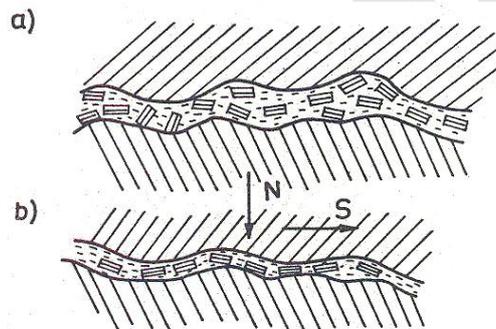
In many cases, especially in the bearings of different drives there is a current flow through bearings supporting the shaft. The root cause of this phenomenon is the asymmetry of the magnetic flux in the motor or it arises as a result of not shielded wires. What are the signs of damage to the bearings in the case of current flow? A tension created at

the boundary between elements and lubricant creates a chemical cell and the resulting sparks cause an increase in temperature in areas of a flow, change the properties of the steel so that initially tiny cavities are being formed (kind of pitting) and the peaceful nature of bearing operation is changing. In order to prevent current flow, a special rolling bearings with ceramic coating on the surface of outer rings, isolating current flow, are manufactured.

### The concept of lubrication with plastic grease

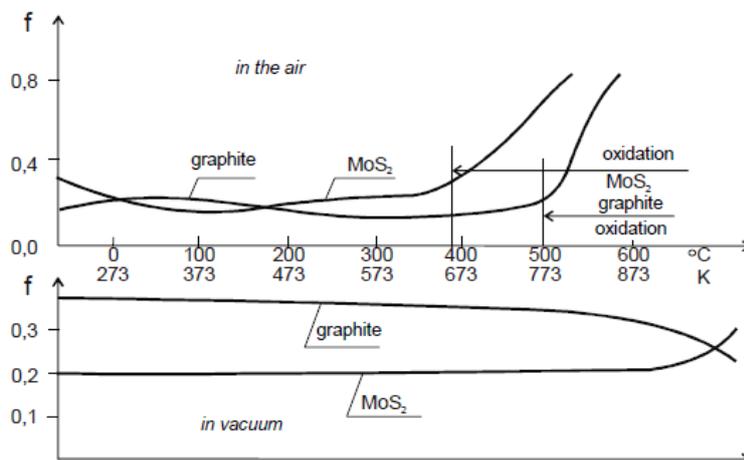
Very often, the elements of the machine are lubricated with plastic grease having graphite or molybdenum disulfide additives. Then, the lubricating layer can be illustrated as shown in Fig.10. It is also known that in the case of lubricating with plastic grease, production of a thick lubricant layer is more difficult than in the case of lubricating with oil. Thus, in many cases, we add lubricants such as graphite, which serves as a thickener, regardless of the base on which they are built. The added crystal elements or compounds, such as graphite (C), molybdenum disulfide ( $\text{MoS}_2$ ) or, less frequently, tungsten, form a buffer layer preventing the seizure of machine parts. Also, in conditions of high pressure and low rubbing velocities between the components of machines, these crystalline compounds or elements, are being placed on the roughened surface of the elements and form a layer of small  $\sigma t$  value, which reduces the coefficient of friction  $\mu$ .

Molybdenum disulfide as a lubricant was widely implemented and tested in the 60-ies of XX century. Due to its structure, it has a property similar to the graphite, which forms a layer of low  $\sigma t$  value on the surface of the lubricated elements and thereby reduces the coefficient of friction  $\mu$ .



**Figure 10:** Layers of lubricant with additives of crystals: a) with a sufficient lubricating layer, b) with a boundary lubricant layer [3]

It must be remembered, however, that the mentioned additives, have their limitations in the application depending on the temperature, as shown on charts, Fig. 11.



**Figure11:** Charts of friction coefficient ( $f=\mu$ ) depending on the temperature for graphite and molybdenum disulfide [3]

After exceeding certain temperature values, the additives lose their properties, reducing the value of friction coefficient and sometimes increasing it.

## FEM method application to modelling of bone degeneration in the contact bone - hip prosthesis

In order to model the mechanism of contact of elements and the origin of pathological changes taking place in the bone tissue after endoprosthesis implantation a simple mechanical model was selected. The model is based on the research that has been carried out by Huiskes [1] and mechanical part of the mechano-control model proposed by Prendergast [14]. In the Fig. 12 there is presented the Prendergast's algorithm.

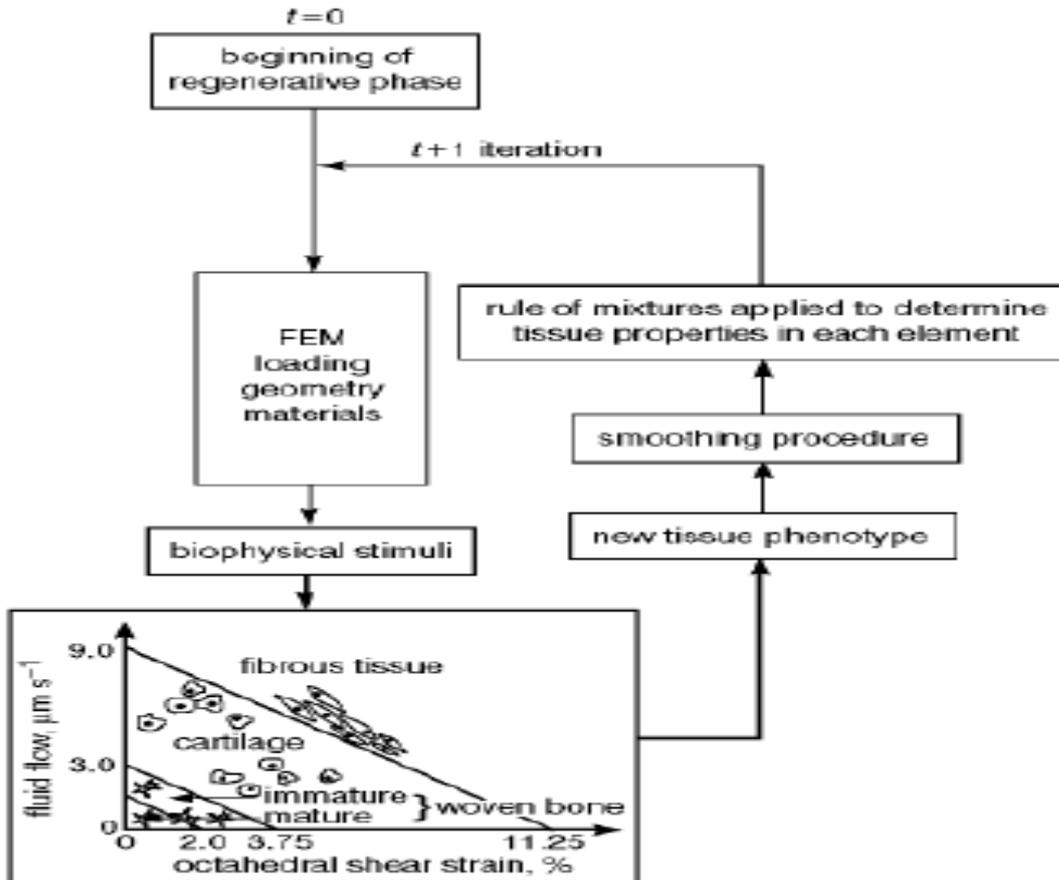


Figure 12: The sequential mechanical-control Prendergast's algorithm [14]

The FEM model of the Moor hip prosthesis (Fig. 13) surrounded by bone has been built. Having applied the Powell's models of forces, the HMH hypothesis was used to estimate the changes in stress distribution in progressive steps of Prendergast's algorithm (Fig. 12).

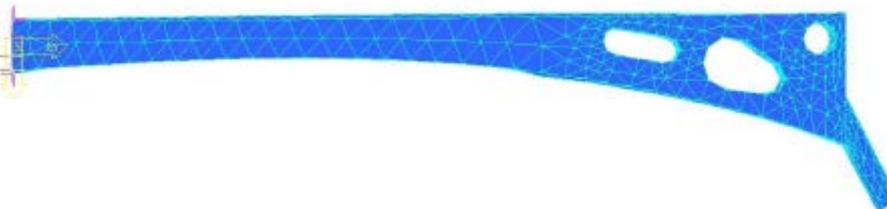
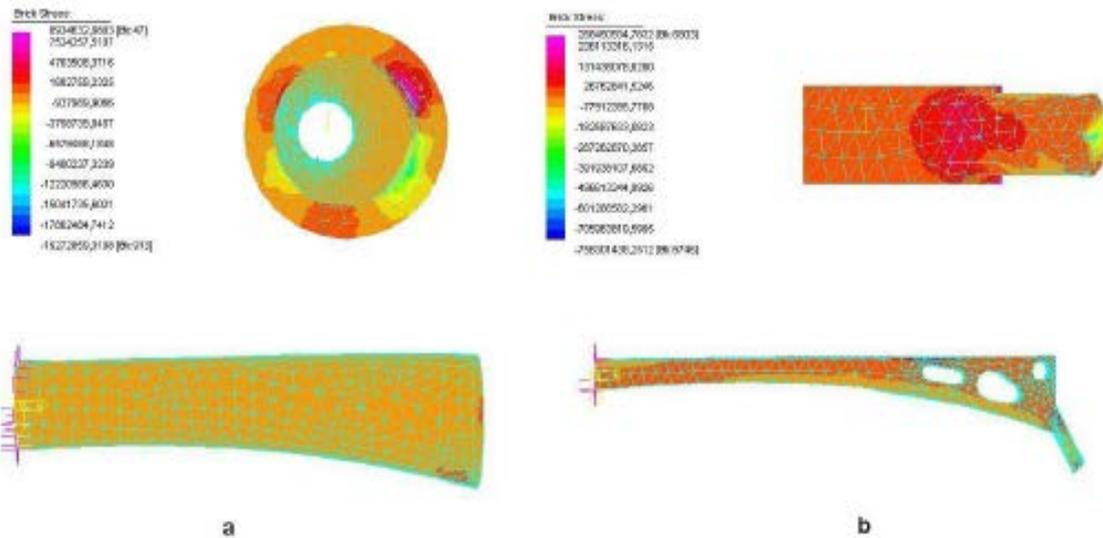
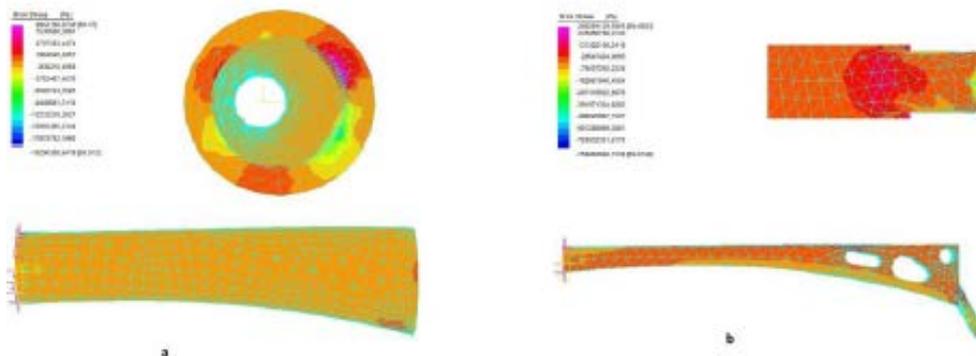


Figure 13: FEM model of Moore's hip endoprosthesis

The results of carried out research are presented in Fig.14 - 15. The bone tissue desorption effects only the stress distribution in the contact zone. The most important factor that influences the long-term success of implantation is the proper stress distribution in the thin bone layer, regardless of whether we are dealing with an intermediate layer of bone cement or cementless connection. The presence of hip endoprosthesis in the organism results in the change of mechanical signals to which the bone tissue surrounding the implant is subjected. As the result dynamic balance can be disturbed and undesirable weakening of tissue can take place.



**Figure 14: Stress distribution a) in the femur b) in the homogenous pivot of Moor's hip endoprosthesis.**



**Figure 15: Stress distribution after sequential launching of mechanical-control Prendergast's algorithm. a) in the bone tissue b) in the endoprosthesis pivot.**

The most important factors influencing the long-term success of implantation are the phenomena of local bone resorption such as the risk of endoprosthesis slack or complications taking place in case of the necessity of reoperation of endoprosthesis implantation. Decrease in the density and, what follows, decrease in bone tissue strength, results in the risk of fracture and damage in case of limb overload.

## Conclusions

In the paper the most important tribology phenomena between contacting elements were shown. Deformation in the Hertz's contact zone of the rolling elements and micro-slips in the contact points, which increase friction wear of the surface layer of the rolling elements were considered as a first stage of abrasive wear causing crack initiation and its further propagation (pitting) being intensified by oil on the rolling element in the contact points. The results of the oil impact on pitting phenomena were obtained on the modified four-ball tester and presented as fatigue curves of typical lubricants. The very different contact phenomena observed in biomechanical systems are presented on the example of bone degradation in the contact with hip prosthesis pivot. The FEM method was used for the purposes of modelling of stress state in the contact zone of bone - hip prosthesis. The sequential Prendergast's algorithm was applied to calculate the long-time changes in bone density and Young modulus resulting in the local bone desorption.

## Acknowledgements

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# ANALYSIS OF VEGETATION ASSEMBLAGE IN THE SALTED PLAIN OF THE LOWER CHELIF, ALGERIA

A. Ababou<sup>1</sup>, M. Chouieb<sup>2</sup>, A. Bouthiba<sup>3</sup>, D. Saidi<sup>4</sup>, M. M'hamed Bouzina<sup>3</sup>, and K. Mederbal<sup>5</sup>

<sup>1</sup>Department of Biology, Faculty of Sciences, University Hassiba Ben Bouali, Chlef, Algeria.  
E-mail: ab\_adda@yahoo.fr

<sup>2</sup>Department of Agronomy, Faculty of Science and Engineering, University Abd El Hamid Ibn Badis, Mostaganem, Algeria.

<sup>3</sup>Department of Agronomy, Institute of Agronomical Sciences, University Hassiba Ben Bouali, Chlef, Algeria.

<sup>4</sup>Department of Biology, Faculty of Sciences, University Hassiba Ben Bouali, Chlef, Algeria.

<sup>3</sup>Department of Agronomy, Institute of Agronomical Sciences, University Hassiba Ben Bouali, Chlef, Algeria.

<sup>5</sup>Department of Biology, Faculty of Science and earth Sciences, University Mustapha Stambouli, Mascara, Algeria.

**Abstract:** In order to establish the relationships between the plants communities and environmental gradients that prevail in the arid plain of the lower Chelif, one of the largest salted alluvial plain in North Africa, we examined vegetation composition and the environmental variables, using 20 species sampled in 111 stands, followed by a direct gradient analysis. Classification of the vegetation using modified TWINSpan classification resulted in the recognition of four vegetation units, each of these four units with a definite floristic composition, highly significantly different according to ANOSIM test, was linked to a specific habitat. Multivariate analyses including detrended correspondence analysis (DCA) and correspondence analysis (CCA) showed that vegetation distribution pattern was mainly related to conductivity and soil structure. CCA axis 1 (45.7% of variance explained) was mainly positively correlated to conductivity, Na<sup>+</sup>, clay and Ca<sup>++</sup>, with an exclusive appearance of halophilous species characteristic of the extreme salinity conditions. While it was negatively correlated mainly with soil structure and pH, these conditions were accompanied by the highest plant diversity in the study area, with the appearance of two vegetation units, adding up 13 species belonging to 8 families. CCA axis 2 (20.1% of variance explained) was positively correlated with soil structure and Na<sup>+</sup>, while it is negatively correlated mainly with Ca<sup>++</sup>, with the occurrence of three species indicating the worst soil structure conditions.

**Keywords:** Anosim, Conductivity, Correspondence analysis, Twinspan, Vegetation units.

## Introduction

The vegetal association is a plant community, characterized by definite floristic and sociological features and grows in uniform habitat conditions (Flahault & Schroter, 1910). As defined by (Westhoff & van der Maarel, 1973), these plant communities are recognized by diagnostic species, with a distinct concentration in a particular vegetation unit (Chytry & Tichy, 2003). Their presence or abundance is considered to indicate certain site conditions. Indeed, vegetation presence or absence is controlled by environmental variables such as soil, topography, and climate (McDonald et al., 1996). Among these different environmental factors, soil is normally of great importance. Using vegetal species as bio-indicators can be the most important tool to assess soil conditions (Wang, 1995). Our study was carried out along the lower Chelif plain, one of the largest salted alluvial plains in North Africa, characterized by particular edaphic constraints, harsh climatic adversities, and suffering from serious soil degradation. The apparent structural simplicity of plant communities in this area provides an ideal model to study the relationship between edaphic factors and plant species. The main purpose of this research was to determine, the strongest edaphic factors affecting the occurrence of vegetal species, to extract the main vegetation units independently to the site conditions, and confront them to the edaphic factors characterizing the lower-Chelif. Understanding relationship between ecological variables and plant species in this harsh ecosystem helps us to apply these findings in management, reclamation, and development of similar regions.

## Material and methods

### Study area

Covering approximately 500 km<sup>2</sup> the lower-Chelif is one of the largest salted alluvial plains of north-western Algeria (Figure 1), it's about 35 km inland from the Mediterranean Sea, with an average altitude of 70 m. The plain is a syncline framed by salted marls hills (Mc Donald & B.N.E.D.E.R 1990). These geological characteristics, accentuated by an arid climate with an average annual temperature of 20° C, a dry period of 7 months, frequent droughts, and minimal precipitation (approximately 250 mm/yr), explain the high salinity conditions of the plain.

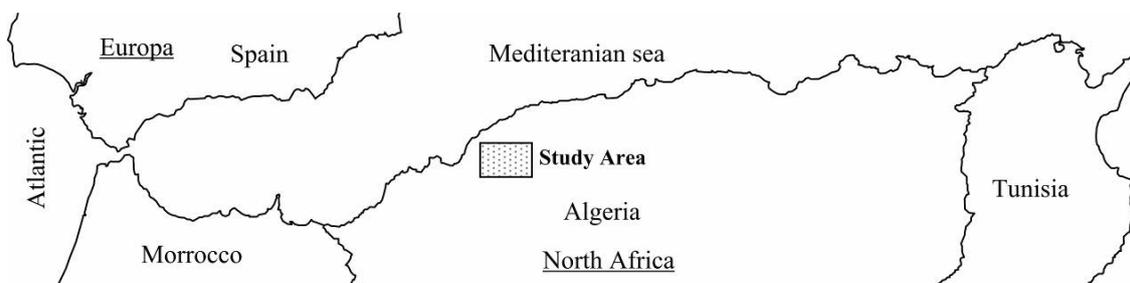


Figure 1. Location of the study area in northern Algeria.

### Soil and vegetation sampling

Phytosociological sampling was recorded during spring 2010 and 2011, by using the Braun-Blanquet seven degree scale (Van der Maarel, 1979). A total of 111 relevés were recorded adding up 30 species among which 10 rare species were excluded from analysis. For constrained ordination methods, a total of 111 soil samples were also collected, soil variables analysed were texture, soil structure (MWD), pH, electrical conductivity (ECe), calcium carbonate (CaCO<sub>3</sub>), Ca<sup>++</sup>, Cl<sup>-</sup>, and Na<sup>+</sup>. Each sampling unit location (latitude, longitude, and altitude) were recorded using a GPS receiver.

### Data analysis

To simplify the continuum of species composition present in the study area and to aid our understanding of species–environment relationships, relevés were classified into a few groups by modified two-way indicator species analysis (TWINSPAN) classification (Rolecek et al., 2009). Thus, by using this algorithm, homogenous groups are formed; the characteristic species of each group were identified by using the phi coefficient of association (Chytry et al., 2002). This coefficient is a statistical measure of association which can be used as a measure of fidelity. It is defined as:

$$\Phi = \frac{N \cdot n_p - n \cdot N_p}{\sqrt{n \cdot N_p \cdot (N - n) \cdot (N - N_p)}}$$

N = number of relevés in the data set; N<sub>p</sub> = number of relevés in the particular vegetation unit; n = number of occurrences of the species in the data set; n<sub>p</sub> = number of occurrences of the species in the particular vegetation unit.

To examine variation in vegetation assemblage structure among groups, we performed an ANOSIM (Legendre & Legendre, 1998) by using Bray-Curtis similarity. Finally, in order to establish the main links between environmental variables and vegetation, first, a co-linearity test showed a strong correlation coefficient between sands and silt, Na<sup>+</sup> and Cl<sup>-</sup>. Therefore, we chose to eliminate Cl<sup>-</sup> and silt. Then, the remaining variables were log-transformed. The most significant variables according to the individual preselection were, ECe, MWD, pH highly significant (P < 0.01), and clay significant (P < 0.05), the remaining variables (Na<sup>+</sup>, sand, CaCO<sub>3</sub>, Ca<sup>++</sup>) were not significant. In order to perform a direct gradient analysis, a detrended correspondence analysis (DCA) (Hill & Gauch, 1980) showed that the longest gradient was 5.78, thus, the best results are shown by canonical correspondence analysis CCA (ter Braak, 1986; Leps & Smilauer, 2003). However, CCA is useful technique strongly affected by double zeros (Zuur et al., 2007). In this case, according to reference (Legendre & Gallagher, 2001), the best option is to apply a special Chord (Orloci, 1967) or Hellinger (Rao, 1995) transformation.

## Results and discussion

### Classification of vegetation

The application of modified TWINSPAN classification on the 20 species enabled us to distinguish four vegetation units (Table 1, Figure 2). These groups were named according to their leading dominant species (those with the highest phi coefficient value) as follows: (A) *Spergularia marina*, (B) *Erodium cicutarium*, (C) *Melilotus officinalis*, and (D) *Bellis perennis*. Each of these four vegetation units could easily be linked to a habitat type.

Vegetation unit A: The 29 samples belonging to this community were characterized by the highest conductivity, Na<sup>+</sup>, Ca<sup>++</sup>, and clay, the lowest pH and relatively low soil structure. The phi coefficient classification showed that this vegetation unit was composed of four diagnostic species, belonging exclusively to Chenopodiaceae and Caryophyllaceae, characteristic of the extreme salinity conditions.

Vegetation unit B: In contrast to the previous vegetation unit, this group of 7 samples presented the best soil structure, the highest pH and sand percentage, the lowest conductivity, Ca<sup>++</sup>, and clay.

Vegetation unit C: This community included 41 samples moderately salty, with alkaline soil reaction, good soil structure, and the lowest Na<sup>+</sup> quantity. This vegetation unit includes the largest number of diagnostic species belonging to 5 different families (Fabaceae, Asteraceae, Bromeliaceae, Primulaceae, Plantaginaceae).

Vegetation unit D: This community was represented in 34 samples, characterized by the worst soil structure, the lowest CaCO<sub>3</sub> percentage, high clay percentage, high Na<sup>+</sup> quantity, and moderate salinity.

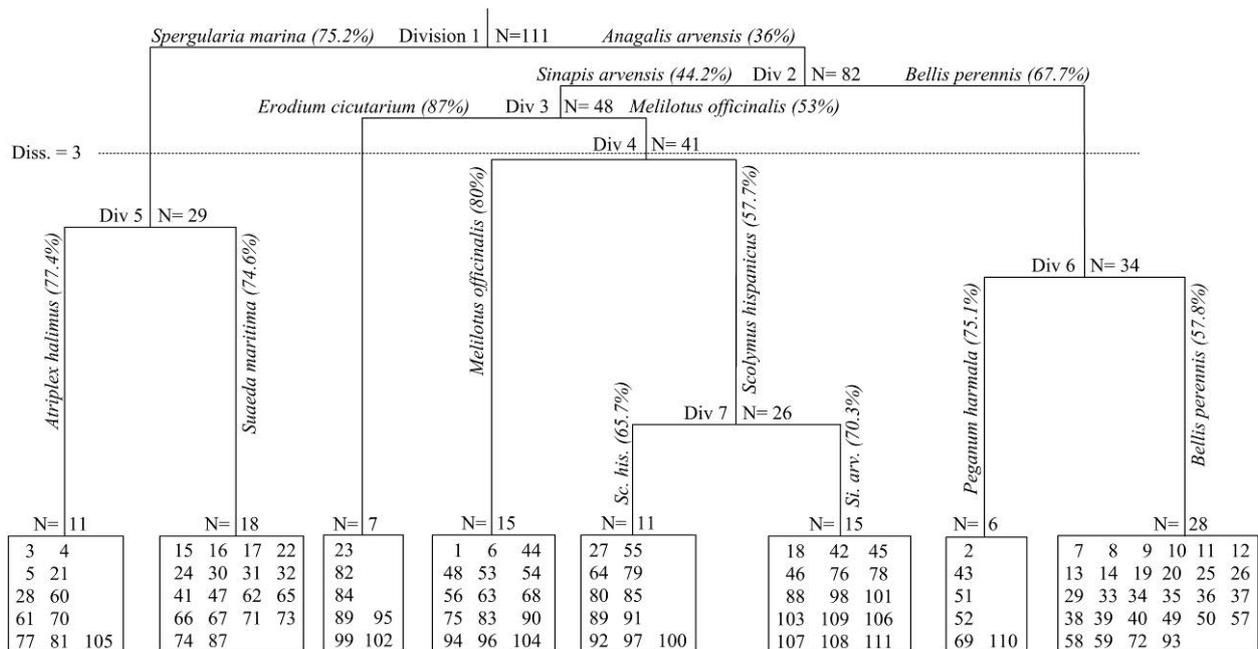


Figure 2. TWINSpan classification of 111 plots. N indicates the number of plots and the value between brackets represent the phi coefficient value in percent.

Table 1: Table of 111 relevés and 20 species, based on fidelity coefficient. Diagnostic species (\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ ) are those with significant  $\phi$  value according to Fisher's test.

| Vegetation unit A<br>(29 Relevés)   | Vegetation unit B<br>(7 Relevés)  | Vegetation unit C<br>(41 Relevés)  | Vegetation unit D<br>(34 Relevés)   |
|---|---|--|---|
| <i>Spargularia marina</i> (71.9***)<br><i>Suaeda maritima</i> (59.8***)<br><i>Atriplex halimus</i> (46.7***)<br><i>Arthrocnemum macrostachyum</i> (28.2*) | <i>Erodium cicutarium</i> (87***)<br><i>Onopordum acanthium</i> (75.1***)<br><i>Foeniculum vulgare</i> (42.1*)<br><i>Torilis nodosa</i> (33.1*)<br><i>Lolium multiflorum</i> (24.3*)<br><i>Cirsium vulgare</i> (17.1) | <i>Melilotus officinalis</i> (53***)<br><i>Scolymus hispanicus</i> (44.1***)<br><i>Sinapsis arvensis</i> (36.8***)<br><i>Calendula arvensis</i> (36.2***)<br><i>Anagallis arvensis</i> (33.3**)<br><i>Scorpiurus muricatus</i> (17.4)<br><i>Plantago lanceolata</i> (15.4) | <i>Bellis perennis</i> (70.5***)<br><i>Phalaris arundinacea</i> (51.4***)<br><i>Peganum harmala</i> (31*) |

Soil characteristics of each of the four vegetation units were analysed through ANOVA (Table 2). Results indicated that among all measured soil parameters, conductivity and pH showed highly significant differences between groups ( $P < 0.01$ ),  $\text{Na}^+$  and soil structure (MWD) showed significant differences ( $P < 0.05$ ), meaning that vegetation composition and distribution in the lower Chelif was highly related to conductivity, pH, soil structure, and  $\text{Na}^+$ .

Table 2 : Mean values with mean standard error and ANOVA F-values of the environmental variables in the sites representing the four groups obtained by TWINSpan.

|                  | Group A    | Group B   | Group C    | Group D     | F     | P      |
|------------------|------------|-----------|------------|-------------|-------|--------|
| ECe              | 16.5 ± 1.6 | 3.3 ± 1   | 6.5 ± 1.13 | 8.5 ± 0.94  | 14.57 | 0.0001 |
| pH               | 7.8 ± 0.03 | 8.1 ± 0.1 | 8.0 ± 0.05 | 7.9 ± 0.04  | 10.23 | 0.0001 |
| $\text{Na}^+$    | 4 ± 0.47   | 2.8 ± 0.6 | 2.8 ± 0.16 | 3.2 ± 0.27  | 3.07  | 0.03   |
| MWD              | 0.8 ± 0.04 | 1.0 ± 0.1 | 0.9 ± 0.05 | 0.8 ± 0.03  | 2.87  | 0.04   |
| $\text{CaCO}_3$  | 17.7 ± 0.5 | 19.1 ± 2  | 18.1 ± 0.5 | 16.6 ± 0.4  | 2.11  | 0.103  |
| $\text{Ca}^{++}$ | 0.5 ± 0.1  | 0.3 ± 0.1 | 0.4 ± 0.04 | 0.5 ± 0.04  | 1.88  | 0.137  |
| Clay             | 5.9 ± 0.5  | 4.7 ± 0.7 | 4.9 ± 0.33 | 5.7 ± 0.19  | 1.63  | 0.186  |
| Sand             | 23.5 ± 1.2 | 26.6 ± 3  | 25 ± 1.2   | 24.2 ± 0.86 | 0.56  | 0.642  |

### Similarity analysis

Similarity analysis test (ANOSIM) (Table 3) showed highly significant differences ( $P < 0.01$ ) in taxonomical composition between (A, B), (A, C), (B, C), (C, D), and significant differences ( $P < 0.05$ ) between (A, D) and (B, D), these significant differences indicate the total absence of overlap between vegetation assemblages. These results were supported by high significant R values, indicating that similarities between relevés within groups are higher than those

between relevés from different groups. Thus the result of similarity analysis (ANOSIM) showed clear differences in taxonomical composition among the different groups.

Table 3: Results of similarity analysis according to Bray-Curtis similarity with p-value (higher matrix) and R-value (lower matrix).

| Bray-Curtis similarity |   | P values (** p < 0.01; * p < 0.05) |         |         |         |
|------------------------|---|------------------------------------|---------|---------|---------|
|                        |   | A                                  | B       | C       | D       |
| R values               | A |                                    | 0.005** | 0.003** | 0.03*   |
|                        | B | 0.788                              |         | 0.005** | 0.01*   |
|                        | C | 0.859                              | 0.395   |         | 0.008** |
|                        | D | 0.694                              | 0.836   | 0.486   |         |

### Canonical correspondence Analysis

The marginal effects indicated that conductivity was the best explanatory variables, followed by soil structure,  $\text{Na}^+$ , pH,  $\text{Ca}^{++}$ , and clay, whereas  $\text{CaCO}_3$  and sand plays a secondary role. The variance of species occurrence data explained by each variable according to the partial CCA was in the following order:  $\text{ECe} = 5.3\%$ , soil structure = 3.3%, pH = 3.1%,  $\text{Na}^+ = 2.8\%$ , Clay = 2.3 %,  $\text{Ca}^{++} = 2.2\%$ ,  $\text{CaCO}_3 = 1.1\%$ , and Sand = 1%. This means that the distribution of vegetal species in the lower-Chelif plain is strongly correlated to conductivity, soil structure and pH.

The variance of species-environment relationship, explained by the first two canonical axes of the correspondence analysis was 65.8%. The first axis with 45.7% of variance explained, was mainly positively correlated to conductivity, and then to  $\text{Na}^+$ , clay, and  $\text{Ca}^{++}$ , with the occurrence of vegetation unit A composed exclusively of Chenopodiaceae and Caryophyllaceae, while it was negatively correlated mainly with pH and subsequently to soil structure, these conditions were accompanied with the highest plant diversity in the study area (Figure 3), with the appearance of vegetation units B and C. The second axis with 20.1% of variance explained was positively correlated with soil structure and  $\text{Na}^+$ , while it was negatively correlated mainly with  $\text{Ca}^{++}$ , with the occurrence of vegetation unit D, indicating the worst soil structure.

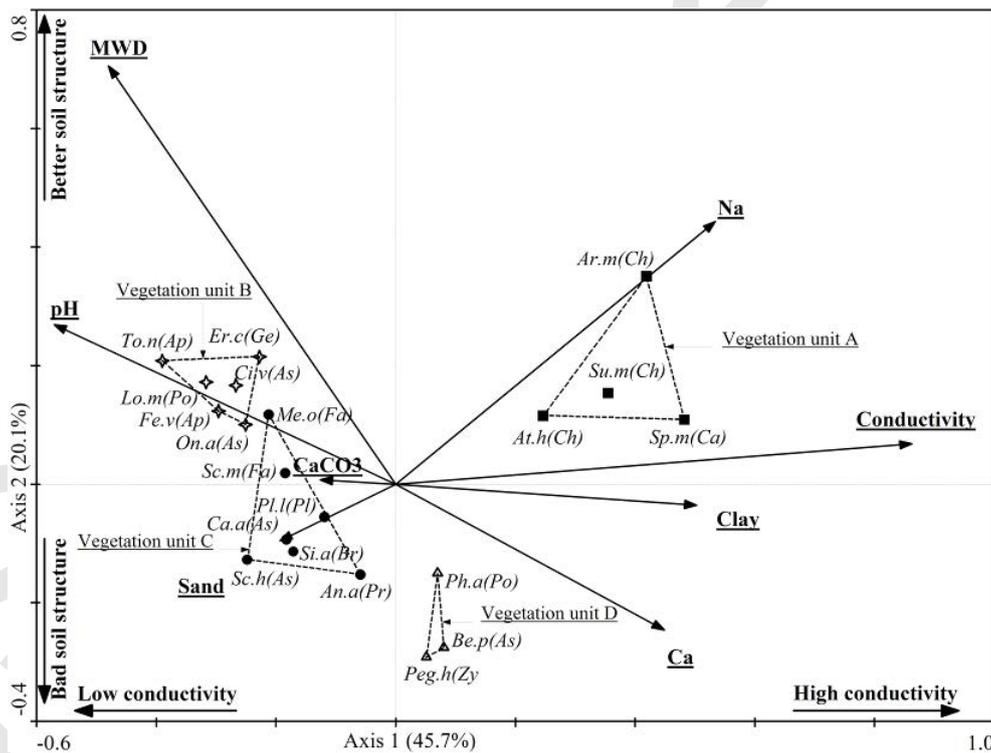


Figure 3. CCA biplot showing edaphic variables and vegetation units derived from TWINSpan.

### Predicting vegetation occurrence according to edaphic variables

A Gauss model (Jongman et al., 1995) was used to examine the relationships between the different vegetation units occurrence, and abiotic habitat variables, especially the most influencing variables. Electrical conductivity, pH,  $\text{Na}^+$ , and soil texture were all statistically significant predictors of species occurrence ( $P < 0.01$ ) according to chi-square approximation. Gauss results (Figure 4) showed that the optimum of vegetation unit A, with respect to electrical conductivity was greater than 35 mmhos. Vegetation unit B was highly sensitive to conductivity with an optimum of only 1 mmhos, whereas the occurrence of vegetation unit C and D increased to an optimum, respectively of 5.8 and 10.5 mmhos followed by declining occurrence, the same behavior towards conductivity was shown towards  $\text{Na}^+$ , the

highest optimums were shown respectively by vegetation unit A and D, and the lowest optimums respectively by vegetation unit C and B. The best soil structure was indicated by vegetation unit B and C with an optimum of 2 mm each, and the worst soil structure was indicated respectively by vegetation unit A (0.45 mm) and unit D (0.65 mm). Slightly alkaline soil reactions were shown by vegetation unit B and C (8.78), whereas vegetation unit A and D prefer neutral pH.

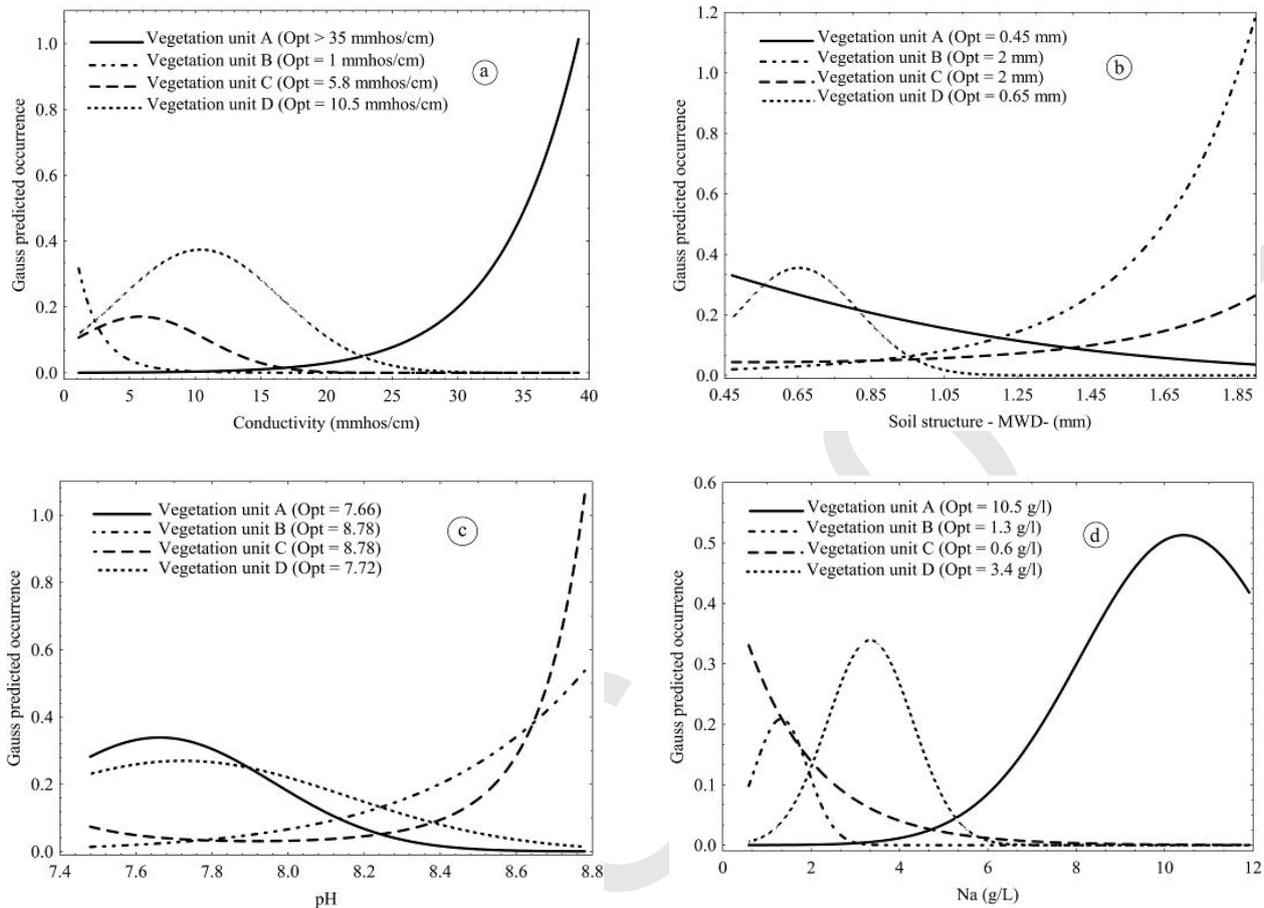


Figure 4. Predicted occurrence of the four vegetation units as obtained by Gauss model according to a. conductivity, b. soil structure, c.  $\text{Na}^+$ , d. pH

## Conclusion

The lower Chelif represents a weakened ecosystem, characterized by particular edaphic constraints and harsh climatic adversities. Traditional methods of evaluation of site conditions are expensive and time consuming, especially in areas as large as the Lower-Cheliff; thus, recognition of vegetation ecology is the easiest way of decreasing cost and saving time in the assessment of environmental conditions. The present study provides fundamental information on the edaphic factors affecting vegetation assemblage and distribution in one of the largest arid area in North Africa. We distinguished vegetation units composed of halophilous species, distributed throughout the salty grounds and more diverse vegetation units, very sensitive to salinity, occupying unsalty to slightly salty grounds. Thus, the assessment of plant communities was a useful tool to classify salinity, especially in terms of revealing the spatio-temporal changes of this variable. Understanding relationships between environmental variables and vegetation distribution in this area helps us to apply these findings in management, reclamation, and development of arid and semi-arid ecosystems.

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# ANALYTICAL METHOD FOR MAGNETIC FIELD COMPUTATION IN THE AIR-GAP OF PMSM CONSIDERING SLOTTING EFFECTS AND USING COMPLEX RELATIVE AIR-GAP PERMEANCE

Brahim Ladghem Chikouche, Département de génie électrique, Faculté de technologie, Université de M'sila, Algérie, LCHBRAHIM@gmail.com  
 Samir Mabrak, Ecole Nationale Polytechnique (LRE-ENP), El Harrach, BP182, 16200, Alger, Algérie, MABRAK.SAMIR@yahoo.fr

**Abstract :** An analytical model expressing PMSM performances in respect to stator iron relative permeability is presented. The flux density distribution, back EMF and electromagnetic torque in the slotted air-gap of permanent-magnet motors with surface mounted magnet bars which are magnetized in shifting direction are calculated in respect to stator iron relative permeability using two-dimensional field theory in polar coordinates. The effect of stator slots is introduced by modulating the magnetic field distribution in the slotless stator by the complex relative air-gap permeance. With this complex permeance, the radial and tangential components of flux density are calculated. In the analytical and numerical study a finite number of magnet bars, which is considered sufficient to get a sinusoidal magnetization, is used.

**Key words :** Air-gap permeance, conformal mapping, finite element, magnetic field, permanent-magnet synchronous motor.

## Introduction

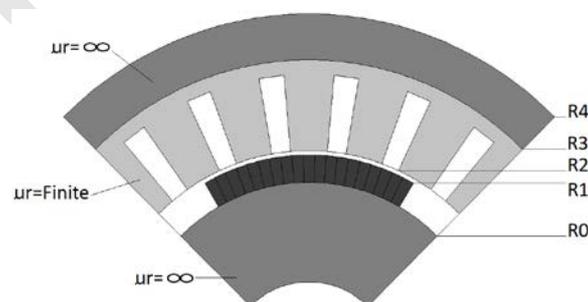
Detailed knowledge of the field distribution in the air-gap of a permanent-magnet (PM) motor is of great importance for accurate prediction of the back electromotive force (EMF) and torque waveforms. The presence of stator or/and rotor slots have a large influence on the air-gap magnetic field distribution. The consequences can be torque ripples causing vibration, noise and speed fluctuations.

The air-gap magnetic field with slotting effects can be evaluated by a variety of techniques [2]-[3]-[4] including analytical or semi-analytical methods as well as numerical techniques like finite elements or boundary integral methods. Finite elements give accurate results considering geometric details and nonlinearity of magnetic materials. However, this method is computer time consuming and poorly flexible for the first step of design stage of electrical machines [5].

In this paper, a new analytical approach for PMSM performances calculation versus relative permeability stator iron is developed.

## I. ANALYTICAL MODEL

The two-dimensional model covers the air gap, the magnet bars, the stator slots and the non magnetic or magnetic cylindrical rotor and stator core, as shown in Fig. 1. The magnetic core in rotor is assumed to have infinite permeability. The conductivity of all regions is assumed to be zero, i.e., eddy current effects are ignored.



**Fig. 1.** Cross section of one pole pitch of the motor

The slots are simplified to a rectangular shape. Because of periodicity the model needs only to cover one pole pitch of the machine. The magnetizing bars and the nonmagnetic cylindrical rotor core material are replaced by continuous and isotropic regions having the same permeability as  $\mu_0$ .

In the developed analytical and numerical models, the number of magnet bars that were used was considered to be sufficient to get a sinusoidal magnetization [1]-[2].

### II.1.a. FIELD DISTRIBUTION ON A SMOOTH STATOR SURFACE

For calculation of flux density distribution on a smooth stator surface, the stator is considered as a smooth passive cylinder. In the rotor domain, we choose the inter-polar axis as the origin ( $\theta = 0$ ).

The permanent magnet volume consists of small magnet bars with shifting direction of magnetization along a magnet pole arc. Each magnet bar may be assumed to be isotropic with uniform and rigid magnetization  $\vec{M}$ , and having a linear demagnetization characteristic.

For the two-dimensional problem the magnetic vector potential  $A$  will have only one component in the direction. The flux density is deduced from

$$\vec{B} = \text{rot}(\vec{A}) \quad B_r = -\frac{1}{r} \frac{\partial A}{\partial \theta} \quad (1)$$

Two zones are considered: zone (1) contains the magnets  $r_0 < r < r_1$  and zone (2) covers the space outside the magnets  $r_1 < r < r_2$  where radii  $r_0$ ,  $r_1$  and  $r_2$  are defined according to Table I. In the zone (1) the magnetic field is governed by

$$\text{rot} \left[ \frac{1}{\mu} (\text{rot} \vec{A}) \right] = \text{rot} \left( \frac{1}{\mu} \vec{M} \right) \quad (2)$$

Where  $\mu = \mu_0 \mu_r$  and  $\mu_r$  is the relative recoil permeability of the magnet. The magnetization of permanent magnets can be expressed as a Fourier series

$$\vec{M} = \sum_{n=1,3,5}^{\infty} M_n \cos(n\theta) \quad \vec{M}_n = \sum_{n=1,3,5}^{\infty} M_n \cos(n\theta) \quad (3)$$

The general solution in the two zones obtained from (2) by separation of variables, with the expressions for the magnetization given by (3), has the form

$$A(r, \theta) = \sum_{n=1,3,5}^{\infty} A_n(r) \sin(n\theta) \quad (5)$$

In the zone 3 and 2, respectively, the vector potential is governed by Laplace's equation

$$\begin{aligned} \frac{\partial^2 A}{\partial r^2} + \frac{1}{r} \frac{\partial A}{\partial r} + \frac{1}{r^2} \frac{\partial^2 A}{\partial \theta^2} &= 0 \quad r_1 < r < r_2 \\ &= \sum_{n=1,3,5}^{\infty} (C_{1n} r^n + C_{2n} r^{-n}) \sin(n\theta) \end{aligned} \quad (6)$$

$$\begin{aligned} \frac{\partial^2 A}{\partial r^2} + \frac{1}{r} \frac{\partial A}{\partial r} + \frac{1}{r^2} \frac{\partial^2 A}{\partial \theta^2} &= 0 \quad r < r_1 \\ &= \sum_{n=1,3,5}^{\infty} (C_{1n} r^n + C_{2n} r^{-n}) \sin(n\theta) \end{aligned} \quad (8)$$

In the permanent magnet (zone 1) the vector potential is governed by quasi-Poissonian equation

$$\begin{aligned} \frac{\partial^2 A}{\partial r^2} + \frac{1}{r} \frac{\partial A}{\partial r} + \frac{1}{r^2} \frac{\partial^2 A}{\partial \theta^2} &= \frac{1}{r} \left[ \frac{\partial A}{\partial \theta} - M_n \right] \\ A(r, \theta) &= \sum_{n=1,3,5}^{\infty} (C_{1n} r^n + C_{2n} r^{-n} + C_{3n}(\theta)) \sin(n\theta) \end{aligned} \quad (10)$$

With  $C_{3n}$  being the particular solution of (13) defined by

$$C_{3n} = \begin{cases} \frac{C_{1n} r^n + C_{2n} r^{-n}}{(n\theta)^2 - 1} & , n\theta \neq 1 \\ -\frac{1}{2} \left( \ln(n\theta) - \frac{1}{2} \right) (C_{1n} + C_{2n}) & , n\theta = 1 \end{cases} \quad (12)$$

The constants  $C_{1n}$ ,  $C_{2n}$ ,  $C_{1n}$ ,  $C_{2n}$ ,  $C_{1n}$ ,  $C_{2n}$  are determined from the boundary conditions as

$$r = r_0: \quad \frac{\partial A}{\partial r} + A = 0 \quad (13)$$

$$r = r_1: \quad \begin{cases} \frac{\partial A}{\partial r} + A = \frac{\partial A}{\partial r} \\ A = A \end{cases} \quad (14)$$

$$r = r_2: \quad \begin{cases} \frac{\partial A}{\partial r} = \frac{1}{r} \frac{\partial A}{\partial \theta} \\ A = A \end{cases} \quad (15)$$

$$r = r_3: \quad \frac{\partial A}{\partial r} = 0 \quad (16)$$

Where  $\mu_r$  is the stator relative permeability  $r_2 < r < r_3$

**TABLE 1** :Parameters of the experimental machine

| Parameter   | Symbol   | Value [unit] |
|---|----------|--------------|
| Permanent magnet remanence  | $B_r$    | 1.18 T       |
| Relative recoil permeability  | $\mu_r$  | 1            |
| Phase current   | $I$      | 6A           |
| Number of slots   | $Q_s$    | 24           |
| Number of turns per coil  | $N$      | 40           |
| Slot opening width  | $l_0$    | $1/3 l_p$    |
| Radius of the external stator surface   | $r_4$    | 46.20 mm     |
|   | $r_3$    | 40.00 mm     |
| Radius of the internal stator surface   | $r_2$    | 28.10 mm     |
| Outer radius of the magnets   | $r_1$    | 27.55 mm     |
| Radius of the internal rotor surface  | $r_0$    | 23.97 mm     |
| Stack length  | $l$      | 50.82 mm     |
| Frequency   | $f$      | 50 Hz        |
| Pole number   | $2p$     | 4            |
| Magnet arc/Pole pitch ratio   | $\alpha$ | 2/3          |
| Number of harmonics used for magnetic field calculation in air-gap and slots domain | $\nu$    | 75           |

### II.1.b. BACK EMF CALCULATION

The back EMF waveform of a surface PM motor can be calculated as

$$e(\theta) = -\frac{d\psi}{dt} \quad (17)$$

Where

$$\psi(\theta) = 2\mu_0 \mu_r \sum_{\nu=1,3,5}^{\nu} \frac{4\mu_0 \mu_r N I \cos(\nu\theta)}{\nu} \quad (18)$$

With  $k_{w\nu}$  is the winding coefficient.

### II.1.c. ELECTROMAGNETIQUE TORQUE CALCULATION

The electromagnetique torque can be written as

$$T = \frac{p}{\Omega} \sum_{\nu=1}^3 \psi_{\nu}(\theta) i_{\nu}(\theta) \quad (20)$$

## II.2. MODEL OF SLOTTING EFFECT IN FLUX DENSITY

The effect of slotting by using relative air-gap permeance obtained from a real conformal function which is able only to take into account the effect of slotting in the radial flux density by multiplying the field distribution in the slotless air-gap by this permeance [6]. The method presented in this paper and developed by Zarko [7], [8] in the case of slotted air-gap permanent magnet motors with sinus magnetization provides a more complete analytical field solution than developed by Zhu [6], and used in several other papers as well [9]–[10], and allows one to calculate accurately both radial and tangential components of the air-gap flux density. It uses the complex nature of the conformal transformation more extensively and defines the relative air-gap permeance as a complex number. This method presented in detail in [7]–[8] has been used in this paper to calculate flux density in the motors with surface-mounted permanent magnet bars magnetized in shifting direction. Therefore, in this paper only the final solution is given. The basic principle of the method is to transform the geometric shape in Fig. 3 into a slotless air gap in which the field solution can be found Fig. 4.

The flux density in the slotted air-gap  $B_{\theta}$  in the  $K$  plane is

$$B_{\theta} = B_{\theta} \left( \frac{z}{R} \right)^* \quad (21)$$

Where  $B_{\theta}$  is the field solution in the slotless air-gap in the  $K$  plane defined as  $B_{\theta} = B_{\theta} + B_{\theta}$

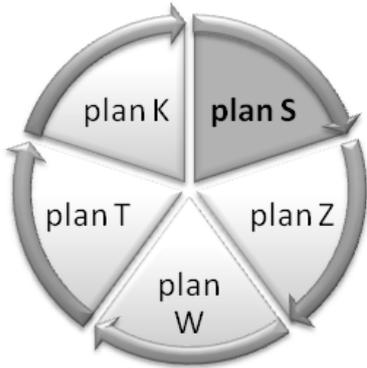
$$\frac{B_{\theta}}{B_{\theta}} = B_{\theta} = \frac{B_{\theta} - I}{(R - z)^{1/2} (R - z)^{1/2}} \quad (22)$$

$$\omega = \omega_2 \omega \left( \frac{\omega' \ln(\omega) + \frac{\omega}{2}}{\omega} \right) \quad (23)$$

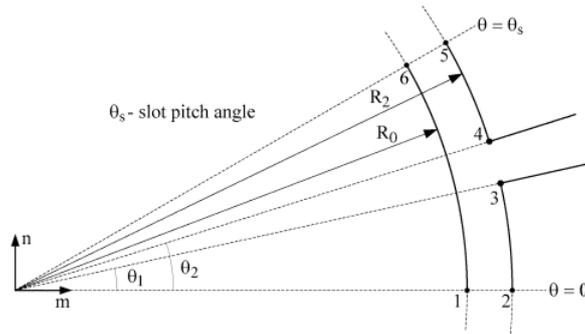
$$\omega = \omega \frac{\omega''}{\omega} \left[ \omega \left| \frac{I + \omega}{I - \omega} \right| - \omega \left| \frac{\omega + \omega}{\omega - \omega} \right| - 2 \frac{\omega - I}{\sqrt{\omega}} \omega \omega^{-1} \frac{\omega}{\sqrt{\omega}} \right] + \omega \quad (24)$$

$$\omega = \sqrt{\frac{\omega - \omega}{\omega - \omega}}, \quad \omega = \ln(\omega_2) + \omega \omega_2, \quad \omega' = \omega \left( \frac{\omega_2}{\omega_0} \right) \quad (25)$$

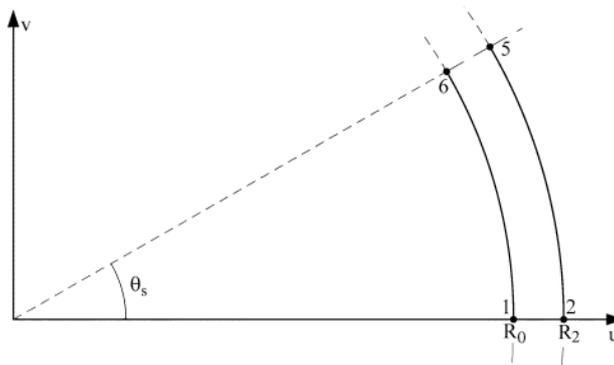
$$\omega = \left[ \frac{\omega'_0}{2\omega} + \sqrt{\left( \frac{\omega'_0}{2\omega} \right)^2 + I} \right]^2, \quad \omega = \frac{I}{\omega} \quad \omega \omega \quad \omega'_0 = \omega_2 - \omega_1 \quad (26)$$



**Fig. 2.** Basic steps required for finding the field solution in the air-gap based on conformal mapping of the slot opening



**Fig. 3.** Single infinitely deep slot opening in the  $z$  plane



**Fig. 4.** Slot opening in the  $z$  plane.

The value of  $z$  is known from the coordinate in the slotted air-gap. If it is required to calculate the flux density at a certain geometric point in the slotted air-gap, then the value of corresponding  $z$  can be calculated from  $z = z(z)$ , where  $z$  is a nonlinear complex function of  $z$ . An iterative technique is required to solve this nonlinear equation to find the value of  $z$  for the given  $z$ . Since  $z$ , depicted in Fig 10, is a complex number, it can be written in the form  $z = z_r + jz_i$ , with

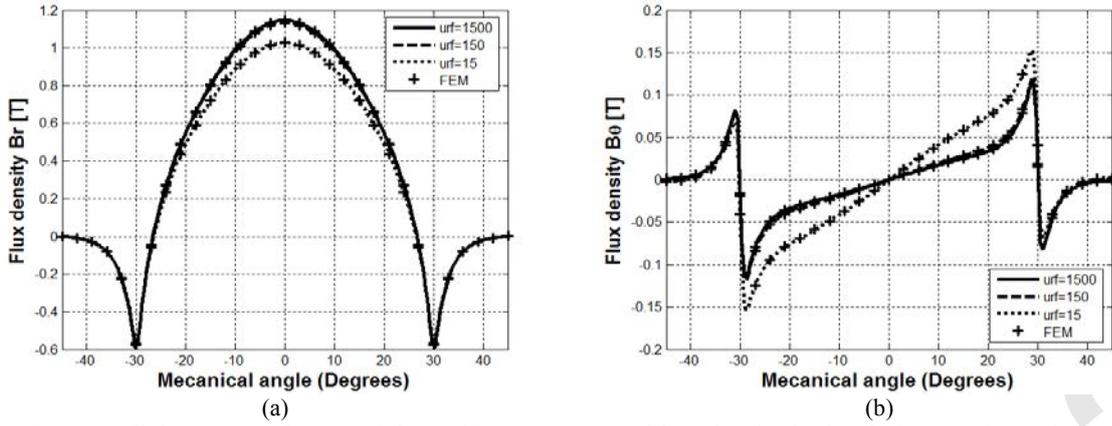


Fig. 5. Radial  $B_r$  (a) and tangential  $B_\theta$  (b) components of flux density in the slotless PMSM calculated analytically and numerically at  $\alpha = (\alpha_1 + \alpha_2)/2$  with  $\alpha = 2/3$

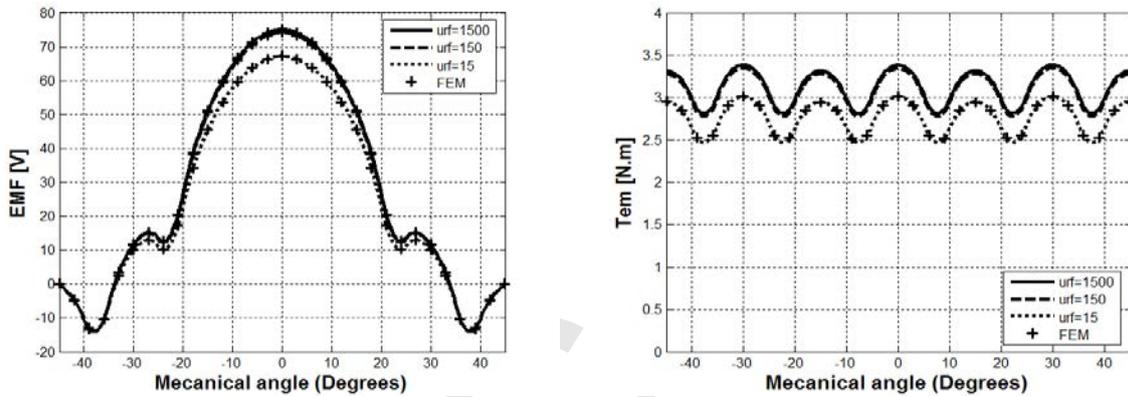


Fig. 6. Analytically and numerically calculated back EMF in the slotless PMSM with  $\alpha = 2/3$

Fig. 7. Analytically and numerically calculated electromagnetic torque in the slotless PMSM for sinusoidal waveform current with  $\alpha = 2/3$

$$B_{\theta} = B_0 + \sum_{n=1}^{\infty} B_{n\theta} \cos(n\theta) \quad (27)$$

$$B_r = \sum_{n=1}^{\infty} B_{nr} \sin(n\theta) \quad (28)$$

Figure (7) shows the electromagnetic torque evolution versus stator relative permeability.

The Fourier coefficients  $B_{n\theta}$  and  $B_{nr}$  are calculated from the waveforms of  $B_\theta$  and  $B_r$  using discrete Fourier transform (FFT). With  $\alpha = \alpha_1 + \alpha_2$ , the radial and tangential components of the flux density in the slotted air-gap are then

$$B_{n\theta} = \alpha(\alpha_1 \alpha_2^*) = \alpha_1 \alpha_2 + \alpha_1 \alpha_2 \quad (29)$$

$$B_{nr} = \alpha(\alpha_1 \alpha_2^*) = -\alpha_1 \alpha_2 + \alpha_1 \alpha_2 \quad (30)$$

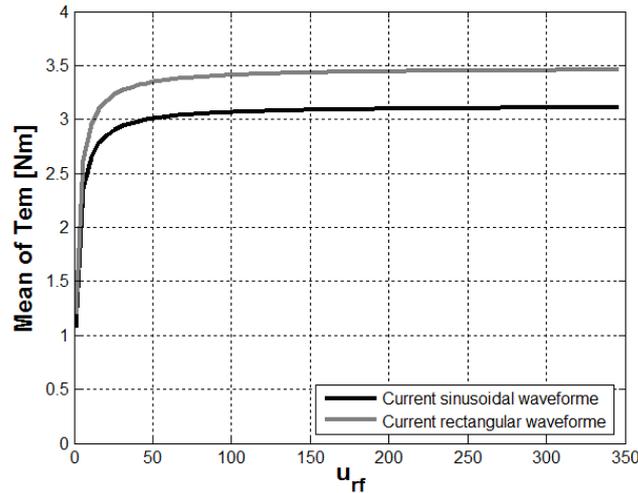


Fig. 8. Effect of stator relative permeability on electromagnetic torque in the slotless PMSM.

### III. NUMERICAL MODEL VERIFICATION

In order to validate the proposed model, the analytical results have been compared with 2-D finite element simulations obtained from FEMM.

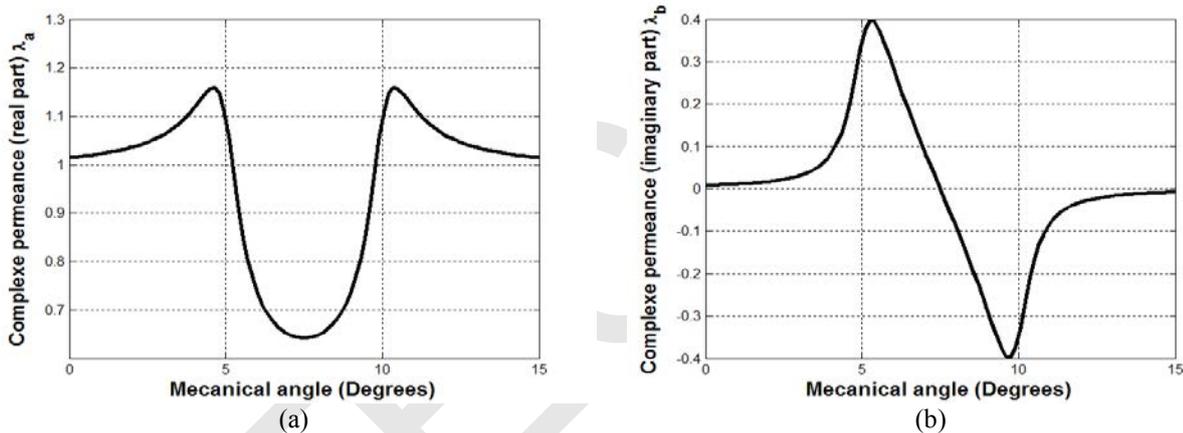


Fig. 10. (a) Real and (b) imaginary part of the complex permeance calculated analytically at  $\mu = (\mu_1 + \mu_2)/2$

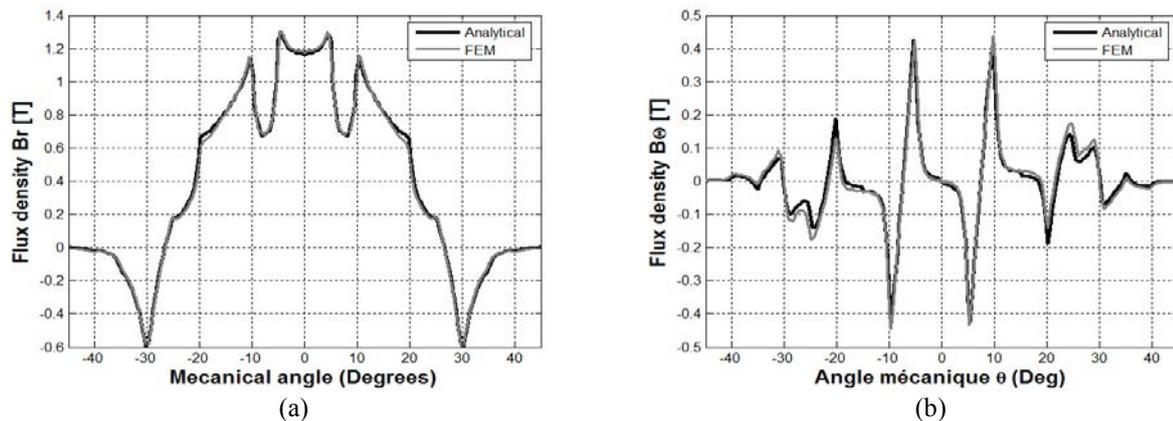


Fig. 11. (a) Radial  $B_r$  and (b) tangential  $B_\theta$  components of flux density in the slotless PMSM calculated analytically and numerically at  $\mu = (\mu_1 + \mu_2)/2$  with  $\mu = 2/3$  for  $\mu = 1500$

The meshes in the air-gap and in the slot regions have been refined until convergent results. The analytical solutions in the air-gap and in the slot domains have been computed with a finite number of harmonic terms  $N_h$  as indicated in Table I.

The flux density distribution in the middle of the air-gap  $\mu = (\mu_1 + \mu_2)/2$  domain is plotted in Fig. 11. The effect of the slots and the relative permeability of the stator is very clear.

## VI. CONCLUSION

An analytical method based on a two-dimensional field analysis and complex conformal mapping was developed to predict the no-load flux density waveform and the torque characteristic of a PMSM with slotted air-gap and shifting magnetization direction of each magnet bar constituting the magnet pole arc.

The concept of complex relative air-gap permeance has been adopted to accurately calculate the air-gap field for both radial and tangential components of the flux density in the slotted air gap. The proposed method has been utilized to calculate the back EMF and the electromagnetic torque waveforms. In all studied cases, the results of analytical calculations were in very good agreement with the results of finite-element simulations. This proves that the proposed analytical approach is reliable for  $\frac{p}{2} > 300$ .

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## ANTIBACTERIAL ACTIVITY OF *MALVA PARVIFLORA* METHANOLIC LEAF EXTRACT

Mohamed mihoub Zerroug<sup>1</sup>, Bahia L. Bencherif<sup>2</sup>, Abderrahmane Senator<sup>3</sup> and Hamama Bouriche<sup>3</sup>

<sup>1</sup>Laboratory of Applied Microbiology, Faculty of Natural and Life Sciences  
University Ferhat Abbas of Sétif 1, ALGERIA

<sup>2</sup>Laboratory of Bacteriology, CHU of Sétif, ALGERIA

<sup>3</sup>Laboratory of Applied Biochemistry, Faculty of Natural and Life Sciences  
University Ferhat Abbas of Sétif 1, ALGERIA  
med.gerroug@gmail.com

**Abstract** Interest in medicinal plants, which are natural sources of antimicrobial substances, has revived as a consequence of current problems associated with the overuse of antibiotics. In this study, the antibacterial activity of methanolic extract of *Malva parviflora* leaves was tested against three referenced bacteria, *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922 and *Pseudomonas aeruginosa* ATCC 27853 and against four pathologic multiresistant bacteria, *Staphylococcus aureus* N°912, *Pseudomonas aeruginosa* N°938, *Enterococcus faecalis* N°908 and *Acinetobacter baumannii* N°695 (isolated in the CHU Hospital of Sétif). The disc and well techniques were used to determine the minimal inhibition concentration (MIC). The obtained results showed that methanolic extract of *Malva parviflora* leaf exhibited a strong bacteriostatic effect against the tested bacteria except *Enterococcus faecalis* N°908. The antibacterial effect was more pronounced against *Staphylococcus aureus* ATCC 25923 with a MIC of 625 µg/ml, followed by *Staphylococcus aureus* N°912 with a MIC of 1250 µg/ml. This effect was less against *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 and *Acinetobacter baumannii* N°695 with a MIC of 2500 µg/ml. The lowest effect, 5000 µg/ml, was registered with *Pseudomonas aeruginosa* N°938.

**Key words:** antibacterial activity, *Malva parviflora*, MIC, methanolic extract.

### Introduction

The use of higher plants for therapeutic purposes is a common practice since thousands of years (Rios and Recio, 2005). Thus medicinal plants represented the oldest and the largest form of medication (Robert and Halberstein, 2005). Recently interest in medicinal plants, which are natural sources of antimicrobial substances, has revived as a consequence of current problems associated with the overuse of antibiotics. This overuse of antibiotics has become the major factor for the emergence and dissemination of multi-drug resistant strains of several groups of microorganisms (Harbottle *et al.*, 2006; Khan *et al.*, 2009). To face this phenomenon, research was focused on the medicinal and aromatic plants which are good sources of compounds with antimicrobial properties (Zerroug *et al.*, 2011). In this context, the decoction and the infusion of *Malva parviflora* L. (family: *Malvaceae*) is used in folk Algerian medicine to treat many infections. The aim of this work was to test the antimicrobial activity of the methanolic extracts of *Malva parviflora* and to determine the minimal inhibition concentration.

### Materials and Method

#### Plant Material

*Malva parviflora* was collected in the Wilaya of Borj bouarrerdj (East of Algeria) and the Methanolic extract was prepared by Pr. BOURICHE H. University Ferhat Abbas of Sétif 1.

#### Bacteria Strains

Three referenced bacteria (*Staphylococcus aureus* ATCC 25923, *E. coli* ATCC 25922 and *Pseudomonas aeruginosa* ATCC 27853) and four multi resistant bacteria (*Staphylococcus aureus* N°912, *Acinetobacter baumannii* N° 695, *Pseudomonas aeruginosa* N° 938 and *Enterofaecalis* N° 908) from the C.H.U. of Sétif were used in this study.

#### Antibacterial Assay

Direct colony suspensions were made of colonies from 18 to 24 hrs cultures. A spectrophotometer was used to standardize the inoculum to obtain a 0.5 McFarland density (approx.  $1.5 \times 10^8$  CFU/mL). After the 0.5 McFarland is prepared swabs were allowed to absorb the inoculum and then spread on MULLER HINTON agar medium.

The crude solution or dilution was tested against the seven mentioned bacteria. To test the antibacterial activity the well technique was used, the crude extract (100 mg of dried material was dissolved in 1 ml of sterile distilled water) or dilutions (1/2, 1/4 and 1/8) was incorporated to the medium. To determine the Minimal Inhibitory Concentration (MIC), a dilution series were made in order to obtain the following concentrations 10000 µg/ml, 5000 µg/ml, 25000 µg/ml, 1250 µg/ml and 625 µg/ml. Plates were incubated at 37°C for 48h.

## Results

The methanolic extract inhibited six of the seventh bacteria with different zones of inhibition and had no effect against *Enterococcus faecalis* N° 908. A strong inhibitory effect was registered with the crude extracts with zone of inhibition of 34 mm, 30 mm, 28 mm, 25 mm, 23 mm and 16 mm against *Pseudomonas aeruginosa* ATCC27853, *Staphylococcus aureus* ATCC 25923, *Staphylococcus aureus* N° 912, *Escherichia coli* ATCC 25922, *Acinetobacter baumannii* N° 695 and *Pseudomonas aeruginosa* N° 938 respectively. This effect decrease with the dilution (table 1). At the dilution 1/8 the methanolic extract had no effect against *Staphylococcus aureus* ATCC 25923, *Staphylococcus aureus* N° 912, *Pseudomonas aeruginosa* N°938, *Escherichia coli* ATCC 25922 and *Acinetobacter baumannii* N° 695 (table 1).

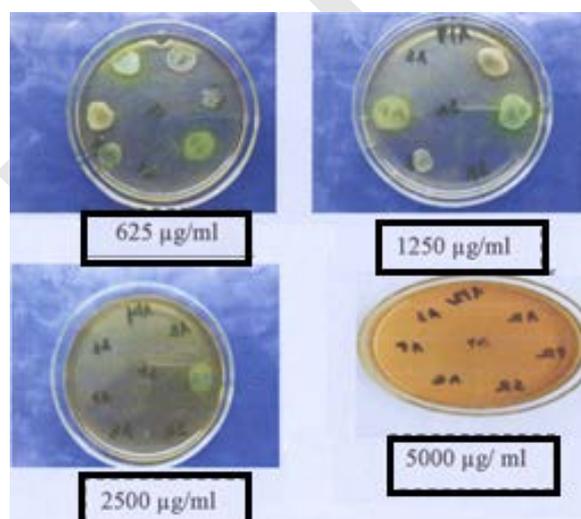
The results showed that methanolic extract of *Malva parviflora* leaf exhibited a strong bacteriostatic effect against the tested bacteria except *Enterococcus faecalis* N°908. The antibacterial effect was more pronounced against *Staphylococcus aureus* ATCC 25923 with a MIC of 625µg/ml, followed by *Staphylococcus aureus* N° 912 with a MIC of 1250 µg/ml. This effect was less against *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 and *Acinetobacter baumannii* N° 695 with a MIC of 2500 µg/ml. The lowest MIC, 5000µg/ml, was registered with *Pseudomonas aeruginosa* N°938 (Figure 1).

## Discussion

In this study, *Malva parviflora* methanolic extract inhibited the bacterial growth with differences between bacterial strains. This activity is may due to the contents of the methanolic extract, Ferhan *et al.* (2012), Afolayan *et al.* (2008) and Grierson and Afolayan (1999) reported that this activity is correlated with the content of the extract in polyphenol, flavonoid, tannin, alkaloid, phenolic and terpenoides compounds. This activity depends upon several factors, plant species, extract preparation, solvent used and bacterial sensitivity (Loziene *et al.*, 2007). Islam *et al.* (2010) reported also that Hexane, chloroform and ethanol extracts of *Malva parviflora* L., displayed antibacterial activity against *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli* and *Proteus vulgaris*. The obtained results are similar to those obtained by Shale *et al.* (2005), they reported that the *Malva parviflora* extracts exhibited antimicrobial activity against *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

**Table 1.** *Malva parviflora* methanolic extract Inhibitory effect.

| Bacterial strains                       | Diameter of inhibition (mm) |     |     |     |
|---|-----------------------------|-----|-----|-----|
|   | Crude extract               | 1/2 | 1/4 | 1/8 |
| <i>Pseudomonas aeruginosa</i> ATCC27853 | 34                          | 25  | 23  | 18  |
| <i>Staphylococcus aureus</i> ATCC 25923 | 30                          | 26  | 13  | -   |
| <i>Staphylococcus aureus</i> N° 912     | 28                          | 23  | 12  | -   |
| <i>Escherichia coli</i> ATCC 25922      | 25                          | 20  | 15  | -   |
| <i>Acinetobacter baumannii</i> N° 695   | 23                          | 18  | 14  | -   |
| <i>Pseudomonas aeruginosa</i> N° 938    | 16                          | 14  | 08  | -   |
| <i>Enterococcus faecalis</i> N° 908     | -                           | -   | -   | -   |



**Figure 1.** Minimal inhibition concentrations of *Malva parviflora*.

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## ANTI-INFLAMMATORY ACTIVITY OF ACETONIC EXTRACT OF *PISTACIA LENTISCUS* FRUITS

Hammama Bouriche\*; Safia Khalfaoui; Hichem Meziti and Abderrahmane Senotor  
Department of Biochemistry, Faculty of Natural Sciences and Life,  
University Ferhat Abass, Sétif, Algeria  
[\\*bouriche\\_ha@yahoo.fr](mailto:*bouriche_ha@yahoo.fr)

**Abstract :** *Pistacia lentiscus* L. (*P. lentiscus*) has traditionally been used as a stimulant, for its diuretic properties, and to treat hypertension, coughs, sore throats, eczema, stomach aches, kidney stones and jaundice. In the present study, the anti-inflammatory effect of acetonc extract of *P. lentiscus* fruits was evaluated. The quantitative estimation of total phenolic compounds showed that the acetonc extract is rich in polyphenols ( $250.6 \pm 14 \mu\text{g GAE/mg}$  of extract) and flavonoids ( $20.6 \pm 5.8 \mu\text{g QE/mg}$  of extract). The anti-inflammatory activity of *P. lentiscus* was evaluated *in vivo* using the ear edema model induced by Croton oil and the air pouch model induced by Lambda carrageenan. Three treatments were used. The simultaneously use of the extract (3mg of extract/ear) with the irritant agent, the topic use of 3mg of extract/ear and oral administration of 300mg of extract/kg 1hour before the induction of the inflammation. Results obtained showed that *P. lentiscus* extract inhibited significantly the ear edema by the percentages of 68%, 72% and 80%, respectively. These inhibitions were statistically similar to the effect of indomethacin used as a standard anti-inflammatory agent. On the other hand, an inhibitory activity of leukocytes migration was observed in the murine air pouch exudate. The treatment by acetonc extract (1mg/pouch) decreased significantly the number of leucocytes in the air-pouch (34%). This inhibition was statistically similar to the effect of indomethacin. Finally, we can conclude that the acetonc extract of *P. lentiscus* fruits have a considerable anti-inflammatory activity, which support the use of this plant specially their fruits in folkloric medicine.

**Key words:** Inflammation, anti-inflammatory, *Pistacia lentiscus*, polyphenols, flavonoids

### Introduction

Medicinal plants have received great interest in biomedical research. They are considered to be an important source of therapeutic compounds and the therapeutic benefit of many medicinal plants is often attributed to their anti-inflammatory and antioxidant properties (Shahidi, et al., 1992; Tunón et al., 1995). The preservative effect of many plant species and herbs suggests the presence of bioactive compounds such as flavonoids, phenolic acids, and phenolic diterpenes (Shahidi et al., 1992; Dutra et al., 2008). *Pistacia lentiscus* (*P. lentiscus*) Linn. (Family - Anacardiaceae), commonly known as mastic tree or mastagi, one of the many evergreen bushes found in the eastern Mediterranean region has a long tradition in folk medicine dating from the times of the ancient. *P. lentiscus* has traditionally been used as a stimulant, for its diuretic properties, and to treat hypertension, coughs, sore throats, eczema, kidney stones and jaundice (Palevitch and Yaniv, 2000). *P. lentiscus* gum had a great effect in healing of mucosa, and its current use is limited to treating stomach aches, heartburn and respiratory problems (Ali-Shtayeh et al., 2000; Lev and Amar, 2002). Also, anti-*Helicobacter pylori* activity has been reported (Serafino et al., 2001). The extract of the different parts of the plant shows various activities like anti-atherogenic, anti-inflammatory, antioxidant, antimicrobial, hypotensive, anticancer, anti-arthritis and anti-gout and in treatment of wound, antiasthmatic and anthelmintic activity (Ansari and Siddiqui, 2012). Polyphenols from the leaves are gallic acid and galloylderivatives (Abdewahab et al., 2007), flavonol glycoside and anthocyanins (Romani et al., 2002). Traces amount of myrcetine derivative and catechin are also present (Kıvcaç and Akay, 2005). Some reports available in the literature, studying the antioxidant properties of extract from this plant (Baratto et al., 2003), as well as the total flavonoids content. A little additional research exists on *P. lentiscus* anti-inflammatory effects. Therefore, the present study was designed to investigate and evaluate the pharmacological basis for the use of *P. lentiscus* fruits extract in folklore medicine for the treatment of inflammatory disorders. Thus, the anti-inflammatory activity of acetonc extracts of *P. lentiscus* fruits were evaluated on two models of acute inflammation, ear edema and air pouch.

### Materials and Method

Chemicals and all reagents were purchased from fluka and Sigma (Germany) and were of analytical grade. The plant material, *P. lentiscus* fruits were collected in November 2010 from Skikda, Algeria. The plant material was identified and voucher specimen was deposited at the laboratory of botany in the University of Sétif, Algeria. The

fruits were cleaned and frozen at  $-32^{\circ}\text{C}$  until use. Swiss albino mice weighing 30–40 g were purchased from the Pasteur Institute of Algiers, Algeria. All animals were divided into different groups each consisting of 7 animals, and were allowed to acclimatize to the animal room conditions for 1 week and had free access to food and water *ad libitum*. Animals were fasted overnight prior the experiments.

The acetonetic extract from *P.lentiscus* fruits was prepared by maceration of 150 g of crushed fruits with 100 ml of acidified acetone/eau (7:3 V/V) at  $4^{\circ}\text{C}$  for 24 h with frequent agitation. After filtration, the filtrate was concentrated under reduced prepressure at  $40^{\circ}\text{C}$ . The residue was lyophilized using a lyophilizator (PHYWE chrisa) to give a dark purple powder.

Total polyphenol contents were estimated by Follin-Ciocalteu method (Li et al. 2007). Practically,  $0.5\mu\text{l}$  of Folin (10%) was added to 100  $\mu\text{l}$  of extract (0-0.5 mg/ml) or gallic acid (used as standard), after 4 min, 400  $\mu\text{l}$  of sodium carbonate  $\text{Na}_2\text{CO}_3$  solution (7.5%) are added to the reaction medium. After 2 h of incubation in darkness at room temperature, the absorbance was measured at 765nm. Results were expressed as  $\mu\text{g}$  of Gallic acid equivalent/mg of extract ( $\mu\text{g AGE/mg}$  of extract).

The flavonoid contents were estimated by  $\text{AlCl}_3$  method (Bahorun et al., 1996). One ml of the extract (0-0.5 mg/ml) was added to 1 ml of 2% methanolic  $\text{AlCl}_3$ . After 10 min of incubation, the absorbance was read at 430 nm. Results were expressed as  $\mu\text{g}$  of quercetin equivalent/mg of extract ( $\mu\text{g QE/mg}$  of extract).

The anti-inflammatory effect of acetonetic extract from *P.lentiscus* fruits was studied using two models of acute inflammation, Croton oil-induced ear edema and ear pouch in mice.

Croton oil-induced ear edema mice was conducted in three ways:

**1. Simultaneously use of the treatment with the irritant agent:** croton oil-induced ear edema was performed according to the method of Manga et al. (2004). Cutaneous inflammation was induced to the inner surface of the right ear of mice (7 mice each group) by application of 15  $\mu\text{L}$  of acetone containing 80  $\mu\text{g}$  of Croton oil as irritant. Treated animals received topically 3 mg/ear of acetonetic extract of *P. lentiscus* fruits. Indomethacin as reference drug was applied topically (0.5 mg/ear). The control group received topically Croton oil alone. The thickness of ears was measured before and 6 h after induction of inflammation using a digital micrometer. The micrometer was applied near the tip of the ear just distal to the cartilaginous ridges, and the thickness was recorded in micrometers. To minimize technique variations, a single investigator performed the measurements throughout each experiment. The edema was expressed as an increase in the ear thickness due to Croton oil application. The inhibition of the inflammation was calculated using the following equation:

Inhibition =  $(\Delta T - \Delta E / \Delta T) \times 100$ , where  $\Delta T$ : edema size of the control and  $\Delta E$ : edema size of the treated group by the extract.

**2. Topical pretreatment 1 hour before the induction of inflammation:** A volume of 15  $\mu\text{l}$  of acetone-water solution (1:1) containing 3 mg of extract or 0.5 mg of indomethacin were applied topically on the inner surface of the right ear of mice. One hour after application of the treatment, 15  $\mu\text{l}$  of acetone-water solution (1:1) containing 80 mg of Croton oil was applied locally on the inner surface of the right ear of each mouse. The control mice received only 15  $\mu\text{l}$  of the solution of Croton oil. The ear thickness was measured before the treatment and then 4h and 6h after the induction of inflammation.

**3. Oral pretreatment 1 hour before the induction of inflammation:** Three groups of mice were respectively received orally 0.2 ml of saline solution (control group), 300 mg/kg of acetonetic extract of *P. lentiscus* fruits and 50 mg/kg of indomethacin. One hour after, 15 $\mu\text{l}$  of acetone-water solution (1:1) containing 80 mg of Croton oil was applied locally on the inner surface of the right ear of each mouse. The ear thickness was measured before treatment and 4 h and 6 h after the induction of inflammation.

The air pouches were raised on the dorsum by subcutaneous injection of 3 ml of sterile air, as previously described (Colville-Nash and Lawrence, 2003). After 4 days, the pouches were re-inflated with 1,5 ml of sterile air. On day 7, inflammation was induced by injection of 0.1ml of Lambda carrageenan suspension 1% (w/v, in saline) into the air pouch under light chloroform anesthesia (Gambero, 2003). One hour after, 0.1 ml of the extract (1mg/pouch) or 0.1 ml of Indomethacin (0.15 mg/pouch) was injected. The control group received only 0.1 ml of Lambda carrageenan suspension. Four hours after the treatment, the mice were sacrificed by cervical dislocation. The pouches were flushed by 0.1 ml of PBS, pH=7.4, and vigorously massage for 30 sec. The pouches were opened with a small incision and the exudates were collected. The leukocytes in the fluid were counted using hemocytometer coulter (MINDRAY Auto Hematology Analyser).

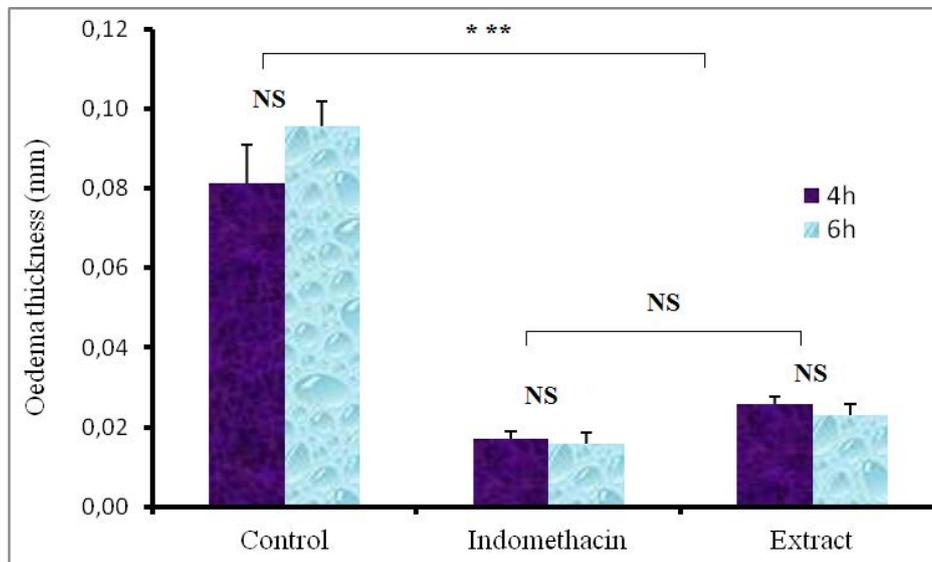
All results were expressed as mean  $\pm$  SEM. The statistical significant of the results as analyzed by the Student t-test with a value of  $<0.05$  are considered significant.

## Results

Results showed that the the acetonetic extract of *P. lentiscus* fruits is rich in polyphenols ( $250.6 \pm 14 \mu\text{g GAE/mg}$  of extract) and flavonoïds ( $20.6 \pm 5.8\mu\text{g QE/mg}$  of extract).

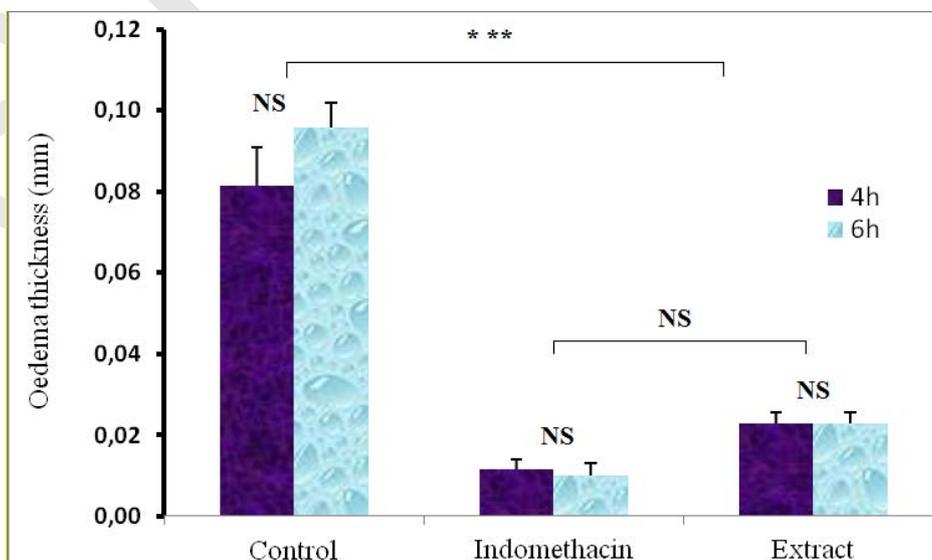
In air edema model, the mice in the control group that received the solution of Croton oil alone developed after 4 h and 6 h an ear edema characterized by increased thickness of  $81 \pm 9 \mu\text{m}$  and  $95 \pm 6 \mu\text{m}$ , respectively. Mice treated group simultaneously with the irritant agent by local application of 3 mg/ear of the acetonetic extract of *P. lentiscus* fruits induced highly significant reduction ( $p < 0.001$ ) of inflammation compared to control mice. The thickness of the edema

4h and 6h after the induction of inflammation was  $26 \pm 2 \mu\text{m}$  after 4 and  $23 \pm 3 \mu\text{m}$  after 6h (Figure 1), which correspond to an inhibition of 68% and 76%, respectively. These values are statistically very close to those obtained with Indomethacin. Indeed, mice treated by Indomethacin showed a highly significant reduction ( $p < 0.001$ ) in the inflammation. Edema thickness of the 4h and 6h after the induction of inflammation were  $17 \pm 6 \mu\text{m}$  and  $15 \pm 4 \mu\text{m}$ , respectively, which corresponds to an inhibition of 79% and 84%, respectively.



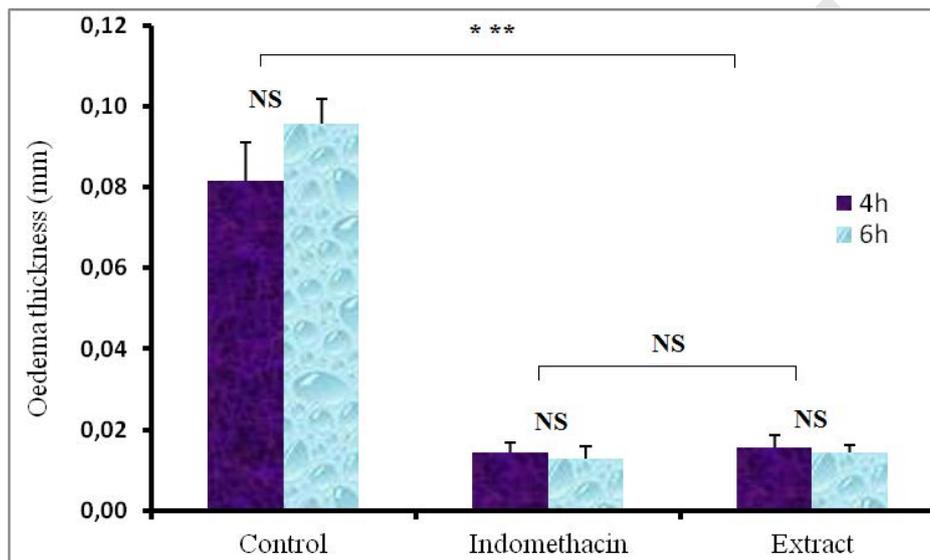
**Figure 1.** Effect of the acetonc extract of *P.lentiscus* fruits applied topically and simultaneously with the irritant agent on ear edema in mice. The edema was induced by topical application of  $80 \mu\text{g}$  of Croton oil on the inner surface of the right ear of mice. Groups of mice were treated locally and simultaneously with croton oil by  $3\text{mg}/\text{ear}$  of the extract or  $0.5\text{mg}/\text{ear}$  of Indomethacin. The control group received the solution of Croton oil alone. Edema is expressed as the mean thickness increase of ears after 4h and 6 h of Croton oil application. Values are expressed as means  $\pm$  SEM ( $n = 7$ ). \*\*\* $P < 0.001$ . NS: not significant versus the control.

A highly significant reduction ( $p < 0.001$ ) in ear edema is observed in mice locally treated by  $3 \text{ mg}/\text{ear}$  extract 1 hour before the induction of inflammation compared to control mice. The thickness of the edema was  $23 \pm 3 \mu\text{m}$  after 4 h and  $21 \pm 5 \mu\text{m}$  after 6 h, which correspond to an inhibition of 72% and 76%, respectively. These rates are statistically similar to those obtained with Indomethacin (Figure 2). In fact, a highly significant reduction ( $p < 0.001$ ) in ear edema is observed in mice treated locally by  $0.5 \text{ mg}/\text{ear}$  of Indomethacin 1 h before the induction of inflammation. The thickness of the edema was  $11 \pm 5 \mu\text{m}$  after 4 h and  $10 \pm 4 \mu\text{m}$  after 6, which correspond to an inhibition of 86% and 89%, respectively.



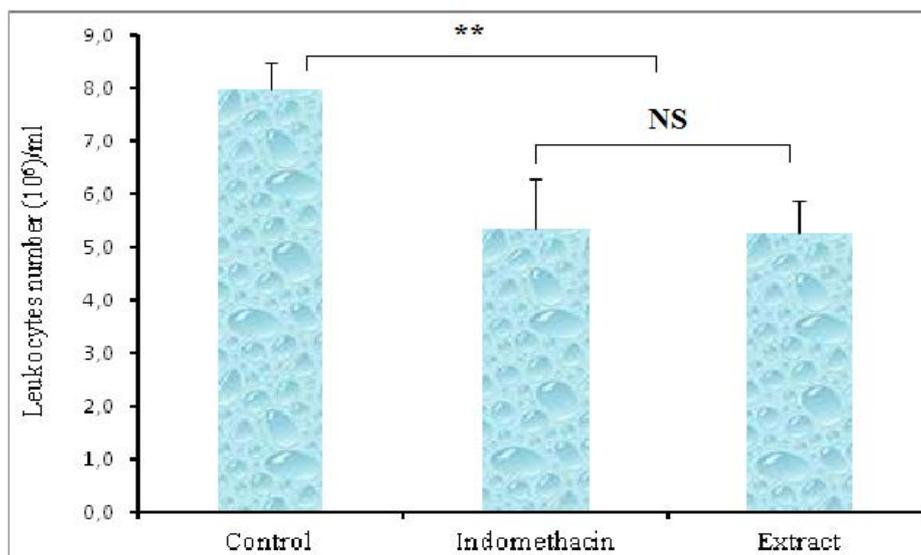
**Figure 2.** Effect of the acetonc extract of *P. Lentiscus* fruits applied topically 1 hour before induction of the ear edema in mice. The edema was induced by topical application of 80µg of Croton oil on the inner surface of the right ear of mice. Groups of mice were treated locally by 3 mg/ear of the extract or 0.5 mg/ear of Indomethacin 1 hour before the application of the irritant. The control group received the solution of Croton oil alone. Edema is expressed as mean thickness increase of ears after 4h and 6 h of the irritant agent application. Values are expressed as means ± SEM ( $n = 7$ ). \*\*\* $P < 0.001$ . NS: not significant versus the control.

In the oral pretreatment 1 hour before the induction of inflammation, treated mice by 300 mg/kg of acetonc extract of *P. Lentiscus* fruits induced a highly significant reduction ( $p < 0.001$ ) of ear edema compared with mice in the control group. The size of the edema was  $16 \pm 3 \mu\text{m}$  after 4 h and  $14 \pm 2 \mu\text{m}$  after 6h, which correspond to an inhibition of 80% and 82%. These rates are statistically similar to those obtained with Indomethacin (Figure 3). Indeed, treated mice with 50 mg/kg of Indomethacin 1 hour before the induction of inflammation showed a significant reduction ( $p < 0.001$ ) compared with the control group. The edema 4 h after induction of inflammation was  $14 \pm 4 \mu\text{m}$  and  $13 \pm 3 \mu\text{m}$  after 6 h, corresponding to an inhibition of 82% and 86%, respectively.



**Figure 3.** Effect of the acetonc extract of *P. Lentiscus* fruits applied orally 1 hour before induction of the ear edema in mice. The edema was induced by topical application of 80µg of Croton oil on the inner surface of the right ear of mice. Groups of mice are treated by oral administration of the extract (300 mg/kg) or Indomethacin (50mg/kg) 1 hour before the application of the irritant. The control group received the solution of Croton oil alone. Edema is expressed as mean thickness increase of ears after 4 h and 6 h of the irritant agent application. Values are expressed as means ± SEM ( $n = 7$ ). \*\*\* $P < 0.001$ . NS: not significant versus the control.

In air Pouch model, the mice of the control group developed after 4 h an inflammation with infiltration of leukocyte by  $7.91 \times 10^6$  cells/ml of exudate. Treatment by 1 mg/pouch of acetonc extract of *P. Lentiscus* fruits induced a significant ( $P < 0.01$ ) reduction in the number of infiltrating leukocytes ( $5.24 \times 10^6$  cells/ml of exudates) compared to control mice. This value corresponds to an inhibition of 34%, which is similar to that of Indomethacin. Indeed, the number of leukocytes in mice treated by Indomethacin was  $5.36 \times 10^6$  cells/ml of exudates after 4 h of induction of inflammation, which corresponds to an inhibition of 32% (Figure 4).



**Figure 4.** Effect of the acetonc extract of *P. Lentiscus* fruits on the number of infiltrating leukocytes in the exudates. The pouch inflammation was induced by carrageenan (1%). One hour after the induction of inflammation, mice were treated by injection of 1mg/Pouch of the extract or 0.15 mg/Pouch of Indomethacin. The control group of mice received only the solution of carrageenan. The comparison is made with respect to the control group. Values represent the mean  $\pm$  SEM (n = 7). : \*\* P < 0.01, NS: not significant (Student's t test).

## Discussion

Acute inflammation is characterized by classical symptoms, such as heat, redness, swelling and pain. Edema is therefore a good measure of inflammation and is useful for the quantification inflammation induced by phlogistic agents such as croton oil. The Croton oil induced ear edema model has certain advantages for natural product testing and has a good predictive value for screening anti-inflammatory agents that could be useful in the treatment inflammatory disorders (Tunón et al., 1995). The effect of the irritant agent, croton oil, is due to the active 12-O-tetradecanoyl phorbol acetate (TPA) it contains. TPA induces an inflammatory response characterized by high production of pro-inflammatory mediators, increased vascular permeability, edema and neutrophil infiltration (Delaporte et al., 2004). These changes are triggered by protein kinase C, which promotes an increase in the activity of phospholipase A<sub>2</sub> (PLA<sub>2</sub>) (Oskarsson et al., 1999). PLA<sub>2</sub> catalyzes the hydrolysis of membrane phospholipids archidonic acid, which is involved in the synthesis of eicosanoïdes, prostaglandins and leukotrienes, which constitute the first step in the inflammatory response (Serhan, 2009).

In the present study, the thickness of the edema is measured 4h and 6 h after topical application of croton oil to assess the anti-edematous effect of the acetonc extract of *P. lentiscus* fruits. Simultaneous treatment of mice with topical application of croton oil and the acetonc extract inhibited the edema formation similarly to the pretreatment by the extract topically or orally 1 h before the induction of the inflammation. This result indicates that there is no interaction between the irritant and the anti-inflammatory agent. The ear edema thickness (68-86%) measured 4h and 6h after induction of inflammation is not statistically significant. This means that 4 hours are sufficient to induce inflammation with croton oil. These results are in agreement with those obtained by Giner-Larza et al. (2002) who reported that the ethanolic extract of the fruits of *Pistacia vera* (a species of the same genus as *P. lentiscus*) inhibited edema induced by carrageenan in mice by a rate of 63%. The anti-inflammatory effect of the acetonc extract of the fruit of *P. lentiscus* is probably attributed to lipophilic soluble substances that are able to penetrate through the skin barrier (Okoli et al., 2007) and exerted its anti-inflammatory activity. Likely candidates for these anti-inflammatory substances are flavonoids, polyphenols, which were isolated from *P. lentiscus*. Indeed, the quantitative estimation of total phenolic compounds showed that the acetonc extract is rich in polyphenols (250.6  $\pm$  14  $\mu$ g GAE/mg of extract) and flavonoïds (20.6  $\pm$  5.8 $\mu$ g QE/mg of extract), respectively. Phenolic compounds are known to interact with and penetrate through lipid bilayers (Rice-Evans, 2004). The anti-inflammatory effect of the acetonc extract of the fruit of *P. lentiscus* was similar to that of Indomethacin, used as standard anti-inflammatory agent. The mechanism of action of indomethacin on inflammation is based on inhibition of the synthesis of pro-inflammatory prostaglandins (Hull et al., 2003). The anti-inflammatory effect observed is also probably due to the presence of antioxidant compounds in the extract. Abdelwahed et al. (2007) reported that gallic acid and 1, 2, 3, 4, 6-pentagalloylglucose, two polyphenols isolated from the fruits of *P. lentiscus* fruits exhibit antioxidant activity which is an additional advantage for the anti-inflammatory activity. In fact, Ying et al. (2010) reported that the content of flavonoids in plant extracts, allows them to act at several levels of the inflammatory response.

Leukocyte recruitment in inflamed tissues is essential to the inflammatory response to cleaning the home lesion and

thereby adequate tissue repair. In contrast, the excessive leukocyte migration leads to inflammatory disorders. That is why we are interested in counting the cells in a household of acute inflammation, created by carrageenan in an air pouch in mice. The mice in the control group developed after 4h an inflammation at the pouch characterized by a high number of leukocytes  $7.91 \times 10^6$  leukocytes/ml in the exudate. Carrageenan stimulates the release of histamine and serotonin from mast cells, initiating a cascade of events that produce other mediators that contribute to the development of the acute inflammatory reaction (Cuzzocrea et al., 1998). Mice treated by acetic extract of *P. lentiscus* showed significant reduction (34%) in the number of leukocytes. This inhibition is similar to that of Indomethacin, used as standard anti-inflammatory agent. Secondary metabolites in fruits of *P. lentiscus* inhibit leukocyte recruitment into the cavity of the air pouch probably by inhibiting the expression of adhesion molecules on endothelial cell as reported before (Anné et al., 1994). Moreover, it reported that anthocyanins and gallic acid inhibit leukocyte migration to inflammatory sites by inhibiting the adhesion molecules ICAM-1 and VCAM-1 and E-selectin in the vascular endothelial cells, this inhibition is due to inhibition of IL-1, TNF- $\alpha$  and NF- $\kappa$ B (Takatoshi et al., 1999; Calixto et al., 2003).

## Conclusions

The acetic extract of the *P. lentiscus* applied topically or administered orally has a good anti-inflammatory effect by inhibiting the development of ear edema and the recruitment of immune cells into the inflammatory site. The anti-inflammatory properties of *P. lentiscus* may be explained in part by the activity of the polyphenols and flavonoids present in its extract. This activities assign a potential role of *P. lentiscus* extracts in human health care and support the traditional uses of this plant in the treatment of inflammatory disorders.

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# APPLICATION OF A CONTINUOUS FB MSZ TYPE CRYSTALLIZER WITH JET PUMP DRIVEN BY COMPRESSED AIR FOR RECOVERY OF PHOSPHATE(V) IONS FROM MINERAL FERTILIZER INDUSTRY WASTEWATER

Agata Mazieńczuk<sup>1</sup>, Nina Hutnik<sup>1</sup>, Krzysztof Piotrowski<sup>2</sup>, Anna Kozik<sup>1</sup>, Andrzej Matynia<sup>1</sup>

<sup>1</sup> Faculty of Chemistry, Wrocław University of Technology, Wrocław, Poland, e-mail: anna.kozik@pwr.wroc.pl

<sup>2</sup> Department of Chemical & Process Engineering, Silesian University of Technology, Gliwice, Poland, e-mail: krzysztof.piotrowski@polsl.pl

**Abstract:** New original construction of continuous FB MSZ (*Fluidized Bed with Mixed Suspension Zone*) crystallizer with internal circulation of suspension driven by jet pump fed with compressed air was used for continuous reaction crystallization of struvite  $\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$  from phosphorus fertilizers industry wastewater by magnesium and ammonium ions addition. This wastewater of  $\text{pH} < 4$  contained 0.445 mass % of phosphate(V) ions and impurities: aluminium, calcium, copper, iron, potassium, magnesium, titanium, zinc, fluosilicate, fluoride and sulphate(VI) ions. Tests were carried out in 298 K, in stoichiometric conditions and at 20% excess of magnesium ions. Crystals of mean size. 27 – 43  $\mu\text{m}$  were produced. Struvite crystals of the largest sizes and acceptable homogeneity were produced at 20% excess of magnesium ions, at  $\text{pH} 9$  and elongated mean residence time of suspension 3600 s. Corresponding crystal linear growth rate was  $8.52 \cdot 10^{-9}$  m/s according to SIG MSMR (*Size Independent Growth, Mixed Suspension Mixed Product Removal*) kinetic model. Concentration of phosphate(V) ions decreased from 0.445 mass % in a feed to  $9.3 \cdot 10^{-4}$  mass % in a postprocessed mother solution. In a product, besides main crystalline component – struvite, also all impurities from wastewater appeared in a form of hydroxides, phosphates(V) and other salts.

**Key words:** Struvite, FB MSZ crystallizer, industrial wastewater, continuous reaction crystallization, product quality, kinetics, phosphorus recycling.

## Introduction

In most DTM (*Draft Tube Magma*) type crystallizers internal circulation of suspension is an effect of stirrer or pump action (Mullin, 1993). These can be, however, alternatively replaced by liquid jet pump devices (Synowiec, 2008). In typical constructions of liquid jet pump crystallizers (Matynia, 1997) driving agent is a possible fines-free mother solution collected from the crystallizer overflow and then redirected through the external circulation pump back into the feeding nozzle of a jet pump device. It is possible, however, to replace the circulating mother solution with the air (Matynia, 2009). Compressed air (or other gaseous medium) provided into feeding nozzle of a jet pump device becomes under these conditions working medium driving the internal circulation and mixing of suspension in the apparatus working volume. Troublesome in operating and control elements like crystallizer overflow and external circulation loop with the pump become thus unnecessary.

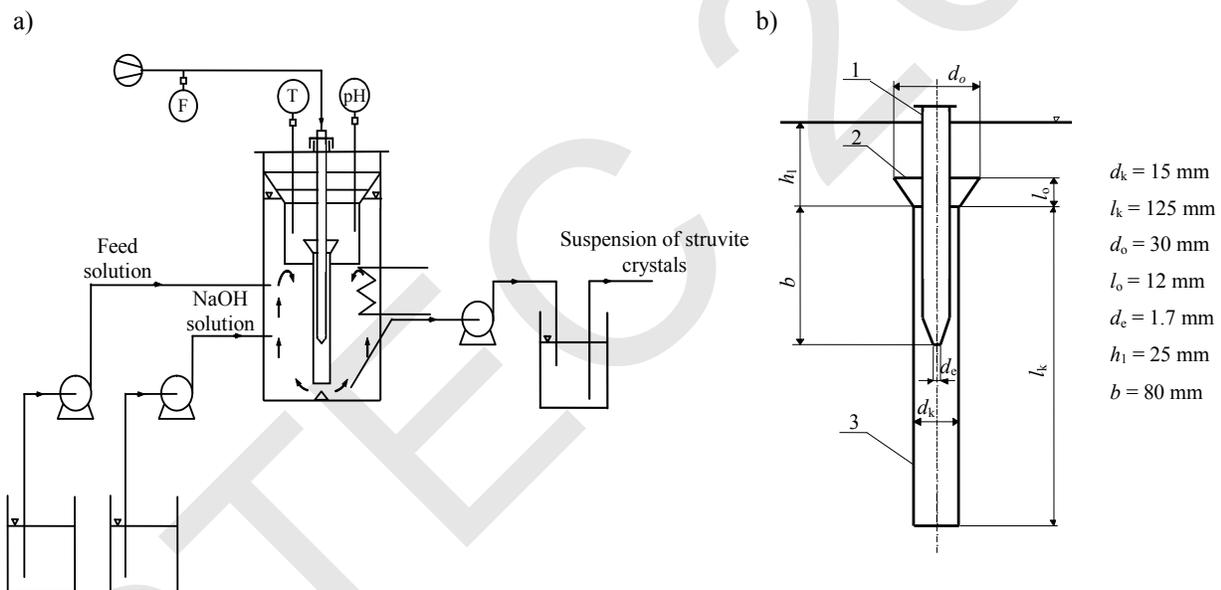
Laboratory research stand with a continuous FB MSZ (*Fluidized Bed with Mixed Suspension Zone*) type crystallizer were designed and constructed. This stand is especially destined for the tests concerning effectiveness, kinetics and optimisation of continuous reaction crystallization processes of struvite ( $\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$ , MAP) from diluted aqueous solutions, wastewaters, liquid manure, etc. containing phosphate(V) ions (Parsons, 2001; Doyle, 2002). Chemical recovery of phosphates(V) from various waste solutions can be numbered among phosphorus recycling (Le Corre, 2009), and resulting products – sparingly soluble crystalline calcium or magnesium salts – can be practically utilized as a mineral fertilizer (de-Bashan, 2004).

The FB MSZ type crystallizer of working volume  $V_w$  1.2  $\text{dm}^3$  with jet pump fed with compressed air was used.

Feeding nozzle of a jet pump was installed inside mixing chamber where compressed air flow was directed downward. In a space between the jet pump mixing chamber and crystallizer body pseudofluidal layer of struvite crystals self-established. The crystallizer was used for struvite continuous reaction crystallization process using real wastewater from phosphorus mineral fertilizers industry (leachate from phosphogypsum slag heap in Z. Ch. POLICE S.A., Poland, containing 0.445 mass % of  $\text{PO}_4^{3-}$ ). It was continuously provided with feed solution (wastewater and reagents premixed) of the assumed molar ratio  $[\text{PO}_4^{3-}]_{\text{RM}} : [\text{Mg}^{2+}]_{\text{RM}} : [\text{NH}_4^+]_{\text{RM}}$  as 1 : 1 : 1 or 1 : 1.2 : 1. Process ran in a constant temperature 298 K. Influence of pH (8.5 – 10) and mean residence time of suspension in a crystallizer  $\tau$  (900 – 3600 s) on the product crystals quality was identified. Fundamental process kinetic parameter values were estimated from the product crystal size distributions. The most simplified model of mass crystallization process kinetics in a continuous MSMPR (*Mixed Suspension, Mixed Product Removal*) crystallizer – SIG (*Size Independent Growth*) – was used for the calculations. Characteristics of crystalline products and kinetic calculation results are presented and discussed below.

## Materials and Method

Scheme of the research stand is presented in Figure 1a. The FB MSZ crystallizer with jet pump driven by compressed air was cylindrical tank of diameter  $D$  90 mm and total height  $H_t$  330 mm, made with *Plexiglas*.



**Figure 1:** Scheme of laboratory stand with a continuous FB MSZ crystallizer with a gas-liquid jet pump: working volume of crystallizer  $V_w$  1.2 dm<sup>3</sup>, crystallizer's geometrical parameters:  $D$  90 mm,  $H_t$  330 mm,  $H_w$  220 mm (a). Jet pump element in a FB MSZ crystallizer: 1 – feeding nozzle; 2 – confusor; 3 – mixing chamber (b).

Inside the crystallizer body gas-liquid jet pump was installed, presented schematically in Figure 1b. Feeding nozzle of a jet pump was provided with experimentally adjusted, minimal volumetric stream of the compressed air,  $q_{ve}$  0.43 dm<sup>3</sup>/s, indispensable only to keep all solid particles in a permanent movement. Resulting intensity of suspension circulation was thus also minimal. Geometrical proportions within a jet pump system are presented in Figure 1b. Owing to relatively small unit power of a feeding gaseous stream, relatively large struvite crystal density ( $\rho$  1710 kg/m<sup>3</sup>) and specific flow hydraulic conditions, the phenomenon of crystal suspension sucking into the mixing chamber space is not observed in a crystallizer. In such defined process conditions the pseudofluidal layer of crystals forms in a space between mixing chamber and crystallizer body.

The raw materials in a continuous struvite reaction crystallization process were: crystalline magnesium

chloride hexahydrate  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$  and crystalline ammonium chloride  $\text{NH}_4\text{Cl}$  (p.a., POCh, Gliwice, Poland), as well as wastewater from phosphorus mineral fertilizers industry (Z.Ch. POLICE S.A., Poland) of pH 3.8 and detailed composition presented in Table 1. The reagents (wastewater,  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$  and  $\text{NH}_4\text{Cl}$ ) were first introduced into the mixer, in which the struvite precipitation reaction substrates dosed in a crystalline form dissolved. Mass stream values of these reagents resulted from the assumed molar ratio  $[\text{PO}_4^{3-}]_{\text{RM}} : [\text{Mg}^{2+}]_{\text{RM}} : [\text{NH}_4^+]_{\text{RM}}$ , assumed mean residence time  $\tau$  of suspension in a crystallizer working volume and from working volume  $V_w$  of the crystallizer used. Clear solution of blended and totally dissolved reagents, of pH 3.6 (stoichiometric proportions of the reagents) or 3.5 (20% excess of magnesium ions), was introduced via pump into the crystallizer working volume. Crystallizer was also provided with aqueous solution of NaOH of concentration 5 mass %, responsible for stabilization of the required pH in struvite continuous reaction crystallization environment. Inlet places of reagents and alkalinizing solution, as well as crystalline product suspension removal port are marked in Figure 1a. Temperature and inflow/outflow streams were strictly controlled and adjusted by computer system (BioScadaLab program).

**Table 1:** Chemical composition of phosphorus mineral fertilizers industry wastewater.

| Component          | Concentration, mass % |
|--------------------|-----------------------|
| $\text{PO}_4^{3-}$ | 0.445                 |
| Al                 | $6.4 \cdot 10^{-4}$   |
| Ca                 | 0.044                 |
| Cu                 | $0.25 \cdot 10^{-4}$  |
| Fe                 | $8.9 \cdot 10^{-4}$   |
| K                  | $4.6 \cdot 10^{-3}$   |
| Mg                 | 0.0306                |
| Si                 | $5.1 \cdot 10^{-3}$   |
| Ti                 | $0.2 \cdot 10^{-4}$   |
| Zn                 | $2.2 \cdot 10^{-4}$   |
| $\text{F}^-$       | $4.2 \cdot 10^{-3}$   |
| $\text{SO}_4^{2-}$ | 0.0703                |

The research tests ran in temperature  $298 \pm 0.2$  K assuming pH 8.5, 9 or 10 ( $\pm 0.1$ ) and mean residence time of suspension in a crystallizer  $\tau$  900, 1800 or 3600 s ( $\pm 20$  s). The reagent concentrations in a feed solution were:  $[\text{PO}_4^{3-}]_{\text{RM}} = 0.445$  mass %,  $[\text{Mg}^{2+}]_{\text{RM}} = 0.114$  mass % and  $[\text{NH}_4^+]_{\text{RM}} = 0.0844$  mass % securing their molar ratio 1 : 1 : 1 or 0.445, 0.137 and 0.0844 for 20% excess of magnesium ions, appropriately. After stabilisation in a crystallizer the predetermined parameter values, process in a steady state ran through  $5\tau$ . After this time there were determined using standard analytical methods: concentration of solid phase in a crystal product suspension ( $M_T$ ), chemical composition of mother solution and solid phase (among others: atomic absorption spectrometer iCE 3000, spectrophotometer UV-VIS Evolution 300), struvite crystal size distribution (solid particle analyser Beckman Coulter LS 13 320) and their habit (computer analysis of scanning electron microscope JEOL JSM 5800LV images). Accuracy of measurement data concerning continuous struvite reaction crystallization process in the described laboratory plant was estimated to be ca. 10%.

Kinetic parameter values of the process were estimated based on the population density distributions  $n(L)$  of the product crystals (Mullin, 1993). The most simplified kinetic model valid for continuous MSMPR crystallizer, SIG kinetic model (Randolph and Larson, 1988), was assumed for the calculations. Equation of crystal population density distribution resulting from the assumed SIG kinetic model is in a form of Eq. (1):

$$n(L) = n_0 \exp\left(-\frac{L}{G\tau}\right) \quad (1)$$

from which for  $L = 0$  one can determine the nuclei population density  $n_0$  value and, from the slope in  $\ln n - L$

coordinate system, linear crystal growth rate  $G$  for the known mean residence time  $\tau$  of suspension in a crystallizer. Nucleation rate  $B$  can be calculated from Eq. (2):

$$B = n_0 G \quad (2)$$

## Results and Discussion

From FB MSZ crystallizer properly shaped product crystals were removed. Statistical parameter values of size distribution of these crystals are presented in Table 2. From the table it results (tests No. 1, 2 and 3 in Table 2), that increase in pH of mother solution in a crystallizer from 8.5 to 10 resulted in decrease of crystal mean size  $L_m$  from 37.2 to 26.7  $\mu\text{m}$  (by ca. 28%). The CV coefficient increased from 90.1 up to 99.3%. Crystal products manufactured under pH 10 characterised thus by not only smaller particle sizes, but also their higher variability. With the pH value increase nuclei population density also increases (see Table 4), what produces shifts in characteristic sizes of struvite crystals:  $L_m$ ,  $L_{50}$  and  $L_d$  towards smaller values. Elongation of mean residence time of suspension in a crystallizer caused, however, increase in mean sizes of product crystals, by ca. 18%. Struvite crystals reached mean size  $L_m$  41.8  $\mu\text{m}$  for mean residence time  $\tau$  3600 s and pH 9. With the mean residence time elongation average supersaturation in solution decreased, producing as a result decrease of both kinetic components of the process: nucleation rate of solid phase and their linear growth rate values (see Table 4).

**Table 2:** Influence of selected technological parameters of continuous struvite reaction crystallization process from phosphorus mineral fertilizers industry wastewater in FB MSZ crystallizer on the product quality. Process temperature: 298 K.

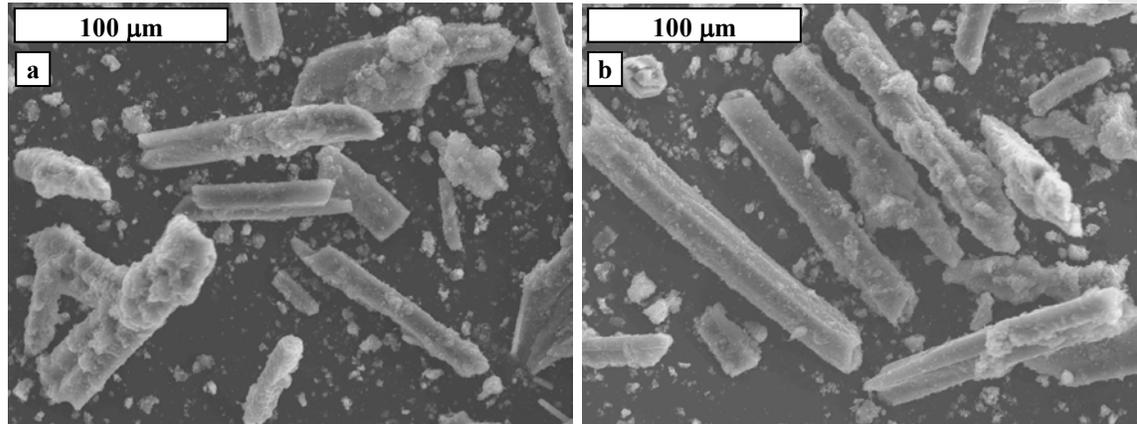
| No.  | Process parameters |             | Suspension in crystallizer          |   |  | Crystal characteristic |                           |                        |         |                |
|--|--------------------|-------------|-------------------------------------|---|--|------------------------|---------------------------|------------------------|---------|----------------|
|  | pH                 | $\tau$<br>s | $M_T$<br>kg crystals/m <sup>3</sup> | $[\text{PO}_4^{3-}]_{\text{solution}}$<br>mg/kg | $[\text{PO}_4^{3-}]_{\text{crystals}}$<br>mass % | $L_m$<br>$\mu\text{m}$ | $L_{50}$<br>$\mu\text{m}$ | $L_d$<br>$\mu\text{m}$ | CV<br>% | $L_a/L_b$<br>– |
| Molar proportions of reagent ions in a feed: $[\text{PO}_4^{3-}]_{\text{RM}} : [\text{Mg}^{2+}]_{\text{RM}} : [\text{NH}_4^+]_{\text{RM}} = 1 : 1 : 1$   |                    |             |                                     |   |  |                        |                           |                        |         |                |
| 1  | 8.5                | 900         | 10.9                                | 63.0  | 39.2   | 37.2                   | 25.3                      | 29.6                   | 90.1    | 5.2            |
| 2  | 9                  | 900         | 11.0                                | 45.0  | 39.3   | 35.5                   | 24.6                      | 28.9                   | 92.6    | 5.0            |
| 3  | 10                 | 900         | 11.0                                | 37.6  | 40.2   | 26.7                   | 22.6                      | 24.5                   | 99.3    | 4.7            |
| 4  | 9                  | 1800        | 11.1                                | 31.8  | 40.1   | 41.7                   | 30.3                      | 36.1                   | 92.6    | 5.1            |
| 5  | 9                  | 3600        | 11.2                                | 22.0  | 42.0   | 41.8                   | 31.1                      | 36.8                   | 90.9    | 5.2            |
| Molar proportions of reagent ions in a feed: $[\text{PO}_4^{3-}]_{\text{RM}} : [\text{Mg}^{2+}]_{\text{RM}} : [\text{NH}_4^+]_{\text{RM}} = 1 : 1.2 : 1$ |                    |             |                                     |   |  |                        |                           |                        |         |                |
| 6  | 9                  | 900         | 11.3                                | 18.6  | 39.2   | 37.9                   | 26.6                      | 30.1                   | 93.9    | 5.2            |
| 7  | 9                  | 3600        | 11.4                                | 9.3   | 42.1   | 43.2                   | 33.3                      | 37.2                   | 92.1    | 5.3            |

$L_m = \sum x_i L_i$ , where:  $x_i$  – mass fraction of crystals of mean fraction size  $L_i$ ;  $L_{50}$  – median crystal size for 50 mass % cumulative undersize fraction;  $L_d$  – crystal mode size;  $\text{CV} = 100(L_{84} - L_{16}) / (2L_{50})$ , where:  $L_{84}$ ,  $L_{16}$ ,  $L_{50}$  – crystal sizes corresponding to 84, 16 and 50 mass % cumulative undersize fractions.

Longer residence time of crystal population in supersaturated solution caused, however, that their sizes increased significantly. In solution of lower average supersaturation crystals grew slower, however more stable. Longer contact time of crystal phase with supersaturated mother solution influenced also struvite final crystal size distribution advantageously. Homogeneity within product crystal population increased slightly. The CV value decreased from 92.6 to 90.9%, in spite of increase in intensity of co-running processes of attrition and breakage of crystals with the elongation of their residence time in a mixed and circulated suspension.

Excess of magnesium ions in relation to phosphate(V) and ammonium ions concentrations in a crystallizer feed resulted in increase in mean size  $L_m$  of product crystals: from 35.5 to 37.9  $\mu\text{m}$  (pH 9,  $\tau$  900 s), as well as from 41.8 to 43.2  $\mu\text{m}$  (pH 9,  $\tau$  3600 s) (tests No. 2 and 6, 5 and 7 in Table 2, respectively). Crystal population homogeneity

decreased slightly since the CV values increased from 92.6 to 93.9% and from 90.9 to 92.1%, respectively. In pure aqueous solutions of phosphate(V) ions excess of magnesium ions influences final sizes of struvite crystals disadvantageously (Kozik, 2012). Presence of impurities in a process system (Table 1) resulted, however, that final result of continuous struvite reaction crystallization process was more advantageous (Table 2). Some of ionic impurities inhibit struvite nucleation, other can catalyse nuclei or crystals growth, while some other can significantly affect their shape and habit (Hutnik, 2011; Hutnik, 2012).



**Figure 2:** Scanning electron microscope images of struvite crystals produced from phosphorus mineral fertilizers industry wastewater in a continuous FB MSZ type crystallizer. Process parameters:  $[\text{PO}_4^{3-}]_{\text{RM}} : [\text{Mg}^{2+}]_{\text{RM}} : [\text{NH}_4^+]_{\text{RM}} = 1 : 1 : 1$  in a feed, pH 9,  $\tau$  900 s (a) and  $[\text{PO}_4^{3-}]_{\text{RM}} : [\text{Mg}^{2+}]_{\text{RM}} : [\text{NH}_4^+]_{\text{RM}} = 1 : 1.2 : 1$  in a feed, pH 9,  $\tau$  3600 s (b). Magnification: 500 $\times$ .

In Figure 2 there are presented the scanning electron microscope images of exemplary product crystals. Diverse sizes of struvite crystals are clearly observable. Also other solid particles, co-precipitated from a complex wastewater system in the process conditions, are visible. The most often they form agglomerates on the struvite parent crystals surfaces. Struvite crystals are just stuck the co-precipitated hydroxides of metal impurities, hydroxyapatite and other salts around. Excess of magnesium ions favoured not only production of struvite crystals of larger sizes (Figure 2b), but also efficiency of phosphate(V) ions removal from wastewater. Concentration of phosphate(V) ions in a postprocessed mother solution  $[\text{PO}_4^{3-}]_{\text{solution}}$  decreased from 45.0 to 18.6 mg/kg (pH 9,  $\tau$  900 s) and from 22.0 to 9.3 mg/kg (pH 9,  $\tau$  3600 s) (see Table 2). The best-formed struvite crystals were produced at low pH value (8.5 – 9), elongated mean residence time  $\tau$  (3600 s) and at 20% excess of magnesium ions in a feed solution. In the process conditions tested, crystal length  $L_a$  to their width  $L_b$  ratio varied from 4.7 to 5.3 (Table 2). The  $L_a/L_b$  simplex values were calculated from planimetric measurements covering 50 crystals randomly selected from three different scanning electron microscope images of the same product sample. Based on microscope images analysis one can conclude, that struvite crystals surface was taken up by solid particles of impurity hydroxides and salts co-precipitated with struvite, what produced generation of significant tensions in parent struvite crystals structures. In result numerous crystal fractures and cracks, irregular surfaces, deformed edges, presence of characteristic tubular and trough-shaped crystals, etc. are observed (Figure 2). Product crystals habit distinctly deviated from the classical shape of struvite crystals produced from pure solutions of phosphates(V) ( $L_a/L_b$  ca. 6) or manufactured in the presence of single impurities (Hutnik, 2011; Hutnik, 2012). One can assume, that struvite crystal sizes and shapes are the resulting net effect of impurities presence in the investigated wastewater system and parameters of struvite continuous reaction crystallization process. From the microscope images it also results, that agglomeration within the struvite crystals was not significant, while attrition and breakage of crystal phase during their mixing and circulation in a crystallizer can be regarded moderate. Generally it speaks advantageously about process conditions established in a crystallizer working volume for struvite nucleation and its crystals growth. Original construction of FB MSZ crystallizer (lack of moving/rotating parts and elements), its work mode (formation of pseudofluidal crystal layer) and relatively low concentration of solid phase in suspension ( $M_T$  ca. 11 kg of struvite/m<sup>3</sup> of suspension) did not contribute to excessive attrition and breakage within crystal phase. Considering, however, all components of a complex process of continuous

struvite reaction crystallization process in a FB MSZ crystallizer one can conclude, that main factor influencing the process course is solution supersaturation, very strongly dependent (assuming constant: feed solution composition, process temperature and mixing/circulation intensity) on process environment's pH and mean residence time of suspension in a crystallizer working volume.

**Table 3:** Chemical compositions of solid phase and mother solution after filtration of crystal suspension removed from continuous FB MSZ crystallizer (see Table 2).

| Component                     | Concentration in mother solution<br>mg/kg | Concentration in<br>solid phase*<br>mass % |
|-------------------------------|---|--|
| PO <sub>4</sub> <sup>3-</sup> | 9.3 – 63.0**                              | 39.2 – 42.1**                              |
| Mg <sup>2+</sup>              | 30 – 240                                  | 9 – 10                                     |
| NH <sub>4</sub> <sup>+</sup>  | 75 – 115                                  | 6.5 – 7.0                                  |
| Al                            | 0.1 – 0.3                                 | (4.8 – 5.5)·10 <sup>-2</sup>               |
| Ca                            | < 50                                      | 2.5 – 4.0                                  |
| Cu                            | 0.02 – 0.10                               | (0.6 – 1.3)·10 <sup>-4</sup>               |
| Fe                            | 0.03 – 0.07                               | 0.10 – 0.20                                |
| K                             | 25 – 39                                   | 0.12 – 0.22                                |
| Si                            | 25 – 42                                   | (8.6 – 9.7)·10 <sup>-2</sup>               |
| Ti                            | < 0.2                                     | < 2·10 <sup>-5</sup>                       |
| Zn                            | < 0.5                                     | (1.6 – 1.9)·10 <sup>-2</sup>               |
| F <sup>-</sup>                | 2 – 24                                    | 0.35 – 0.48                                |
| SO <sub>4</sub> <sup>2-</sup> | 400 – 560                                 | 1.5 – 1.8                                  |

\* after drying, without water washing of crystals on a filter

\*\* see Table 2

In Table 3 there are presented the components concentration ranges identified in the postprocessed mother solution and in solid phase (without water washing of crystals on a filter and after their drying) removed from FB MSZ crystallizer (see Table 2). Crystalline product, as it results from Table 3, besides main component MgNH<sub>4</sub>PO<sub>4</sub>·6H<sub>2</sub>O, contained also all impurities present in wastewater, among others: phosphates(V) and metal hydroxides, fluosilicates, fluorides and sulphates. From these data analysis it results, that at magnesium ions excess practically total precipitation of aluminium, calcium, copper, iron and zinc ions is observed (compare these ions concentrations in raw wastewater (Table 1) and in postprocessed mother solution (Table 3)). One can also notice, that phosphate(V) ions concentration in a postprocessed mother solution varied from 63.0 (pH 8.5, τ 900 s) to 22.0 mg/kg (pH 9, τ 3600 s) (tests No 1 – 5 in Table 2). These concentration values decreased systematically with the pH raise and with elongation of mean residence time τ of struvite crystals suspension in a crystallizer. From the comparison it results, that phosphate(V) ions concentration decreased even 3-time. It is attributed to struvite solubility decrease with the increase in pH of reactive mixture or longer contact time of crystals with the supersaturated solution in a crystallizer (more thorough discharge of the generated supersaturation). The [PO<sub>4</sub><sup>3-</sup>]<sub>solution</sub> values can be regarded small, thus efficiency of phosphate(V) ions removal from feed solution (above 98%) as a fully satisfactory.

Excess of magnesium ions with relation to concentration of phosphate(V) and ammonium ions influenced the process yield advantageously. Concentration of phosphate(V) ions in a postprocessed mother solution was ca. 2-time smaller than in stoichiometric conditions (see tests No 6 and 7 in Table 2).

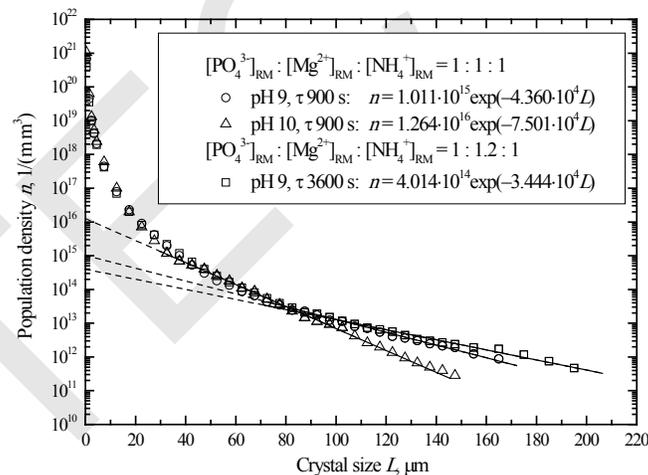
In Figure 3 there are presented the exemplary experimental population density distributions of crystals produced at pH 9 and 10 for mean residence time of suspension in a crystallizer 900 s (stoichiometric conditions) and at pH 9, τ 3600 s (20% excess of magnesium ions). From these distribution courses, presented in  $\ln n - L$  coordinate system it results, that for particles of sizes  $L > 70 \mu\text{m}$  (pH 8.5 and 9) or  $L > 30 \mu\text{m}$  (pH 10) these dependencies can be, with satisfactory precision, approximated with linear function. From Eq. (1) one can calculate linear crystals growth

rate  $G$  value, and from Eq. (2) their nucleation rate  $B$ .

**Table 4:** Nucleation rate  $B$  and crystal linear growth rate  $G$  values estimated for continuous struvite reaction crystallization process in a FB MSZ crystallizer. Kinetic parameters calculated with SIG MSMPR model. Process conditions – see Table 2.

| No.<br>(see Table 2<br>for details)  | Process kinetic parameter values (SIG MSMPR model)  |                                  |                       |                      |                     |
|--|---|----------------------------------|-----------------------|----------------------|---------------------|
|  | $n(L)^*$  | $R^2$<br>(for linear<br>segment) | $n_0$<br>$1/(m\ m^3)$ | $G$<br>m/s           | $B$<br>$1/(s\ m^3)$ |
| Molar proportions of reagent ions in a feed: $[PO_4^{3-}]_{RM} : [Mg^{2+}]_{RM} : [NH_4^+]_{RM} = 1 : 1 : 1$   |   |                                  |                       |                      |                     |
| 1  | $n = 7.783 \cdot 10^{14} \exp(-4.098 \cdot 10^4 L)$ | 0.983                            | $7.8 \cdot 10^{14}$   | $2.71 \cdot 10^{-8}$ | $2.1 \cdot 10^7$    |
| 2  | $n = 1.011 \cdot 10^{15} \exp(-4.360 \cdot 10^4 L)$ | 0.993                            | $1.0 \cdot 10^{15}$   | $2.55 \cdot 10^{-8}$ | $2.6 \cdot 10^7$    |
| 3  | $n = 1.264 \cdot 10^{16} \exp(-7.501 \cdot 10^4 L)$ | 0.995                            | $1.3 \cdot 10^{16}$   | $1.48 \cdot 10^{-8}$ | $1.9 \cdot 10^8$    |
| 4  | $n = 4.075 \cdot 10^{14} \exp(-3.453 \cdot 10^4 L)$ | 0.989                            | $4.1 \cdot 10^{14}$   | $1.61 \cdot 10^{-8}$ | $6.6 \cdot 10^6$    |
| 5  | $n = 4.014 \cdot 10^{14} \exp(-3.444 \cdot 10^4 L)$ | 0.987                            | $4.0 \cdot 10^{14}$   | $8.06 \cdot 10^{-9}$ | $3.2 \cdot 10^6$    |
| Molar proportions of reagent ions in a feed: $[PO_4^{3-}]_{RM} : [Mg^{2+}]_{RM} : [NH_4^+]_{RM} = 1 : 1.2 : 1$ |   |                                  |                       |                      |                     |
| 6  | $n = 6.682 \cdot 10^{14} \exp(-4.134 \cdot 10^4 L)$ | 0.987                            | $6.7 \cdot 10^{14}$   | $2.69 \cdot 10^{-8}$ | $1.8 \cdot 10^7$    |
| 7  | $n = 3.610 \cdot 10^{14} \exp(-3.261 \cdot 10^4 L)$ | 0.991                            | $3.6 \cdot 10^{14}$   | $8.52 \cdot 10^{-9}$ | $3.1 \cdot 10^6$    |

\*) for  $L > 70\ \mu\text{m}$  (pH 8.5 and 9),  $L > 30\ \mu\text{m}$  (pH 10)



**Figure 3:** Exemplary population density distributions of crystals produced in a FB MSZ type crystallizer fed with a phosphorus mineral fertilizers industry wastewater assuming stoichiometric ratio between the main reagents and at 20% excess of magnesium ions. The points – experimental data, solid lines – values calculated with Eq. (1) (see Table 4) for crystals of sizes  $L > 70\ \mu\text{m}$  (pH 8.5 and 9) and  $L > 30\ \mu\text{m}$  (pH 10), dashed lines – linear extrapolations of SIG model to  $L = 0$ .

Determined parameters of population density distribution function  $n(L)$  (Eq. (1)) for struvite product crystals and calculated on this basis  $G$  and  $B$  values are presented in Table 4. Nonlinearity in population density distribution courses for the crystals of size  $L$  smaller than 30 or 70  $\mu\text{m}$  (in a  $\ln n - L$  coordinate system, Figure 3) points on more complex process kinetics than it results from the assumed “linear” SIG MSMPR model. Thus the presented kinetic

parameter values of the investigated process should be regarded only as the estimated ones. It especially concerns nucleation rate value  $B$  calculated with Eq. (2), with the use of strongly devaluated values of nuclei population density  $n_0$  ( $n(L)$  for  $L = 0$ ). As it results from Figure 3, the differences between  $n_0$  values predicted by extrapolation with linear SIG MSMPR kinetic model and real population density values for the smallest crystals are in the order of  $10^5$ . Calculated values of nucleation rate  $B$  are thus useful only for relative, conventional comparison of the investigated process parameter effects on its course and final results.

Analyzing the kinetic data presented in Table 4, one can notice regular decrease of struvite crystal linear growth rate  $G$  with the increase in process environment pH and with elongation of mean residence time of suspension in a crystallizer. Generally higher crystal growth rate values are observed for the shortest mean residence times in apparatus, what is in accordance with the observations concerning classical continuous mass crystallization processes. Exemplary, increase in pH of process environment in a crystallizer from 8.5 to 10 for  $\tau$  900 s results in decrease of linear growth rate of struvite crystals from  $2.71 \cdot 10^{-8}$  to  $1.48 \cdot 10^{-8}$  m/s. It is large decrement of  $G$  value (by ca. 45%). It is additionally accompanied by significant increase in nuclei population density  $n_0$  value, thus nucleation rate  $B$  (from  $2.1 \cdot 10^7$  to  $1.9 \cdot 10^8$  1/(s m<sup>3</sup>)). In result final crystal mean size  $L_m$  decreased ( $37.2 \rightarrow 26.7$   $\mu$ m). Elongation of mean residence time of suspension in a crystallizer limited struvite nucleation rate  $B$  (from  $2.6 \cdot 10^7$  to  $3.2 \cdot 10^6$  1/(s m<sup>3</sup>) for  $\tau$  900  $\rightarrow$  3600 s, pH 9). Linear crystal growth rate also decreased ( $G$   $2.55 \cdot 10^{-8} \rightarrow 8.06 \cdot 10^{-9}$  m/s), however longer contact time with supersaturated mother solution caused, as it was mentioned earlier, increase in mean struvite crystal size.

Excess of magnesium ions in a feed mixture caused advantageous changes in kinetic parameters of struvite continuous reaction crystallization process: decrease of nucleation rate and increase in linear crystal growth rate (compare: No. 2 and 6, as well as No. 5 and 7 in Table 4). Net effect of all partial interactions within the analysed process turned out to be advantageous for manufacturing the product crystals of larger sizes.

## Conclusions

The research tests of struvite continuous reaction crystallization from phosphorus mineral fertilizers industry wastewater in a FB MSZ type crystallizer with internal circulation of suspension driven by jet pump fed with compressed air were carried out. Test results can be regarded satisfactory and advantageous. The FB MSZ crystallizer worked stable in a continuous work mode. Its original construction (absence of moving or rotating elements) and its work mode (formation of pseudofluidal crystals layer) did not arrange excessive attrition and breakage effects within the crystal phase. It was concluded, that the product crystals homogeneity was significantly influenced by technological process parameters (pH, mean residence time of suspension in a crystallizer, excess of magnesium ions in relation to phosphate(V) and ammonium ions in a feed), as well as intrinsic chemical composition of wastewater.

From FB MSZ crystallizer properly shaped struvite crystals of mean size  $L_m$  from ca. 27 to ca. 43  $\mu$ m were removed. It was experimentally proved, that increase in pH value (from 8.5 to 10) caused decrease of mean crystal size (by ca. 28%,  $L_m$  37.2  $\rightarrow$  26.7  $\mu$ m,  $\tau$  900 s). Contrary, elongation of mean residence time of suspension in a crystallizer from 900 to 3600 s produced significant increase in this size (by ca. 18%,  $L_m$  41.8  $\mu$ m at pH 9 and  $\tau$  3600 s). Products of low size homogeneity (CV  $\sim$  90 – 100%) were removed from the crystallizer. It is a net effect of a complex influence of pH and mean residence time of suspension, as well as crystals attrition and breakage on supersaturation level in mother solution.

For the process kinetic parameters estimation the simplest kinetic model developed for ideal MSMPR crystallizer was applied. It was concluded, that linear crystal growth rate values of struvite varied within the  $8.06 \cdot 10^{-9}$  –  $2.71 \cdot 10^{-8}$  m/s range, while nucleation rate within the  $3.2 \cdot 10^6$  –  $1.9 \cdot 10^8$  1/(sm<sup>3</sup>) range. With the elongation of mean residence time of suspension both kinetic parameter values decreased. With the pH rise nucleation rate increased while simultaneously linear growth rate decreased. Reduction of both kinetic parameter,  $B$  and  $G$ , values with the elongation of mean residence time was correlated with increase in mean size  $L_m$  of product crystals. Lower values of linear growth rate are thus compensated with excess by longer contact time of crystals with supersaturated mother solution. Simultaneously decreasing nucleation rate values also advantageously affected the process of crystal phase growth and self-establishing in these conditions size distribution of the product suspension.

Excess of magnesium ions in a process system definitely advantageously influenced the struvite continuous reaction crystallization process yield. Concentration of phosphate(V) ions decreased from 0.445 mass % in a feed to  $9.3 \cdot 10^{-4}$  mass % in a postprocessed mother solution, what can be regarded as a very good result of their removal

process from inlet solution. It was accompanied by rise of mean size of product crystals ( $L_m$  up to 43.2  $\mu\text{m}$ ), crystal linear growth rate ( $G$  up to  $8.52 \cdot 10^{-9}$  m/s) and nucleation rate decrease ( $B$  to  $3.1 \cdot 10^6$  1/( $\text{sm}^3$ )).

In crystal product, besides main component – struvite, all impurities originally present in wastewater appeared in a form of hydroxides, phosphates(V) and other salts. Aluminium, copper, iron and zinc ions practically totally co-precipitated with struvite. Direct application of such crystalline mixture in agriculture is limited, however part of these impurities can be regarded as the soil enriching components (nutrients).

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# APPLICATION OF THE BANKRUPTCY MODEL IN05 FOR THE FINANCIAL STABILITY EVALUATION IN THE CZECH REPUBLIC

Pavel Šlégr, Ondřej Kopecký  
Department of Business Administration  
University of Economics in Prague  
Czech Republic  
pavel.slegr@vse.cz, xkopo03@vse.cz

**Abstract:** This paper is focused on presenting bankruptcy model IN05. This model was designed especially to evaluate the financial health of companies in the Czech Republic and reflects the specifics in the Czech market. IN05 is applied to a group of the biggest companies in the Czech Republic and assesses their financial stability during the time period 2006-2010. Another objective of the article is to analyze the particular components of the index IN05. Their interaction with the index IN05 during the reporting period is evaluated by correlation.

**Key words:** IN05, crisis, Czech Republic, financial stability, large companies.

## Introduction

Overindebtedness of U.S. households (mainly by mortgage loans) led to the collapse of the U.S. real estate market in 2007. The crisis spread quickly, because many banks and funds from around the world bought derivatives based on U.S. mortgage loans. This loans have become since the year 2007 almost worthless and a wave of revaluation of these loans has come in 2008, we have already spoken about the global crisis since this moment. Almost every company in the world had to face a decline in demand as a result of the crisis. Companies also had to reduce their margins to keep as many customers as possible (Palley 2012). Management of the most companies in the Czech Republic underestimated this crisis and responded to it with a delay (Kislingerová 2010). Reactions often came up in a situation where the companies had liquidity problems. Under normal circumstances, the companies dealt the lack of liquidity through the bank instruments, but the banks responded to the crisis by limitation of the credit (Huizinga 2009). This situation thus had necessarily reflect on a reduced financial stability of the companies. A deterioration of the financial health of the companies can be documented using the index IN05. This is a solvency-bankruptcy model, which is developed specifically for an assessment of the financial stability of medium and large enterprises running a business in the Czech Republic. IN05 is designed to reflect not only the financial stability of a company but also its future prosperity. The object of evaluation is a group of the largest companies which have their company address in the Czech Republic. The biggest companies are selected because they are the basic pillars of the domestic economy. Moreover many other producers are bound with them as their suppliers, which only adds to their importance for the economy of the Czech Republic.

This article aims to demonstrate that the crisis affected the financial stability of these companies. However, companies responses (though they came late) for a given situation at least partially restored their original financial health. Another aim is to demonstrate the relationship between the variables of the model and index IN05 and a determination of their significance.

This article is elaborated as an output of the research project *Analyza uplatňování controllingo-vých nástrojů a vyhodnocení rozdílů v přístupu ke controllingu v době krize a v postkrizovém řízení (Analysis of the use of controlling tools and the evaluation of different controlling approaches in crisis and after crisis)* registered at FPH VŠE in Prague, Czech republic under registration number IGA F3/26/2012.

## Method

In this case, we observe 51 largest companies that are registered in the Czech Republic. The companies were selected on the basis of the CZECH TOP 100 ranking for the year 2011. There are presented 100 largest companies in terms of their annual turnover in a given year in this ranking. As mentioned above, they are the most important companies in the region because they form the backbone of the national economy. They are also leaders in their fields who have a strong bargaining position with their stakeholders. This allows them to use a wide variety of tools that provide them with a financial stability. The data sources are annual reports of the selected companies, which are publicly available on the website of the Ministry of Justice Czech Republic [www.justice.cz](http://www.justice.cz). We use the data for the years 2006-2010, which allow to get an overview of a financial stability before the crisis, its changes during the crisis and the impact of the company's management steps, which respond to the crisis.

First, we must introduce bankruptcy model IN05. This is one of a series of soveny-bankruptcy models IN and was created by husband and wife Neumaier. Model accurately describes the business conditions in the Czech Republic. Its formula is as follows (Neumaierová 2005):

$$IN05 = 0,13(X1) + 0,04(X2) + 3,97(X3) + 0,21(X4) + 0,09(X5)$$

where

IN05 = overall index,

X1 = total assets/total debt,

X2 = earnings before interest and taxes/ interest expense,

X3 = earnings before interest and taxes/total assets,

X4 = sales/total assets,

X5 = current assets/short-term liabilities.

Companies whose value of the index is below the value 0.9 are put in danger of bankruptcy with a probability of 86%. Values above the 1.6 are financially stable companies with a probability of 67%. Between the values 0.9 and 1.6 is the so-called "grey zone" where it is not clearly to say whether the company is financially healthy or not. It should be noted that in the case of low debt of company, the variable X2 reaches a very high value, that can distort the final index value. Therefore, we limit the maximum of the variable X2 at the value of 9.

If the formula IN05 model is compared with the other generally respected and used bankruptcy model Altman's Z-Score, we find that there are many similarities. We use the revised Z-score of which the formula is (Altman 2000):

$$Z' = 0,717(X1) + 0,847(X2) + 3,107(X3) + 0,420(X4) + 0,998(X5)$$

where

Z' = overall index,

X1 = working capital/total assets,

X2 = retained earnings/total assets,

X3 = earnings before interest and taxes/total assets,

X4 = net worth/total debt,

X5 = sales/total assets.

As can be seen, in both models are identical two most important variables. In both models, the X3 variable *earnings before interest and taxes/total assets* (Return On Assets) has by far the highest coefficient, which means that it is the most important variable for the construction of both models. The X3 variable is even more important in the model IN05 than in the Z-Score model, because the X3 variable coefficient is much higher in comparison with the other variables coefficients. In both models is identical the second major variable too – *sales/total asset*. Worth mentioning is also the variable X1 in the IN05 model and the variable X4 in the Z-Score model. These variables are not identical, but basically express the same information - the share of a foreign capital in the assets of the company.

In order to evaluate the general movement of the index IN05 during the time period, we need to filter out extreme values that might distort the evaluation. Therefore, we use the quartiles (25 percentil, median, 75 percentil) as a basic characteristic of the measured data (Hindls 2007). We calculate the value of index IN05 for each year and each company and from this data we calculate all three quartiles for each year.

To evaluate the relationship between the index IN05 and its particular variables we are going to use the correlation between the index IN05 and each of its particular variables (Hindls 2007).

## Results

First of all, we need to evaluate the development of the financial stability in the years 2006-2010. The Figure 1 shows the development of all quartiles in the time period.

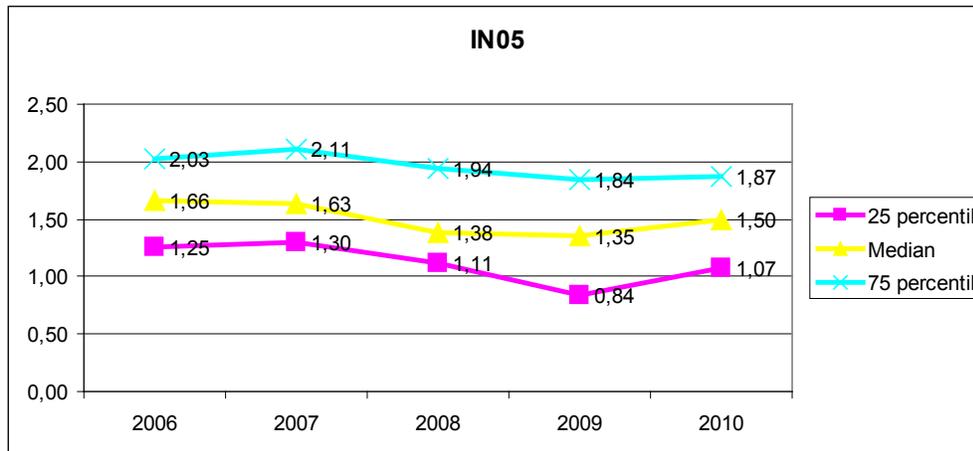


Figure 1 IN05 development

The Figure 1 shows that the crisis really damage the financial stability of companies during the time period 2006-2010. Since 2007, the decline in the index IN05 values can be seen. It indicates financial problems of companies. In 2010, the recovery comes and the index values increase. This is a result of the management actions that lead to strengthen the financial stability. This conclusion is confirmed by the development of the Z-Score values measured for the same companies in the Figure 2 (only quartiles are shown).

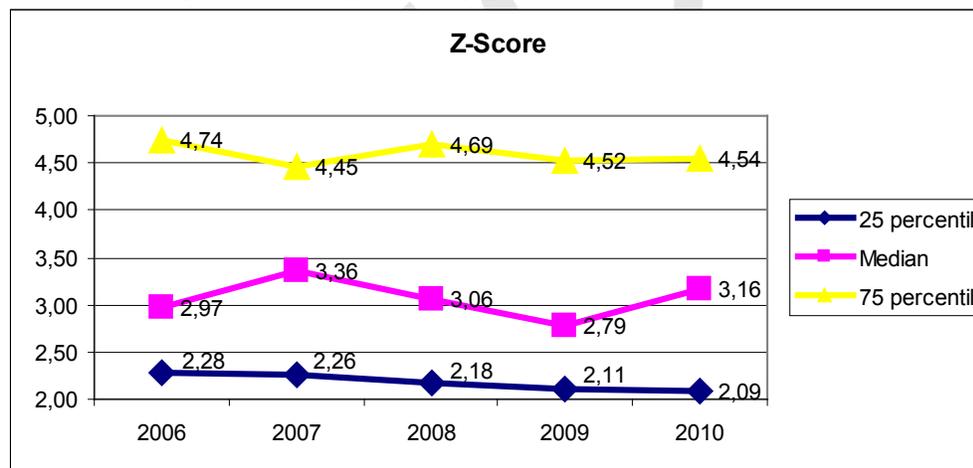


Figure 2 Z-Score development

To assess the development of the particular variables and their relationship with the development of the entire index IN05 is used their correlation. The results in the Figure 3 shows that the strongest relationship is between the index IN05 and the X3 variable. This relationship is especially affected by the high coefficient of this variable. During the time period there is a decline in the margins, which has a significant impact in the numerator (EBIT) of the variable. This fact contributes to the decline of the index IN05 most of all. The second major variable is X4, which is assigned the second highest coefficient. A decline of the variable is caused by a decline of the sales. Interpretation of the X2 variable correlation is problematic. There are only 3 negative correlations and so the

relationship between the X3 variable and the index IN05 seems to be strong. But we have to limit the value of this variable in all the years by value 9 in 18 cases. It means, that X2 variable does not change during the years and index IN05 does. So we can not assess a mutual relationship between them.

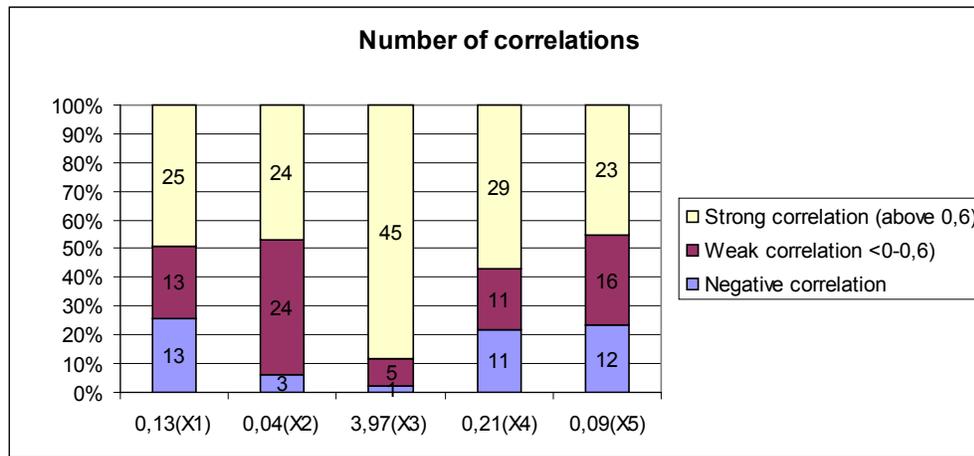


Figure 3 Correlation

## Conclusion

As we proved in the article, the last global crisis affected the financial stability of the selected Czech largest companies. This fact is supported by the values obtained from the index IN05 for the time period 2006-2010. The index IN05 is one of a series of solvency-bankruptcy models (similar to the Altman's Z-Score), which was developed specifically for the Czech business environment and took into account local specificities. Between 2008 and 2009 the values of the index IN05 declined. It meant that the financial stability of companies has been affected by the crisis. However, in 2010, there was a slight increase IN05 caused by a response of the companies to the crisis. The companies at least partially restored their stability and ensured future prosperity.

From the formula of the model IN05 is obvious that a solvency of a company is most affected by two model variables which have the highest coefficients: *EBIT/total assets* and *sales/total assets*. We also demonstrated it by using the correlation between the index IN05 and its variables. Both variables had the highest number of positive correlations. During the crisis, there was an overall decline in demand, so the sales of the companies decreased. Because we researched the largest companies which were not significantly flexible, they could not immediately respond to a decline in sales by selling an idle capacity. Therefore, the variable X4 *sales/total assets* decreased. Companies were trying to retain their customers by providing their products and services at a lower price at the expense of their margins. This had a negative impact on the EBIT and thus decreased the index *EBIT/total assets*. The crisis has negatively affected both major variables of the index IN05 after year 2008. It can be well seen as a decline in the value of the model IN05 in 2008 and 2009.

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# ASSESSING MEASUREMENT INVARIANCE OF THE MATHEMATICS LEARNING STRATEGIES ACROSS TURKEY AND HONGKONG-CHINA

## TÜRKİYE VE HONGKONG-ÇİN İÇİN MATEMATİK ÖĞRENME STRATEJİLERİ ÖLÇEĞİNİN ÖLÇME DEĞİŞMEZLİĞİNİN DEĞERLENDİRİLMESİ

Fatma NOYAN\*, Gülhayat GÖLBAŞI ŞİMŞEK\*\*

**ABSTRACT:** The purpose of this article is to investigate the measurement invariance of the Mathematics Learning Strategies Scale (MLSS) across Turkey and HongKong-China using multi-group confirmatory factor analysis (MGCFA). These countries were selected for the purpose of comparison on the basis of their mathematics achievement rankings in the PISA 2003 study. Findings suggested that MLSS was not a fully or partial measurement invariance across the two countries. In order to understand the nonequivalence, two separate single-group confirmatory factor (CFA) analyses were developed for each country. The fit indices from single-group CFA analysis for Turkey indicated a perfect fit of the MLSS. However, the fit indices from single-group CFA analysis for HongKong-China indicated a bad fit of the data to the proposed scale. We found for HongKong-China a clear factor structure for mathematics learning strategies that isn't similar to what OECD reported.

**Keywords:** learning strategies, measurement invariance, PISA

\* Assistant Prof. Dr., Department of Statistics, Yıldız Technical University, noyanf@gmail.com

\*\* Associate Prof. Dr., Department of Statistics, Yıldız Technical University, gulhayatgolbasi@gmail.com

# AŞIRI DOZDA AKIŞKANLAŞTIRICI KATKI KULLANIMININ BETON ÖZELLİKLERİNE ETKİSİNİN YAPAY SİNİR AĞI UYGULAMASI

Mücteba Uysal  
Sakarya University, Civil Engineering Department, Esentepe Campus, 54187  
Sakarya, Turkey  
[mucteba@sakarya.edu.tr](mailto:mucteba@sakarya.edu.tr)

Hüseyin Ulugöl  
Sakarya University, Civil Engineering Department, Esentepe Campus, 54187  
Sakarya, Turkey  
[hulugol@sakarya.edu.tr](mailto:hulugol@sakarya.edu.tr)

**Özet:** Beton çağdaş toplumların temelini oluşturan malzemelerin en önemlilerinden birisidir. Bir yapı malzemesi olan betondan temel olarak istenen belirli bir basınç dayanımına sahip olması ve uzun süre bozulmadan özelliklerini devam ettirebilmesidir. Literatürde çeşitli malzeme oranları için geliştirilmiş birçok basınç dayanım formülasyonları mevcuttur. Ancak günümüzde özellikle yüksek performanslı betonlar olarak ifade ettiğimiz ve belli katkı malzemelerinin kullanıldığı betonlarda, akışkanlaştırıcı katkı maddeleri betonun özelliklerini olumlu yönde değiştirmekle beraber, bu formülasyonların kullanımını da kısıtlamaktadır. Bunun temelinde beton teknolojisindeki gelişmelerin çok hızlı olması ve beton karışım dizaynlarının değişmesi gelmektedir. Bu sorunları ortadan kaldırmak için, literatürde yapay sinir ağları olarak tariflenen ve farklı amaçlar için geliştirilen bu teknik günümüzde birçok alanda özellikle mühendislik problemlerinin çözümünde yaygın olarak kullanılmaktadır. YSA öğrenme kabiliyeti ve adaptasyonu, az bilgi ile çalışabilme özelliği, hızlı çalışması ve tanımlama kolaylığı ile son yılların en popüler konularının başında gelmektedir. Bu kapsamda, deney neticesinde bulunan basınç dayanım değerlerinin yapay sinir ağlarıyla modellenmesi amaçlanmış ve çeşitli malzeme miktarları ile hangi basınç dayanım değerlerine ulaşılacağı modellenmesi yapılmıştır.

**Anahtar Kelimeler:** Yapay sinir ağları, beton, süper akışkanlaştırıcı katkı.

**Abstract:** Concrete is one of the most important materials which constitutes base of importance contemporary society. Concrete has to provide certain compressive strength and durability as a construction material. There are some formulations for compressive strength in the literature for various material proportions but today, these formulations are not used because of new generations of high performance concrete. Concrete technology has developed fast and mixture design changed for concrete and the use of these formulations out of service. Artificial Neural Networks (ANN) are used commonly to abolish these problems in the concrete industry and is used the most of engineering concerns and provide very attractive solutions for this reason. In decades, ANN is the most popular area of study due to the ability of training and adaptation, the property of working by limited data, convenience of definition. In this content, the modelling was done for the values of compressive strength test results by artificial neural networks and the relationship between compressive strength test results and design parameters was presented.

**Keywords:** Artificial neural networks, concrete, plasticizers.

## 1 Giriş

Bilim ve teknolojinin hızla ilerlediği günümüzde mühendislik problemlerindeki parametrelerin çokluğu yeni hesap ve analiz tekniklerinin ortaya çıkmasına sebep olmuştur. 20. yüzyılın ikinci yarısında temelleri atılan ve günümüzde büyük bir kitlenin üzerinde çalıştığı yapay zeka tekniği, pek çok problemin analizinde başarı ile kullanılmış ve klasik programlamaya alternatif olmuştur. Yapı malzemelerinin temelini oluşturan beton, farklı dizaynlarda üretime imkan vererek çok çeşitli dayanım değerlerinin elde edilmesine olanak sağlamaktadır. Çevremize baktığımızda binalar, yollar, köprüler, barajlar, santraller, limanlar, hava alanları vb. betondan yapıldığını görürüz [1]. Bilindiği gibi çimento, su, kimyasal, mineralojik katkı ve agrega olarak ifade ettiğimiz kum, çakıl, kırmataş ve taştözünden oluşan beton, farklı karışım yüzdelerinde üretilmektedir. Yapay sinir ağları, beton üretimindeki çeşitli karışım oranları arasındaki ilişkiyi en ideal şekilde modelleyerek dayanım tahminine imkan vermektedir [2]. Literatürde bu ilişkiyi açıklayan yapay sinir ağları ile ilgili modellere rastlanmamıştır. Aynı şekilde çeşitli dayanım değerleri için sabit miktarlardaki malzeme oranlarında herhangi bir malzeme miktarındaki değişimin beton basınç dayanımına etkisi, agregaların tane dağılımının beton dayanımını ne oranda etkilediği, beton üretiminde üzerinde önemle durulması gereken su miktarının optimizasyonu, bağlayıcı miktarının dayanımı ne şekilde değiştirdiği ve sertleşmiş beton üzerinde ihtilaf vuku bulduğunda herhangi bir malzeme miktarının tahmini yapay sinir ağlarını inşaat mühendisliğinde cazip kılmaktadır.

## 2 Yapay Sinir Ağları

Beynin üstün özellikleri, bilim adamlarını üzerinde çalışmaya zorlamış ve beyin nörofiziksel yapısından esinlenerek matematiksel modeli çıkarılmaya çalışılmıştır. Beynin bütün davranışlarını tam olarak modelleyebilmek için fiziksel bileşenlerinin doğru olarak modellenmesi gerektiği düşüncesi ile çeşitli yapay hücre ve ağ modelleri geliştirilmiştir. Böylece Yapay Sinir Ağları denen yeni ve günümüz bilgisayarlarının algoritmik hesaplama yönteminden farklı bir bilim alanı ortaya çıkmıştır. Yapay sinir ağları; yapısı, bilgi işleme yöntemindeki farklılık ve uygulama alanları nedeniyle çeşitli bilim dallarının da kapsam alanına girmektedir [3]. Yapay Sinir Ağları, kapsam olarak beyin bir işlevi yerine getirme yöntemini modellemek için tasarlanan bir sistem olarak tanımlanabilir. YSA, yapay sinir hücrelerinin birbirleri ile çeşitli şekillerde bağlanmasından oluşur ve genellikle katmanlar şeklinde düzenlenir. Donanım olarak elektronik devrelerle yada bilgisayarlarda yazılım olarak gerçekleştirilebilir. Beynin bilgi işleme yöntemine uygun olarak YSA, bir öğrenme sürecinden sonra bilgiyi toplama, hücreler arasındaki bağlantı ağırlıkları ile bu bilgiyi saklama ve genelleme yeteneğine sahip paralel dağılmış bir işlemcidir. Öğrenme süreci, arzu edilen amaca ulaşmak için YSA ağırlıklarının yenilenmesini sağlayan öğrenme algoritmalarını ihtiva eder.

## 3 Beton

Beton, çimento, su, agrega ve gerektiğinde katkı maddelerinin belirli oranlarda homojen olarak karıştırılmasıyla elde edilen başlangıçta plastik kıvamlı olup zamanla çimentonun hidrasyonu nedeniyle katılaşmış sertleşen bir yapı malzemesidir. Beton mutlak hacmini, %75 oranında agrega (kum, çakıl, mıcır) %10 oranında çimento, %15 oranında su oluşturur. Gerektiğinde, çimento ağırlığının %2'sinden fazla olmamak şartıyla katkı maddeleri ilave edilir [4]. Beton inşaat sektöründe ağırlıklı bir yere sahiptir. Betonun bu derece yaygın kullanılan bir yapı malzemesi olmasının çeşitli nedenleri vardır. Diğer pek çok yapı malzemesine göre; ekonomik olması, daha kolay şekil verilebilir olması, fiziksel ve kimyasal dış etkilere dayanıklı olması, her yerde üretilebilir olması ve üretimde daha az enerji tüketiliyor olması, çelik donatı ile adanasının iyi olması, yüksek basınç dayanımlarına ulaşılabilir olması ve çeşitli pigmentlerle renk verilebilir olması betonu üstün kılan özelliklerin başında gelmektedir [5].

### 3.1 Beton Kalitesinin Yapıdaki Önemi

Beton, yük taşıyıcı bir malzemedir. Taze beton, yeni karılmış, hamur halindeki özelliğini yani yumuşaklığını kaybetmemiş kolayca şekil verilebilen bir malzemedir. Birkaç saat içinde kati hale geçen, günlerce süren bir süreç sonunda sertliği artan ve yeterince mukavemet kazanmış betona da sertleşmiş beton denir. Betondan beklenen üç temel özellik vardır. Bunlar; İşlenebilirlik; taze betonun özelliği olup, taze betonun kolay karıştırılması ve yerleştirilebilmesi, karıştırırken, taşınırken ve yerleştirirken ayrışmaması, homojenliğini yitirmemesidir. Mukavemet; Sertleşmiş beton özelliğidir. Beton taşıyıcı bir malzeme olduğundan istenilen sınıf dayanımı güvenle sağlamalıdır. Dış etkilere dayanıklılık (Durabilite); bu özellik bir sertleşmiş beton özelliği olup hava, su ve kimyasal çevrenin etkisiyle donma-çözülme, ıslanma-kuruma gibi fiziksel etkiler ve hatta beton iç yapısında agrega ve çimento arasında oluşabilecek reaksiyonlar sonucu beton niteliklerini kaybedebilir. Örneğin; betonun mukavemeti azalır, geçirimsizliği artar ve kolay parçalanabilir. Betonun buna benzer bozulmalara direnç göstermesi gerekir. Buda betonun durabilitesidir.

### 3.2 Betonda Akışkanlaştırıcı Kullanımının Amaç ve Yararları

Uygulamada genelde üç amaçla akışkanlaştırıcılar kullanılmaktadır. Bunlar;

- Katkısız betonla aynı işlenebilmeyi sağlayarak su/çimento oranını azaltıp, daha yüksek mukavemet elde etmek,
- Kütle betonlarında hidrasyon ısısını düşürmek için çimento miktarını azaltarak aynı işlenebilmeyi sağlamak. Katkı bu şekilde kullanılarak daha ekonomik bir beton elde edilmiş olur.
- Ulaşılamayan (dar ve sık donatılı) yerlere kolay yerleşmeyi sağlayabilmek için işlenebilirlik arttırmak.

Bu katkılar sayesinde yüksek mukavemetli beton üretilmekte, aynı zamanda düşük su/çimento oranlarında normal islenebilen betonlar elde edilmektedir.

#### 4 Deneysel Çalışmalar ve Deney Sonuçları

Bu çalışmada normal/süper akışkanlaştırıcı katkıların aşırı dozda kullanımının beton basınç dayanımına etkisi yapay sinir ağı kullanılarak araştırılmıştır. Konu ile ilgili olarak laboratuvardaki çeşitli akışkanlaştırıcı katkılarla beş grupta otuzdört karışım hazırlanmış ve bu katkıların üretilen betonlar üzerindeki olumlu ve/veya olumsuz etkileri irdelenmiştir. Farklı dozlarda katkı miktarları normal akışkanlaştırıcıda %0.5, %1, %5, %10 ve süper akışkanlaştırıcıda %1.5, %3, %5 ve %10 oranlarında kullanılmıştır. Üretilen betonlar üzerinde 28 günlük basınç dayanımı deneyleri yapılarak farklı oranlardaki katkı miktarlarının, betondan asil istenen basınç dayanımı özelliği olması nedeniyle, katkı değişiminin beton mukavemeti üzerindeki etkisi incelenmiştir. Farklı oranlardaki akışkanlaştırıcı katkı maddelerinin beton performansına etkisini araştırmak üzere laboratuvarda beş grup deney yapılmıştır. Bu beş grup deney toplam 34 parti beton hazırlanarak yapılmıştır. Bu betonlarda çimento, su, akışkanlaştırıcı katkı, I nolu mıcır, kırma kum ve doğal kum kullanılmıştır. Agregaların karışım granülometrisi TS 706'ya göre belirlenmiştir. Karışımda kullanılan malzemeler ve elde edilen basınç dayanımı değerleri eğitim ve test seti için Tablo 1 ve 2'de verilmiştir.

**Tablo 1.** Eğitim seti için deneyde kullanılan malzemeler ve elde edilen sonuçlar

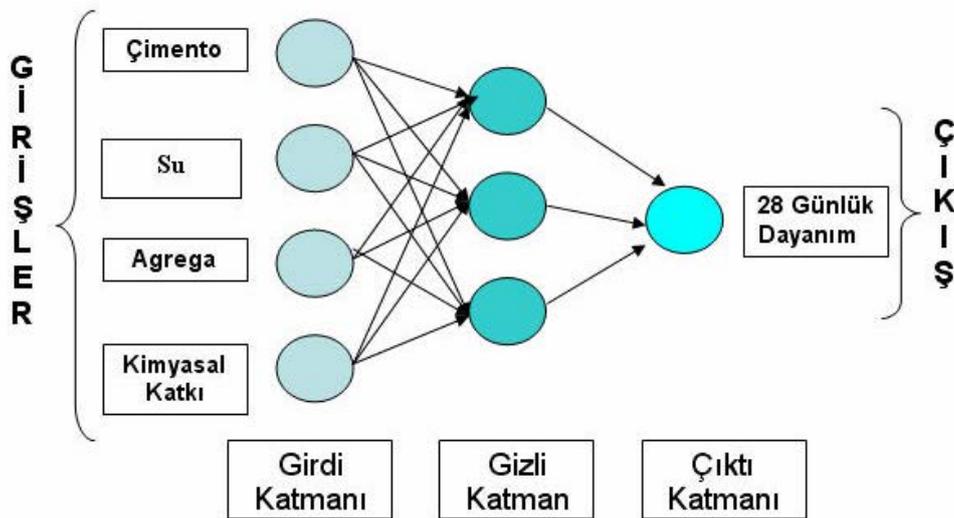
| Çimento (kg) | Su (kg) | Katkı (%) | Agrega (kg) | 28 Günlük Dayanım Değeri (Mpa) |
|--------------|---------|-----------|-------------|--------------------------------|
| 450          | 186     | 0         | 1730        | 47.8                           |
| 300          | 159     | 0.5       | 1900        | 34.9                           |
| 300          | 150     | 1         | 1900        | 39.2                           |
| 300          | 139     | 5         | 1900        | 30.3                           |
| 450          | 171     | 1         | 1730        | 48.2                           |
| 450          | 142     | 5         | 1730        | 45.3                           |
| 450          | 119     | 10        | 1730        | 40.5                           |
| 300          | 165     | 0.5       | 1900        | 42.4                           |
| 300          | 156     | 1         | 1900        | 31.4                           |
| 300          | 142     | 5         | 1900        | 25.6                           |
| 450          | 168     | 1         | 1730        | 48.4                           |
| 450          | 119     | 10        | 1730        | 35.8                           |
| 300          | 145     | 1.5       | 1900        | 34.1                           |
| 300          | 137     | 3         | 1900        | 24                             |
| 300          | 125     | 5         | 1900        | 21.3                           |
| 300          | 106     | 10        | 1900        | 12.4                           |
| 450          | 171     | 1.5       | 1730        | 58.3                           |
| 450          | 160     | 3         | 1730        | 46.8                           |
| 450          | 144     | 5         | 1730        | 39.3                           |
| 300          | 142     | 1.5       | 1900        | 44.9                           |
| 300          | 136     | 3         | 1900        | 33                             |
| 300          | 128     | 5         | 1900        | 27.8                           |
| 450          | 181     | 1.5       | 1730        | 48                             |
| 450          | 160     | 5         | 1730        | 35.9                           |
| 450          | 130     | 10        | 1730        | 31.2                           |

**Tablo 2.** Test seti için deneyde kullanılan malzemeler ve elde edilen sonuçlar

| Çimento (kg) | Su (kg) | Katkı (%) | Agrega (kg) | 28 Günlük Dayanım Değeri (Mpa) |
|--------------|---------|-----------|-------------|--------------------------------|
| 300          | 174     | 0         | 1900        | 29.3                           |
| 300          | 114     | 10        | 1900        | 23.1                           |
| 450          | 177     | 0.5       | 1730        | 52.2                           |
| 300          | 123     | 10        | 1900        | 17.7                           |
| 450          | 171     | 0.5       | 1730        | 50.1                           |
| 450          | 160     | 5         | 1730        | 42                             |
| 450          | 104     | 10        | 1730        | 34.4                           |
| 300          | 111     | 10        | 1900        | 12.1                           |
| 450          | 176     | 3         | 1730        | 41.1                           |

#### 4.2 Deneysel Verilerin Yapay Sinir Ağlarına Uygulanması

Ağı eğitmek için hazırlanan eğitim setinde girdi vektörü elemanları normalize edilerek ağ'a sunulmuştur. Eğitim seti deney sonucu elde edilen 25 veriden oluşmaktadır. Test seti ise toplam 34 veriden rasgele seçilmiş 9 örnekten oluşmaktadır. Dayanım değerleri için 4 adet girdi katmanında 3 adet gizli katmanda ve 1 adet çıktı katmanında olmak üzere toplam 8 adet nöron kullanılmıştır. Girdi vektörü elemanları 0 ile 1 arasında normalize edileceğinden, girdi vektörünün her elemanı eğitim setinde bulunan en büyük değere bölünerek 0 ile 1 aralığına indirgenmiştir. Dolayısıyla girdi vektörü elemanlarından çimento miktarı 450 ile, su miktarı 186 ile, katkı miktarı 10 ile ve agrega miktarı ise 1900 ile bölünerek normalize edilmiştir. Gizli katman nöron sayısı yapılan denemeler neticesinde belirlenmiştir. Dayanım değerleri için geliştirilen ağ topolojisi Şekil 1' de verilmiştir.


**Şekil 1.** Dayanım değerleri için geliştirilen ağ topolojisi

Oluşturulan test seti ve eğitim seti için normalize edilmiş değerler Tablo 3 ve 4’de sunulmuştur.

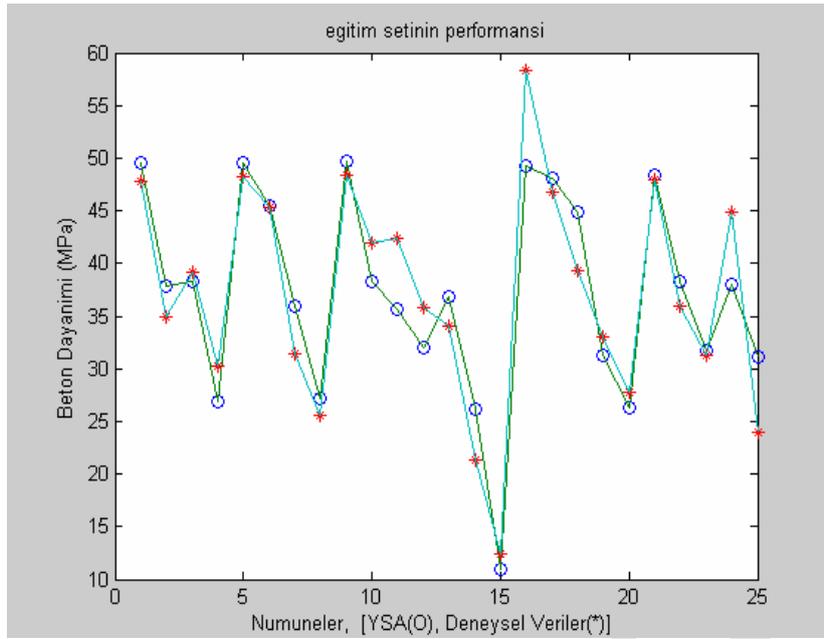
**Tablo 3.** Oluşturulan test seti için normalize edilmiş değerler

| Çimento (kg)<br>(Girdi 1) | Su (kg)<br>(Girdi 2) | Katkı (%)<br>(Girdi 3) | Agrega (kg)<br>(Girdi 4) | 28 Günlük Basınç Dayanımı<br>(Mpa) (Çıktı) |
|---------------------------|----------------------|------------------------|--------------------------|--|
| 1                         | 0.946237             | 0.3                    | 0.910526                 | 0.685                                      |
| 0.666667                  | 0.596774             | 1                      | 1                        | 0.201667                                   |
| 1                         | 0.55914              | 1                      | 0.910526                 | 0.573333                                   |
| 1                         | 0.860215             | 0.5                    | 0.910526                 | 0.7  |
| 0.666667                  | 0.66129              | 1                      | 1                        | 0.295                                      |
| 1                         | 0.919355             | 0.05                   | 0.910526                 | 0.835                                      |
| 0.666667                  | 0.612903             | 1                      | 1                        | 0.385                                      |
| 1                         | 0.951613             | 0.05                   | 0.910526                 | 0.87                                       |
| 0.666667                  | 0.935484             | 0.00001                | 1                        | 0.488333                                   |

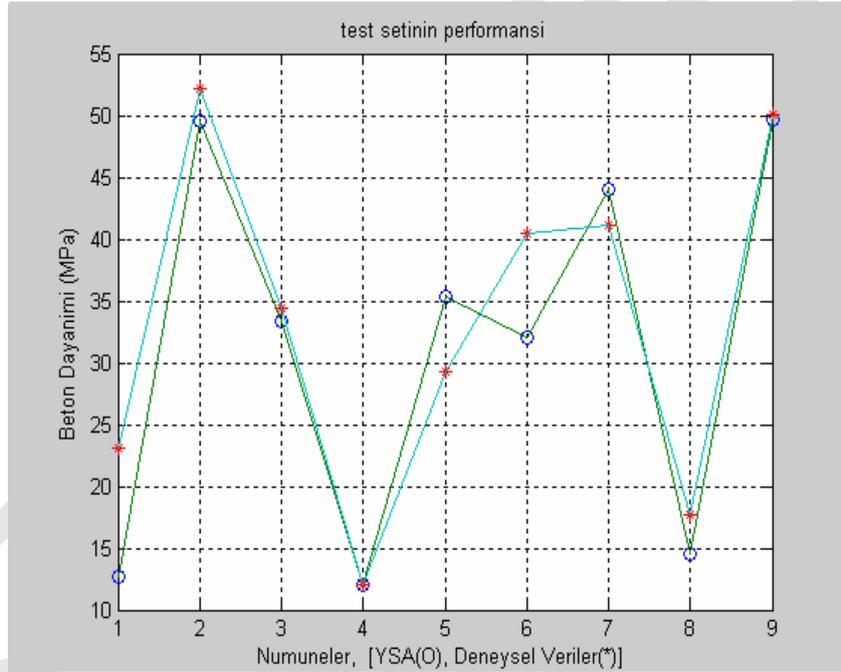
Oluşturulan eğitim seti ve test seti bir program üzerinde yapay sinir ağlarına uygulanmış ve aşağıdaki sonuçlar elde edilmiştir. Sekil 2’de Yapay Sinir Ağının verilen eğitim setiyle problemi öğrenmesini gösteren grafik verilmiştir. Sekil 3’de ise verilen test seti için YSA’ nın elde ettiği sonuçlarla olması gereken sonuçların karşılaştırılmasının yapıldığı grafik verilmiştir. Grafikten de anlaşılacağı gibi YSA eğitim ve test setinde de belli oranda başarılı olmuştur.

**Tablo 4.** Oluşturulan eğitim seti için normalize edilmiş değerler

| Çimento (kg)<br>(Girdi 1) | Su (kg)<br>(Girdi 2) | Katkı (%)<br>(Girdi 3) | Agrega (kg)<br>(Girdi 4) | 28 Günlük Basınç Dayanımı<br>(Mpa) (Çıktı) |
|---------------------------|----------------------|------------------------|--------------------------|--|
| 1                         | 1                    | 0.00001                | 0.910526                 | 0.796667                                   |
| 0.666667                  | 0.854839             | 0.05                   | 1                        | 0.581667                                   |
| 0.666667                  | 0.806452             | 0.1                    | 1                        | 0.653333                                   |
| 0.666667                  | 0.747312             | 0.5                    | 1                        | 0.505                                      |
| 1                         | 0.919355             | 0.1                    | 0.910526                 | 0.803333                                   |
| 1                         | 0.763441             | 0.5                    | 0.910526                 | 0.755                                      |
| 1                         | 0.639785             | 1                      | 0.910526                 | 0.675                                      |
| 0.666667                  | 0.887097             | 0.05                   | 1                        | 0.706667                                   |
| 0.666667                  | 0.83871              | 0.1                    | 1                        | 0.523333                                   |
| 0.666667                  | 0.763441             | 0.5                    | 0                        | 0.426667                                   |
| 1                         | 0.903226             | 0.1                    | 0.910526                 | 0.806667                                   |
| 1                         | 0.639785             | 1                      | 0.910526                 | 0.596667                                   |
| 0.666667                  | 0.77957              | 0.15                   | 1                        | 0.568333                                   |
| 0.666667                  | 0.736559             | 0.3                    | 1                        | 0.4  |
| 0.666667                  | 0.672043             | 0.5                    | 1                        | 0.355                                      |
| 0.666667                  | 0.569892             | 1                      | 1                        | 0.206667                                   |
| 1                         | 0.919355             | 0.15                   | 0.910526                 | 0.976667                                   |
| 1                         | 0.860215             | 0.3                    | 0.910526                 | 0.78                                       |
| 1                         | 0.774194             | 0.5                    | 0.910526                 | 0.655                                      |
| 0.666667                  | 0.763441             | 0.15                   | 1                        | 0.748333                                   |
| 0.666667                  | 0.731183             | 0.3                    | 1                        | 0.55                                       |
| 0.666667                  | 0.688172             | 0.5                    | 1                        | 0.463333                                   |
| 1                         | 0.973118             | 0.15                   | 0.910526                 | 0.8  |
| 1                         | 0.860215             | 0.5                    | 0.910526                 | 0.598333                                   |
| 1                         | 0.698925             | 1                      | 0.910526                 | 0.52                                       |



Sekil 2. YSA' nın eğitim seti öğrenme grafiği [6]



Sekil 3. YSA' nın test seti sonuçları ile deney sonuçlarının karşılaştırılması [6]

## 5 Sonuçların İrdelenmesi

Çalışmada, yapay sinir ağı kullanılarak farklı oranlardaki malzeme miktarları ile elde edilen basınç dayanım değerlerinin eğitilmesi ve test edilmesi gerçekleştirilmiştir. Bir sonraki aşama olarak ise değişik malzeme miktarları kullanılarak dayanım değerlerinin tahmin edilebilmesinin ne derece mümkün olacağı incelenebilecektir. Eğitim setinin ağ'a öğretilmesinde geriye yayılma algoritmasından faydalanılmıştır. Eğitim Seti sonuçları ağın problemi 5000 iterasyonda +%1,7 ile -%2 hata mertebelerinde öğrendiğini göstermiştir. Test seti sonuçları da ağın istenilen sonuçları +%0,8 ile -%6,5 hata ile elde ettiğini göstermiştir. Elde edilen sonuçlar ağın yeter yaklaşıklıkta sonuçlar verdiğini göstermiştir. Elde edilen sonuçlar ışığında yapay sinir ağlarının yapı malzemesi alanında bir çok deneysel verinin matematiksel modellemesine imkan vereceği ve bu metodun karışım dizaynında oldukça etkili olacağı ve betondan

temel olarak istenen etkili bir basınç dayanım değeri olduğuna göre optimum dayanım elde edilmesine birçok katkılar sağlayacağı düşünülmektedir.

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# BEHAVIOR OF *STAPHYLOCOCCUS AUREUS* IN A CHEESE PRODUCED BY LOCAL LACTIC ACID BACTERIA

**Koïche M.**, Dilmi Bouras A., Bouchakour H., Drahmoune L.

Laboratory of local natural bioresources- University HassibaBenbouali– BP 151 Hay Essalem- Chlef – Algeria

[Koiche\\_malika@yahoo.fr](mailto:Koiche_malika@yahoo.fr), [dilmibourasa@hotmail.com](mailto:dilmibourasa@hotmail.com) <tel:00213773430321>

**Abstract:** *Staphylococcus aureus* is a pathogenic bacterium that infects the milk and dairy products including cheese, causing food borne infections in humans. The objective is to scrutinize the growth and evolution of *S. Aureus* in cheese made with lactic acid bacteria isolated from local plants that are *Lactococcus lactis subsp. cremoris* and *Lactococcus lactis subsp. lactis biovar diacetylactis*. In the first part, the milk that was used in the manufacture of cheese was contaminated with *Staphylococcus aureus*, the antimicrobial activity was studied *vis-à-vis* *S. aureus* and the antagonistic effect of the latter against the lactic strains. In the second part, we performed counts of *lactococci* and *S. aureus* as the contaminated cheese in various stages of cheese production. From contaminated milk before manufacture of cheese, we have noticed a steady decline of lactic ferments after curdling and in parallel we have seen a decrease in the number of *S. aureus* during the early stages of production to increase again in the salting. The results of contaminated cheeses after their manufacture revealed a significant decrease in lactic strains and the pathogenic strain in both types of cheese after 24 and 72 h of their contamination. *Lactococci* don't have inhibitory activity *vis-à-vis* *S. aureus*, and *S. aureus* did not inhibit lactic strains used in the manufacture of cheese. Thus, it preserves its contamination and poses a risk to human health.

**Key words:** *Staphylococcus aureus*, Contamination, cheese, local lactic acid bacteria.

## Introduction

The lactic bacteria have presented a very crucial role in the manufacture of food fermented such as cheese for several centuries. The cheese is a complex medium made up mainly of water, coagulated proteins and milk fats in which, the pH, the activity of water, the potential of oxydoreduction, the content of salt and the activity of the microorganisms present in the leavens used, constitute a form of protection against the pathogenic ones. *Staphylococcus aureus* is a pathogenic bacterium which contaminates milk and the dairy products whose cheese, and for this reason it presents a major concern for animal and human health throughout the world. In certain contexts where lactic bacteria are the normal dominant microflora, as in cheese, *S. aureus* colonizes it sometimes and expresses the factors of virulence and produces a food poisoning. This study is devoted to manifest the interaction between the lactic acid bacteria and *S.aureus* and to show the capacities of inhibition which the lactic acid bacteria could have on the growth of *S. aureus* in the event of contamination milk which is used to produce cheese or its contamination after its production.

## Materials and Methods

### 1. Material

#### 1.1. Biological material

##### - Milk

Milk which has been used is a cow milk of the Montbeliard French race having 4 years old. It was selected following the selections carried out on several samples intended for the manufacture of cheese.

##### - Rennet

Commercial Rennet powder of forces 1/100.000 to 720 mg of Chymosine/100g. The powder of rennet is safely preserved from the light and moisture.

##### - Lactic acid bacteria

The lactic acid bacteria used are isolated starting from fermented plants (carrots, olives and cabbages) and identified at the local natural laboratory of Bioresources of the Faculty of Science of the university Hassiba Ben Bouali, Chlef, Algeria, they are *Lactococcus lactis subsp. cremoris* and *Lactococcus lactis subsp. lactis biovar diacetylactis*.

### - *Staphylococcus aureus*

The strain of *S.aureus* used, was isolated and identified at the local natural laboratory of Bioresources of the Faculty of Science of the university Hassiba Ben Bouali, Chlef, Algeria, starting from red Meat of cows.

## 1.2. Culture media

M17 broth and gelose (ref.: FABRI ms) For the preparation of the inoculum and the enumeration of the lactococci. For *Staphylococcus aureus*, we used the nutritive Broth (ref.: Pasteur institute of Algiers) for preparation of pre-culture, Giolitti Cantoni (ref.: Pasteur institute of Algiers) for enrichment and Chapman medium (ref.: Pasteur institute of Algiers) For the enumeration of *Staphylococcus aureus*.

For the interaction between the lactococci and *S.aureus* Mueller-Hinton media (ref.: FABRI ms) is used.

## 2. Methods

### 2.1. The examination of the purity of the bacteria

The examination of the lactic bacteria is done by macroscopic and microscopic observations: the colouring of Gram and search for catalase are used. The scrutiny of *S.aureus* is made by macroscopic and microscopic observations, search of catalase and test of mannitol mobility.

For the transplanting of the lactic bacteria 1 mL of inoculum is ensemenced in 09 mL of milk. Homogenize and well sealed the tubes then incubated at 30 °C during 72 h.

For *Staphylococcus aureus* add 15 mL of a Potassium Tellurite solution to the medium of Giolitti Cantoni, and mix carefully. Carry aseptically 1 mL by dilution of *Staphylococcus aureus* in a sterile tube. Mix the medium and the inoculum.

The incubation is done with 37°C during 24 to 48 hours. Be presumed positive the tubes having transferred to black. To make sure that it is required a development of *Staphylococcus aureus*, these tubes will be the subject of a confirmation by isolation on Agar Chapman previously melted, casting petri dishes and thoroughly dried. Chapman boxes thus seeded will be incubated in their turn with 37°C during 24 to 48 hours. After this time to locate the suspect colonies with knowing the colonies of average size, smooth, brilliant, pigmented in yellow and equipped with a catalase and a coagulase.

### 2.2. Study of the antimicrobial effect of *Lactococcus sp.* on *Staphylococcus aureus*

#### 2.2.1. *In vitro* study

##### - Preparation of the pre-cultures

The lactic acid bacteria are ensemenced in tubes which contain 09 mL of M17 broth. The tubes are incubated during 24 h with 30 °C. *S.aureus* is inoculated into a tube containing 09 mL of nutritive broth; this tube is then incubated with 37° C during 24 h - 48 h.

#### 2.2.2. Methods of interaction of the *Lactococcus sp.* and *Staphylococcus aureus*

The interaction is tested according to the method of Tadesse *et al.* (2004) known as a disc method or carries germ, and that was made in two manners. Firstly, discs are impregnated by *S.aureus* and the lactic acid bacteria are cultured on agar, and secondly, the discs impregnated by the lactic acid bacteria and *S.aureus* ensemenced on agar.

### 2.3. Manufacture of cheese contaminated by *Staphylococcus aureus*

#### 2.3.1. Raw materials

- **Preparation of milk**

14 g of dried milk is dissolved in 100 mL of distilled water, and then pasteurized in a Marie bath regulated with 75°C during 15 to 20 minutes. After that, milk is cooled at 37°C.

- **Preparation of the inoculum**

Ensemence some colonies of lactic acid bacteria "*Lc. lactis subsp cremoris* and *Lc. lactis subsp lactis biovar diacetylactis* " in prepared milk (each strain in a bottle). Homogenize and well seal the bottles then incubate with 30°C during 24 hours.

- **Preparation of lactic ferments.**

Prepare o milk (dried milk 14g in 100 mL of distilled water); Take 2 mL of inoculum prepared in 100 mL of prepared milk then incubates at 30°C during 16 to 18 hours.

- **Preparation of the solution of rennet**

Dissolve 1g of rennet powder in 100 mL of distilled water and preserve at 4°C during one week in maximum.

- **Preparation of dilutions of the inoculum of *Staphylococcus aureus***

We aseptically take using a graduated pipette 1 mL of inoculum and introduce it into a sterile tube containing 09 mL of physiological water, this solution is regarded as dilution  $10^{-1}$ , with the same method, one obtains dilutions  $10^{-2}$ ,  $10^{-3}$ .

### 2.3.2. Stages of the manufacture of cheese

We conducted two ways: Prepared Cheese starting from milk contaminated by *S.aureus* and Cheese preparation then its contamination by *S.aureus*.

#### a/ Preparing cheese starting from contaminated milk by *S.aureus*

- **Curdling**

- **Cheese of the lactic type**

- Pasteurize 1 liter of cow's milk in a Marie bath regulated in  $75^{\circ}\text{C}$  during 15 to 20 minutes;
- Cool the milk until the  $30 - 37^{\circ}\text{C}$ .
- Add 15 mL of lactic leaven of types *Lc. lactis subsp cremoris* and 15 mL of lactic leaven of type *Lc. lactis subsp lactis biovar diacetylactis*;
- Ensemence milk by 1 mL of dilution  $10^{-3}$  of the inoculum of *Staphylococcus aureus*;
- Homogenize and well seal the container;
- Leave the curdled milk at a temperature of  $25^{\circ}\text{C}$  during approximately 16 to 18 hours;

- **Cheese of the mixed type**

- Cheese curdling of the mixed type is identical to the first type of cheese, by adding 0,4 mL (1g/100 mL) with the solution of rennet for 1 L of milk;
- Ensemence milk by 1 mL of dilution  $10^{-3}$  of the inoculum of *Staphylococcus aureus*;
- Homogenize and well seal the container;
- Leave the curdling milk at a temperature of  $27^{\circ}\text{C}$  during approximately 16 to 18 hours;

- **Draining**

- After the coagulation of milk, put the curd on a filter;
- Leave curd drained spontaneously during 24 hours;
- Recover the lactoserum;

- **moulding**

- The curd is put out of mould after 24 hours of draining;
- Make the 1<sup>st</sup> reversal of the curd;
- After 12 hours, make the 2<sup>nd</sup> reversal.

- **Salting**

- The curd is put in brine (6.5 % of NaCl) during 10 to 20 minutes;
- Follow-up of a final draining (24 hours at  $18^{\circ}\text{C}$ ).

- **Refining**

- The refining and the conservation are 10 to 12 days at  $14^{\circ}\text{C}$

#### b/ Contaminated cheese by *S.aureus* after its manufacture

Cheese of a lactic type and cheese of a mixed type with a concentration of 6.5% of NaCl are prepared with the same manner and they are contaminated after 10 days of conservation by *S.aureus*.

### 2.3.3. Enumeration of the lactic acid bacteria and *S.aureus*

The enumeration of the lactic flora and *S.aureus* is done along the principal stages of the manufacturing process of the cheese (initial Load of the inoculum, Curdling, Draining, moulding, draining, Salting, Refining, Cheese before contamination, Cheese after 24 h of contamination and 72 h of contamination). The enumerations are carried out for the two types of cheeses (lactic and mixed).

## 3. Results and discussion

### 3.1. Testing of the purity of the bacteria

#### a/ The lactococci

All the taken colonies starting from M17 are round or lenticular, with regular contours, white, opaque and smooth, indicating that there are the lactococci as was confirmed by Leveau and Bouix (1980), Guiraud (2003) and Badis *et al.* (2005).

After Gram colouration, the microscopic examination allowed us to notice the aspect of the cells and their mode of regrouping. Only the positive Gram bacteria are retained. The microscopic aspect of all the strains used is presented in the form of shells, as Guiraud (1998) indicates it. The lactococci ones do not have a catalase, which is confirmed by Guiraud (2003).

#### b/ *Staphylococcus aureus*

During the macroscopic identification of *S.aureus* on Chapman medium, the insulated colonies appear in the form spherical of gilded yellow color, with a regular contour with Catalase + and Mannitol-mobility + as it was indicated by Avril (1997).

The fermentation of the mannitol results in the appearance of a yellow color due to the acidification of the medium. The mobile bacteria produce disorders in the medium and the motionless bacteria persist meadows of the central puncture (Guiraud, 1998). Thus *S.aureus* ferments in anaerobiose the mannitol and it is motionless.

According to the results, we can deduce that it is about the *S.aureus* germ. These results are sustained by those of Baird Parker taken by Guiraud (1998).

### 3.2. Interaction of the *lactococcus sp.* and *staphylococcus aureus (in vitro)*

#### 3.2.1. Inhibition of *S.aureus* by *lactococcus sp.*

According to the results obtained, no effect was noted, the pure cultures and the mixed cultures of lactococci do not have an inhibiting activity on *S.aureus* (figures 1 and 2).

This result is not in agreement with the work of Schillinger and Lucke (1989) which revealed that the lactococci ones have an inhibiting activity, *in vitro*, of the strain of *S.aureus*. This difference is probably related to the origin of the local lactic acid bacteria which are isolated starting from the plants (carrots, cabbages and olive black) where the ecological niche is not the same one. In the same context, the work of Yuksekdag *et al.* (2004) manifest the capacity of lactococci to inhibit *S taphylococcus aureus in vitro*.

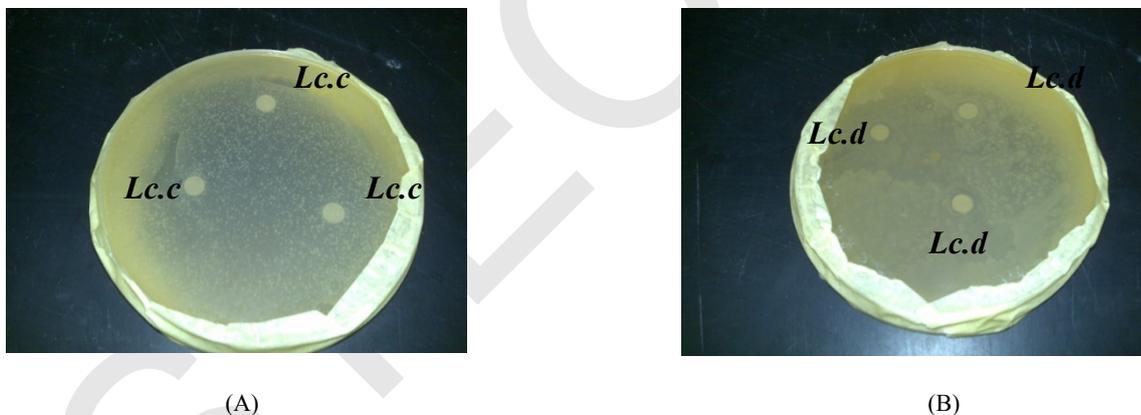


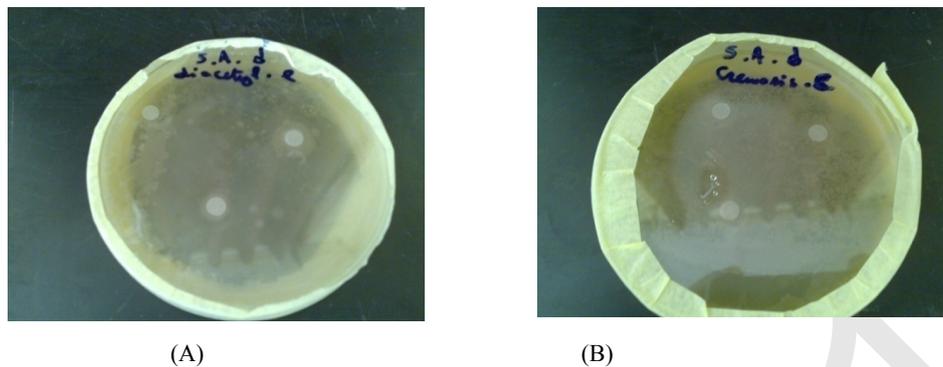
Figure 1: Antibacterial activity of the pure cultures of *Lc. cremoris* (A) and *Lc. diacetylactis* (B) with *Staphylococcus aureus*.



Figure 2: Antibacterial activity of the mixed cultures of *Lc. cremoris* + *Lc. diacetylactis* with *Staphylococcus aureus*.

#### 3.2.2. Inhibition of the *lactococcus sp.* by *S.aureus*

When the discs were impregnated with *S.aureus* and the lactococci ones were spread out over the agar, we noted that there is no inhibition of lactococci by *S.aureus* (figures 3 and 4), which confirms that the lactococci ones used in the majority of the cases as probiotic against the pathogenic persons in charge for gastroenteritis are not inhibited by the latter what is confirmed by the former work of Luquet and Corrieu (2005) which showed that the intestinal lactic flora is a first line of defense which oppose to the microbes and the other infectious agents.



**Figure 3:** antibacterial Activity of *Staphylococcus aureus* vis-à-vis of pure cultures of *Lc. cremoris* (A) and *Lc. diacetylactis* (B).



**Figure 4:** Antibacterial activity of *Staphylococcus aureus* on the mixed cultures of *Lc. cremoris* + *Lc. Diacetylactis*

### 3.3. Interaction of the lactococcus sp. and staphylococcus aureus in cheese

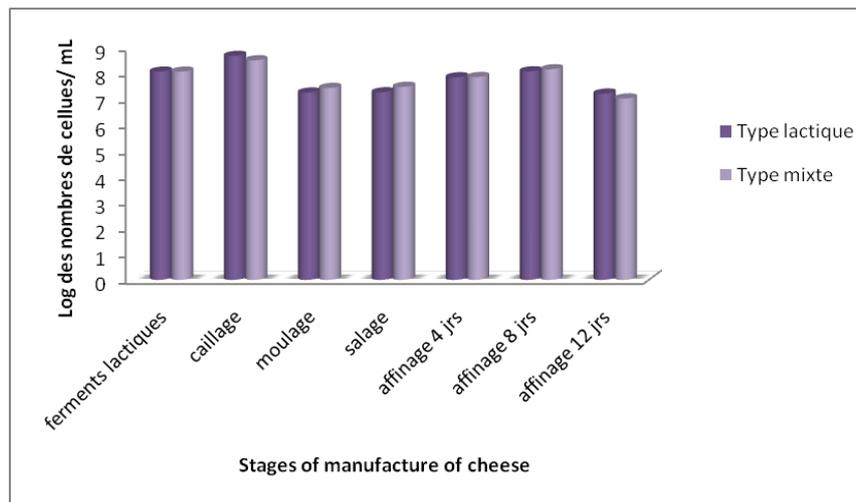
#### 3.3.1. Prepared cheese starting from a milk contaminated by *S.aureus*

##### a/ The lactococci

Enumerations of the total lactic flora were carried out after each stage of development of the two types of cheese (lactic and mixed) contaminated by *S.aureus*. After the curdling of milk, the number of cells of the leavens is relatively high with  $4.73 \times 10^8$  cells/mL for cheese of the lactic type and  $3.2 \times 10^8$  cells/mL for cheese of the mixed type. The increase in the leavens is allotted to the substrates which are rich in nutriments for the lactic acid bacteria.

Subsequently and after the moulding and salting, the concentration of the leavens decreases relatively to reach respectively  $1.8 \times 10^7$  cells/mL and  $1.83 \times 10^7$  cells/mL for cheese of the lactic type and  $2.75 \times 10^7$  cells/mL and  $2.99 \times 10^7$  cells/mL for cheese of the mixed type. These results are in agreement with that of Kim *et al.* (1994) who observed a reduction in the population of lactococci in fresh and refined cheeses after salting. Undoubtedly, this is because of their sensitivity to salt, as well as the loss of a certain number of bacteria in the whey after draining. By this token, Mahaut *et al.* (2000) show that the content sodium chloride of milks of cheese dairy can influence the survival of the lactococci ones.

During refining, the number of cells of the leavens increases again to reach  $7.06 \times 10^7$  cells/mL for cheese of the lactic type and  $7.17 \times 10^7$  cells/mL for cheese of the mixed type after 4 days (figure 5). The bacterial concentration remains high after 8 days of refining for the two types of cheese. Then, the number falls again and this is due to the exhaustion of the medium in nutriments during the last days of refining. This result is in conformity with the one that has been found by Eck and Gillis (1997) which demonstrate that an 8 weeks refining to 12°C reduced little the population of lactic bacteria.



**Figure 5:** Enumeration of the cheese leavens during the stages of manufacture of cheese contaminated by *S. aureus*

#### b/ *Staphylococcus aureus*

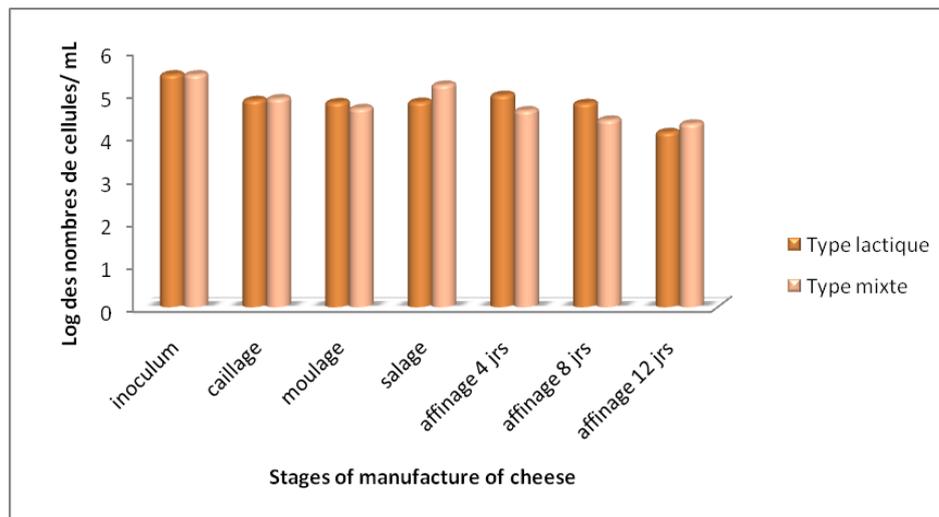
The enumerations of the cheese ferments were carried out after each stage of development of the two types of cheese (lactic and mixed) contaminated by *S.aureus*. The initial load of *S.aureus* is  $2.8 \times 10^5$  cells / mL in the two types of cheese. The results obtained indicate that the number of *S.aureus* falls considerably during the stages of curdling and the moulding for the two types of cheese manufactured and arrives respectively at  $7.05 \times 10^4$  cells/mL and  $6.25 \times 10^4$  cells/mL for cheese of the lactic type and  $7.6 \times 10^4$  cells/mL and  $4.5 \times 10^4$  cells/mL for cheese of the mixed type (figure 6), this reduction is allotted to the pH of milk. For this very reason, Leyral and Vierling (2007) showed that the lactic acid bacteria ferment lactose and acidify milk because of the massive production of lactic acid. Milk coagulates when the pH reached of the values less than 4.6 which is the isoelectric pH of milk.

Similarly, Hatreds and Hermon (1973) confirm that the inhibition of *S.aureus* by the lactic production of acid must take place after several hours in cheese. According to Gilliland and Speck (1974), antagonism towards *S.aureus* remains obvious when milk is maintained with a pH of 6.5. In the same context Meyrand *et al.* (1999) corroborates that the inhibition of *S. aureus* by the lactic acid bacteria is implemented at the time of the coagulation of milk.

The number of *S.aureus* increases again to reach a value of  $6.31 \times 10^4$  cells/mL in cheese of the lactic type and  $1.61 \times 10^5$  cells/mL in cheese of the mixed type during salting (figure 6). According to Han *et al.* (2005), *S.aureus* is an euryhaline bacterium which is able to multiply in medium of laboratory up to 12% of NaCl.

Throughout refining, we noted a reduction in the number of cells of *S.aureus* in the two types of cheese, which arrives at  $1.24 \times 10^4$  cells/mL for cheese of the lactic type and  $1.95 \times 10^4$  cells/mL for cheese of the mixed type, that can be explained by a proteolytic activity, a reduction in the activity of water (aw), an increase in the environmental temperature or an exhaustion of medium in nutrients.

Mayrand and Vernozy-Rozand (1999) displayed that the population of *Staphylococcus aureus* stabilizes itself or tends to decrease in particular during a long refining. But even after 12 days the number remains significant for a pathogenic bacterium such as *S.aureus* where their pathogenic character is directly related to the presence of toxins and its incidence on human health is only possible from starting from a strong contamination:  $10^6$  Staph. / g of cheese, and even the regulation can be regarded as not satisfying a threshold more than  $10^4$  Staph. / g of cheese.



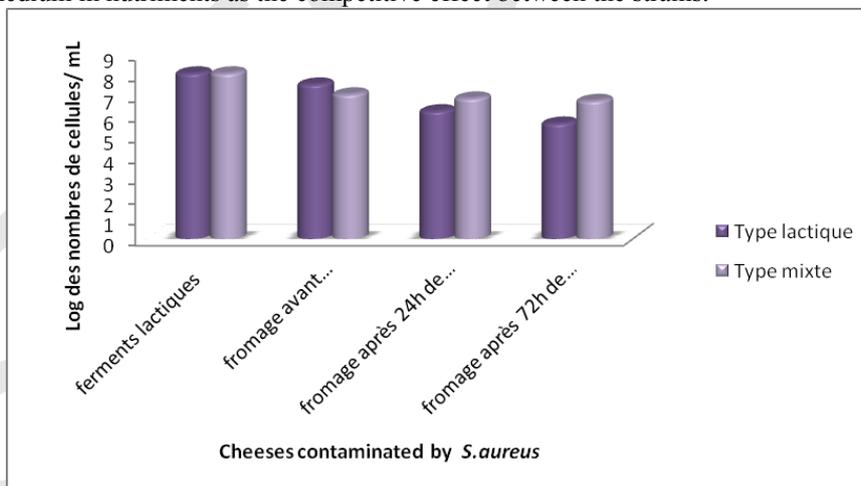
**Figure 6:** Enumeration of *S. aureus* during the stages of manufacture of cheese contaminated by *S. aureus*.

### 3.3.2. Cheese contaminated by *S.aureus* after its manufacture

We contaminated the two types of cheese by the *S.aureus* stock after their manufacture then, we carried out enumerations of the lactic strains and pathogenic strain after 24 and 72 hours.

#### a/ The lactococci

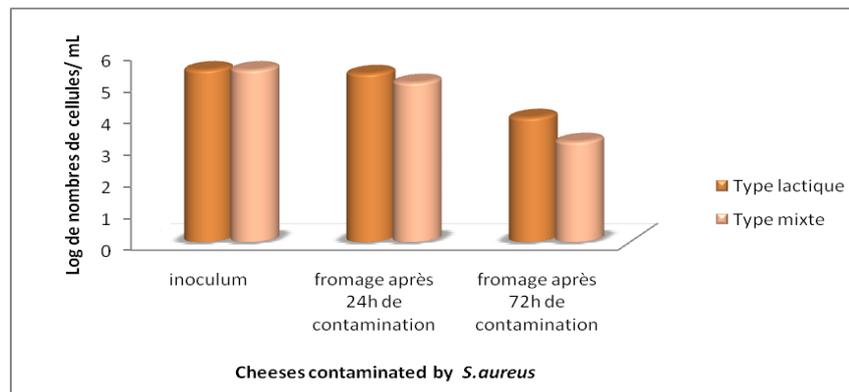
During the storage of cheese with 4°C, a reduction in the number of cells is recorded according to time (figure 7). The concentration reaches  $3.36 \times 10^7$  cells/mL for cheese of the lactic type and  $1.11 \times 10^7$  cells/mL for cheese of the mixed type after 10 days of storage. We noted that the load of the lactic flora decreases in the two types of cheese contaminated by the *S.aureus* strain. According to Bornarel *et al.* (2003) during marketing, the cheese is preserved at the cold, a temperature which has not to exceed 8°C, during 1 month or more. Under these conditions, the leavens of cheese do not multiply, but they, nevertheless, preserve a metabolic activity, the reduction is also allotted to the exhaustion of the medium in nutrients as the competitive effect between the strains.



**Figure 7:** Enumeration of the lactic acid bacteria after the manufacture of contaminated cheese by *S. aureus*.

#### b/ *Staphylococcus aureus*

Following the results mentioned in figure 8, we observed a continuous reduction in a number of cells of *S.aureus* to arrive at a value of  $0.86 \times 10^4$  cells/ mL in cheese of the lactic type and  $0.15 \times 10^4$  cells / mL in cheese of the mixed type after 72h of their contaminations. According to Cathy (2006), the presence of the lactic acid bacteria in the cheese ecosystems generally operates a barrier effect on the establishment and the growth of *Staphylococcus aureus*. Along the same line of thought, Duquenne (2010) reports those technological agents and factors such as rennet, the leavens of acidification or refining, the mechanical and physical operations, the temperatures of manufacture and the conditions of refining can also influence the growth of *S. aureus*.



**Figure 8:** Enumeration of *S. aureus* in cheese contaminated after its manufacture.

## Conclusions

The pure and the mixed cultures of *Lc. lactis subsp cremoris* and *Lc. lactis subsp lactis biovar diacetylactis* do not have an inhibiting activity with respect to *S.aureus*, of the same *S.aureus* did not inhibit lactic acid bacteria used *in vitro*.

The enumeration of lactococci and *S.aureus* during various stages of cheese-making manufacture (lactic and mixed) starting from contaminated milk being used to manufacture cheese showed a continuous reduction in the lactic leavens after curdling and in parallel the number of *S.aureus* fell during the first stages of manufacture to increase again during salting and that for both types of cheese.

The study of the evolution of the lactic strains and *S.aureus* in the two types of cheeses contaminated after their manufacture is characterized by a significant reduction in the lactic strains and pathogenic strain in the two types of cheese after 24 h and 72 h of their contaminations. Despite this, the cheese preserves its contamination with *S.aureus* in the course of time and remains a danger to human health.

## Acknowledgement

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# BEHAVIOUR STUDY OF INDUCTION MACHINE WITH PRESENCE OF SEVERAL DEFECTS

Djalaleddine KHODJA, Saad BELHAMDI, Bachir BENDJAIMA

*Department of Electrical Engineering, Faculty of Technology, University of M'sila, Algeria  
BP N°116 Ichbelia M'sila 28000  
E-mail: djatal\_ed@yahoo.fr*

**Abstract:** The online diagnosis rotor and stator faults in the induction machines in order to reach a predictive maintenance have prompted the researchers to develop various techniques. The work in their majority is based on the signature (harmonic analysis) indicatory values such as current, torque using the theory of rotating fields and electrical circuits. Moreover, the analysis methods of stator defects using the structural parameters of knowledge model to detect and locate defects. The key point to ensure the effectiveness of these methods is to choose a model of knowledge. Indeed, the type of defect that has to be detected will be based on the model used. Initial work relating parameter estimation began with relatively simple methods. The next step is therefore necessarily to pass to a more knowledge model of machine, while retaining the ability to identify the desired parameter. In fact, the diversity of defects (stator, rotor and supply defects) of the induction machine, they cannot be obtained by the same mathematical model. Indeed, every failure should be modelled separately by its own model.

**Key words:** Induction machine, Stator faults, Multi-turns Model, Diagnosis.

## 1. Introduction

In general, the actual machines are known for their windings and their geometries are too complex. To lend them to an analysis taking into account their exact configurations, we must develop a model for each type whose behavior is as close as possible to the actual model [1]. Modeling of electrical machines is a critical phase for the observation and analysis of the various changes in its electromechanical variables on the one hand and the other hand to develop control systems and diagnostics. [2]. For the model system, three tasks must be accomplished [3,4]:

- Choose the model.
- Determine parameters.
- And in the end verify its validity.

## 2. Induction machine modeling in presence of faults

To model the behavior of the short-circuits between coils, we will present another method for modelling of the induction machine, taking into account the changing parameters such as resistors and inductors, i.e. the matrix is stator resistance and the one of stator inductors are time-varying [5, 6,7,8, 9]. This model requires a precise and rigorous study of fault signatures of the induction machine.

In addition, the conventional modelling of a three-phase induction machine to the stator and the rotor wound (if the machine is cage made, we can consider the winding-phase equivalent), based on the classical assumptions. Under these assumptions, the machine can be modelled by the following equations:

$$[U_s] = [R_s][I_s] + [P\Phi_s] \quad (1)$$

$$[0] = [R_r][I_r] + [P\Phi_r] \quad (2)$$

$$[\Phi_s] = ([M_{ss}] + [L_{sf}])[I_s] + [M_{sr}][I_r] \quad (3)$$

$$[\Phi_r] = [M_{rs}] + ([M_{rr}] + [L_{rf}])[I_r] \quad (4)$$

- the variables  $[U_s] = \begin{bmatrix} u_{sa} \\ u_{sb} \\ u_{sc} \end{bmatrix}$ ,  $[I_s] = \begin{bmatrix} i_{sa} \\ i_{sb} \\ i_{sc} \end{bmatrix}$ ,  $[\Phi_s] = \begin{bmatrix} \varphi_{sa} \\ \varphi_{sb} \\ \varphi_{sc} \end{bmatrix}$  present the voltages, the currents, and the stator flux.

The variables  $[I_s] = \begin{bmatrix} i_{sa} \\ i_{sb} \\ i_{sc} \end{bmatrix}$ ,  $[\Phi_r] = \begin{bmatrix} \Phi_{ra} \\ \Phi_{rb} \\ \Phi_{rc} \end{bmatrix}$  present the currents and the rotor flux.  $N_s$  is the number of turns in healthy regime of the induction machine. A short-circuit stator leads to a decrease in the number of turns of each stator phase. Using the same steps as those of Park transformation we get the new three phase model which represents the model of the induction machine in the presence of faults in the stator. The global model by considering all factors of defects between coils becomes:

$$\left\{ \begin{aligned} \frac{di_{sa}}{dt} &= K_{A1}i_{sa} + K_{A2}i_{sb} + K_{A3}i_{sc} + G_{A1}\Phi_{ra} + G_{A2}\Phi_{rb} - G_{A3}\Phi_{rc} + V_{A1}U_{sa} + V_{A2}U_{sb} + V_{A3}U_{sc} \\ \frac{di_{sb}}{dt} &= K_{B1}i_{sa} + K_{B2}i_{sb} + K_{B3}i_{sc} - G_{B1}\Phi_{ra} + G_{B2}\Phi_{rb} + G_{B3}\Phi_{rc} + V_{B1}U_{sa} + V_{B2}U_{sb} + V_{B3}U_{sc} \\ \frac{di_{sc}}{dt} &= K_{C1}i_{sa} + K_{C2}i_{sb} + K_{C3}i_{sc} + G_{C1}\Phi_{ra} - G_{C2}\Phi_{rb} + G_{C3}\Phi_{rc} + V_{C1}U_{sa} + V_{C2}U_{sb} + V_{C3}U_{sc} \\ \frac{d\Phi_{ra}}{dt} &= f_{A1}i_{sa} - f_{A2}i_{sb} - f_{A3}i_{sc} - H_{A1}\Phi_{ra} - H_{A2}\Phi_{rb} - H_{A3}\Phi_{rc} \\ \frac{d\Phi_{rb}}{dt} &= f_{B1}i_{sa} + f_{B2}i_{sb} - f_{B3}i_{sc} - H_{B1}\Phi_{ra} - H_{B2}\Phi_{rb} - H_{B3}\Phi_{rc} \\ \frac{d\Phi_{rc}}{dt} &= f_{C1}i_{sa} - f_{C2}i_{sb} + f_{C3}i_{sc} - H_{C1}\Phi_{ra} - H_{C2}\Phi_{rb} - H_{C3}\Phi_{rc} \end{aligned} \right.$$

The equation of motion is given by:

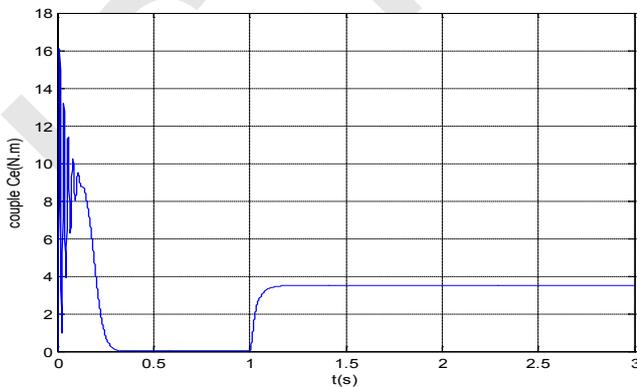
$$J \frac{d}{dt} \Omega + f \Omega = C_e - C_r$$

The torque is given by the following expression:

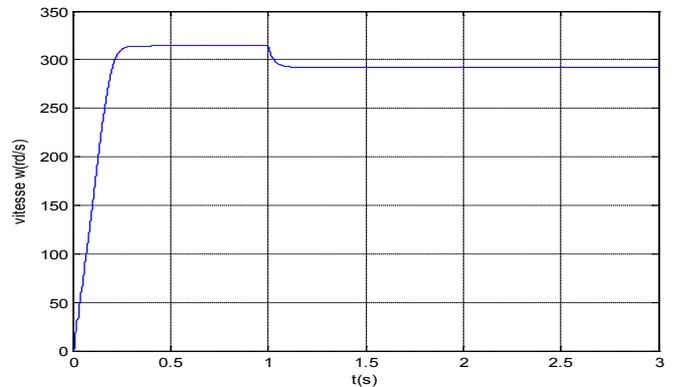
$$C_e = P \frac{M_{sr}}{L_r} \left[ (i_{sb}\Phi_{rc} - i_{sc}\Phi_{rb}) - (i_{sa}\Phi_{rc} - i_{sc}\Phi_{ra}) + (i_{sa}\Phi_{rb} - i_{sb}\Phi_{ra}) \right]$$

### 3 Simulation of the asynchronous machine in normal operation

The asynchronous machine is connected to the mains phase 220/380V, frequency: 50Hz, this machine starts to empty, for applying a resisting torque ( $C_r = 3.5 \text{ Nm}$ ) ( $t = 1 \text{ sec}$ ). At time  $t = 1 \text{ s}$  we applied a torque  $C_r = 3.5 \text{ Nm}$



Electromagnetic Torque  $C_{em}$  (N.m).



Speed  $w$  (rad/sec).

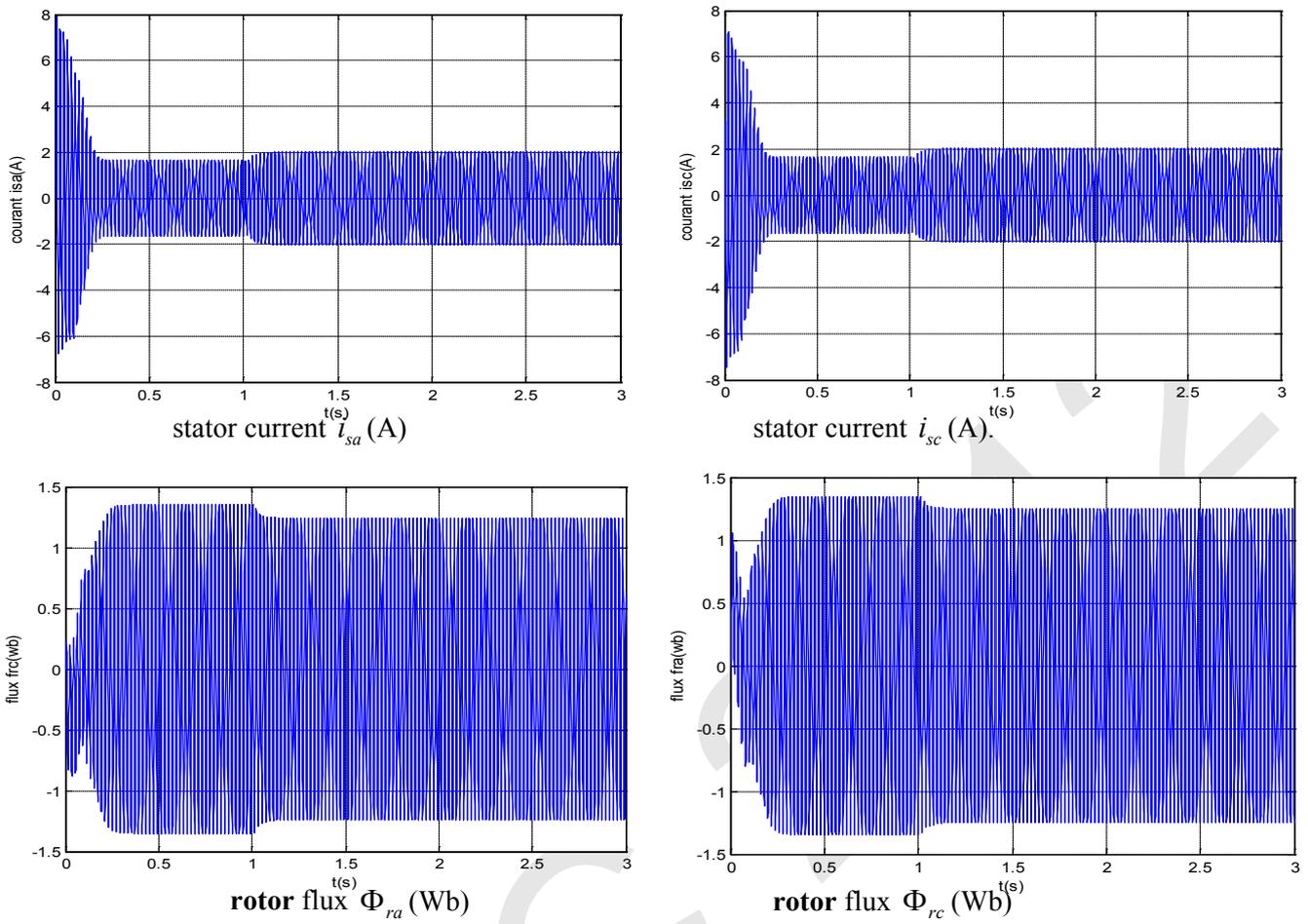


Figure.1 Simulation results of a direct start of the machine supplied with voltage, followed by applying a perturbation of ( $C_r = 3.5 \text{ Nm}$ ) ( $t = 1 \text{ sec}$ ).

During startup, a high inrush current when it has exceeded excessive but it disappears quickly after a few alternations to give rise to sinusoidal constant amplitude after application of the load there is a slight increase in the current. It is necessary to develop a high torque in the first moments of startup. This torque tends to zero, after application of the load, it reaches the value of torque. We see that start, there is a nearly linear increase of the speed, it tends towards a steady state. The application of the load ( $C_r = 3.5 \text{ Nm}$ ) causes a decrease in the rotational speed of the rotor flux for same.

#### 4 Modeling of machine in the abnormal working

introduced in previous work, one of the most common faults in electrical machines is the fault between turns in the stator winding. In this section, we focus on the modeling and study of faults between turns of the stator winding. A fault between turns indicates degradation of the insulation between turns of a winding of the same phase of the stator. The insulation fault is modeled by a resistor connecting two points of the turns, its value depends on the severity of the defect.

$N_s$  is the number of turns in the diet of the asynchronous machine. A short-circuit stator lead to a decrease in the number of turns of each phase of stator. We define the coefficients of a short circuit the following:

$$\text{Coefficient of short circuit on the stator pahse1: } k_{sa} = \frac{N_{cc1}}{N_s}$$

$$\text{Coefficient of short circuit on the stator pahse2: } k_{sb} = \frac{N_{cc2}}{N_s}$$

$$\text{Coefficient of short circuit on the stator pahse3: } k_{sc} = \frac{N_{cc3}}{N_s}$$

Le number of turns on short circuit :  $N_{cc}$

The number of active turns for the three stator phases is given by:

$$N_1 = N_s - N_{cc1} = (1 - k_{sa})N_s = f_{sa}N_s$$

$$N_2 = N_s - N_{cc2} = (1 - k_{sb})N_s = f_{sb}N_s$$

$$N_3 = N_s - N_{cc3} = (1 - k_{sc})N_s = f_{sc}N_s$$

The matrix  $[R_s], [M_{sr}], [M_{rs}], [M_{ss}]$  et  $[L_{sf}]$  depend to three coefficients  $f_{sa}, f_{sb}, f_{sc}$

## 5. Simulation of machine in the abnormal working:

We simulate open loop all models (healthy, with defects) that we have developed for the asynchronous machine.

Figures 2 and 3 are the simulation results in the presence of faults.

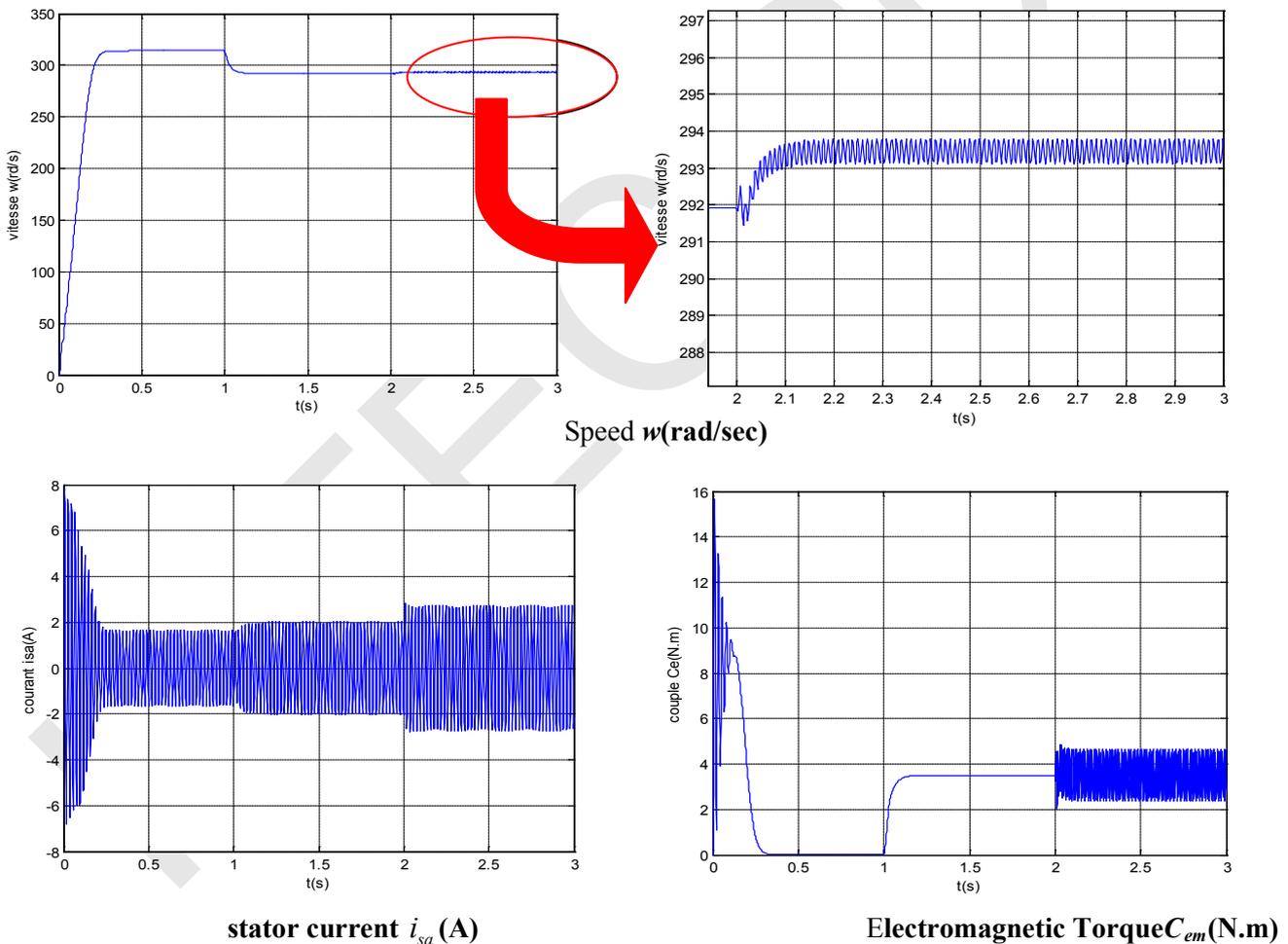
We studied two cases of short-circuit between turns in the same phase:

→ short circuit between turns 20 (12.5%).

→ short circuit between turns 40 (25%).

At time  $t = 1$ s was applied torque (3.5Nm), followed by a short-circuit fault at  $t = 2$ s.

a) Short circuit between turns (12.5%) of the first phase (A):



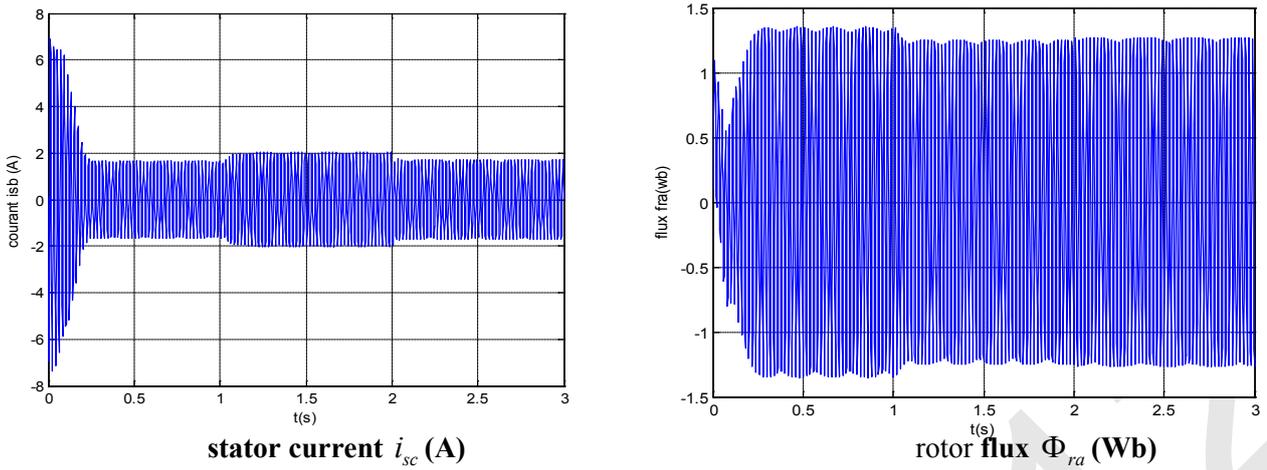


Figure.2 results of 12.5 % turns on short circuit of the phase (A).

B) Short circuit of 25% turns of the first phase .

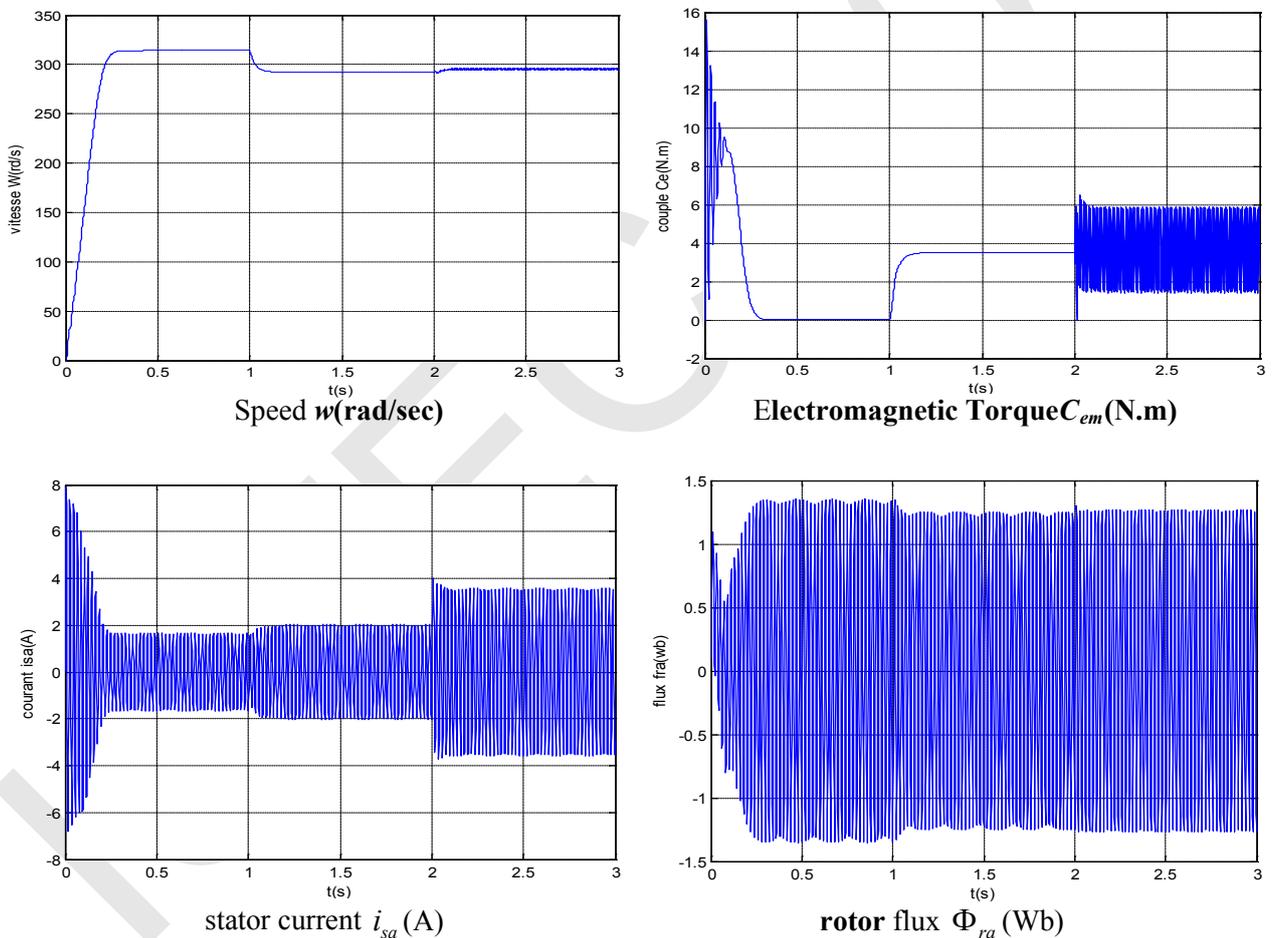


Figure. 3 results of 25% short-circuit of turns of phase (A).

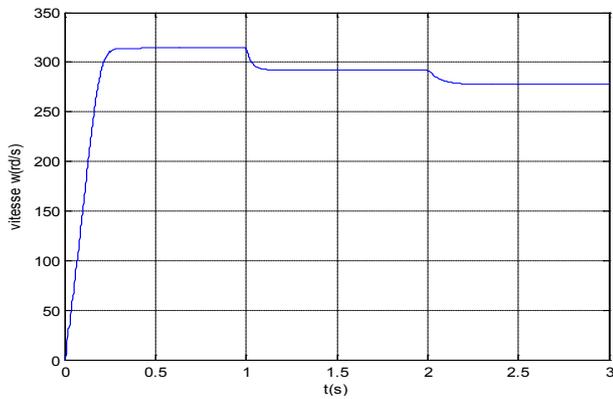
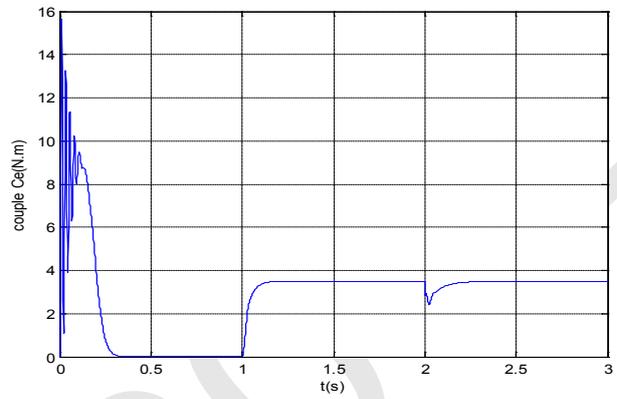
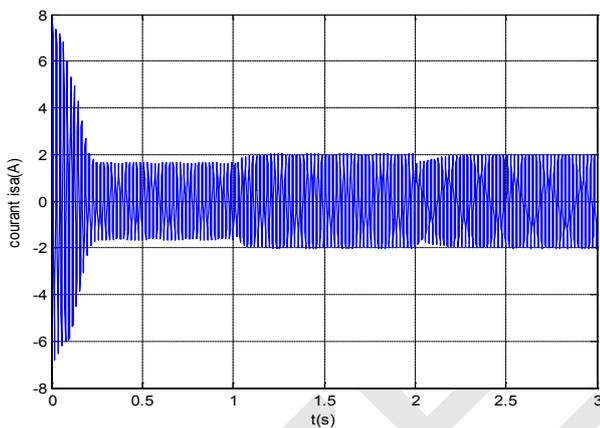
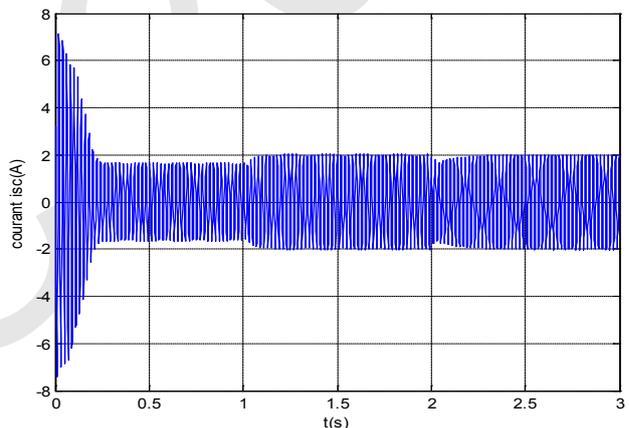
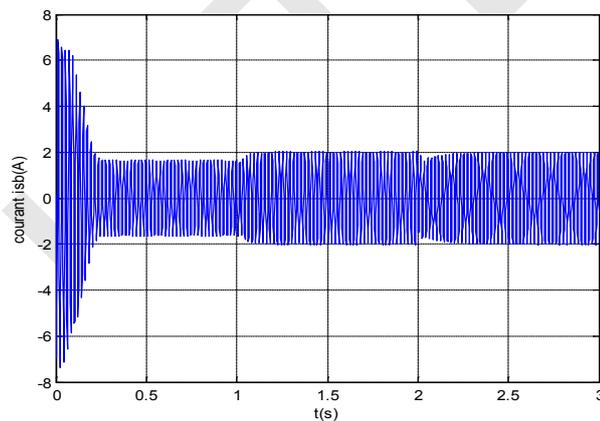
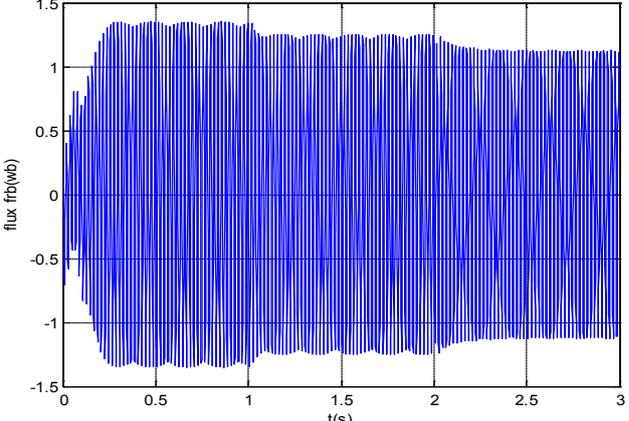
## 6.Results Interpretations:

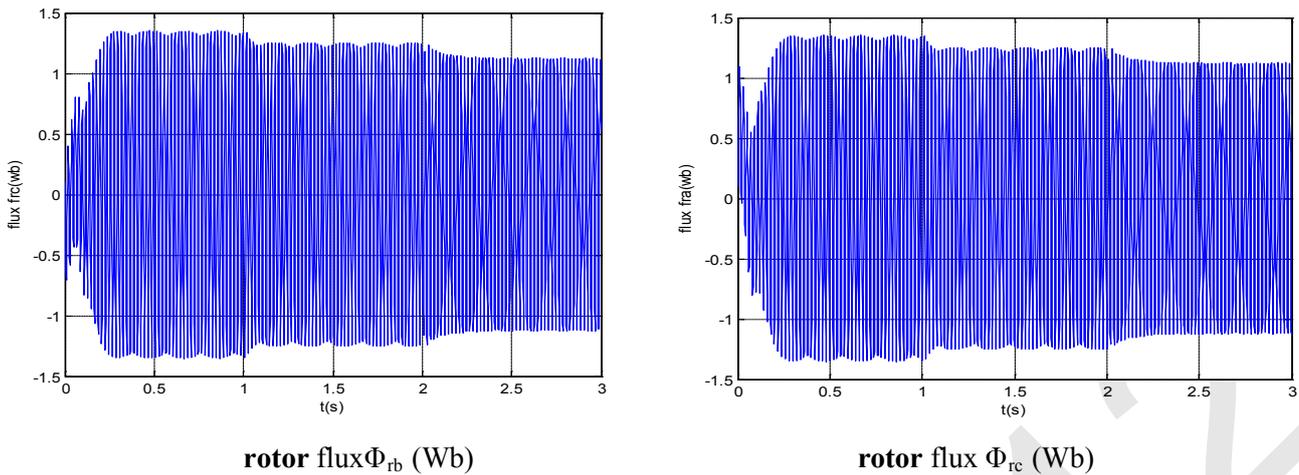
During abnormal operation, electrical values are characterized with respect to the normal by a sudden change when the fault occurs, in our case the fault is created at time 2 s. We also note that the amplitude of the current in phase infected is greater than the other phases.

The electromagnetic torque of the asynchronous machine in a situation of short-circuit faults stator has a value

substantially equal to that in normal. However, we note that the signal is noisy from the fault. There is also a decrease in the rate at which applies a default.

When there are short-circuited windings, the inductance of a stator phase infected exchange, and therefore the other phase currents change because of the magnetic coupling. More the number of turns in short - circuit, the greater the increase in current is more significant. And the speed increase. figure 4 this results in the variation of the rotor and stator resistance 50% due to the heating of the machine. At time  $t = 2s$ . But there will be a 50% increase of these parameters to the resistive time  $t = 3s$ . At that time takes its nominal value. The results show that prior to the time ( $t = 2s$ ), that is to say at the moment of resistive parameter variation, no variation in the curves of speed, torque, current and flux. At  $t = 2s$ , the parameter becomes resistive 1.5 to the nominal setting.


 Speed  $w(\text{rad/sec})$ 

 Electromagnetic Torque  $C_{em}(\text{N.m})$ 

 stator current  $i_{sa}(\text{A})$ 

 stator current  $i_{sb}(\text{A})$ 

 stator current  $i_{sc}(\text{A})$ 

 rotor flux  $\Phi_{ra}(\text{Wb})$


 Figure.4 Effect of variation of 50% de  $R_s$  et  $R_r$ 

## 7. Conclusion

In this work, the three phases model in its classical form of the asynchronous machine was obtained. This allows to represent the behavior of the asynchronous machine with the stator is balanced or not and simulate faults such as stator phase and cut or short circuits between turns of the same phase. However, even if the two-phase model is faster because of the simplicity of the equations can not simulate faults that occur in the stator.

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# BETONARME KESİTLERDEKİ MOMENT-EĞRİLİK İLİŞKİSİ İÇİN BASİT BİR FORMÜLASYON

Naci CAGLAR<sup>1</sup>, Aydın DEMİR<sup>1</sup>, Muzaffer ELMAS<sup>1</sup>, Hakan OZTURK<sup>2</sup> ve Abdulhalim AKKAYA<sup>3</sup>

<sup>1</sup> Sakarya Üniversitesi, Mühendislik Fakültesi, İnşaat Mühendisliği Bölümü, Sakarya, Türkiye

<sup>2</sup> Kilis 7 Aralık Üniversitesi, Mühendislik Fakültesi, İnşaat Mühendisliği Bölümü, Kilis, Türkiye

<sup>3</sup> Sakarya Üniversitesi, Teknoloji Fakültesi, İnşaat Mühendisliği Bölümü, Sakarya, Türkiye

**Özet:** Betonarme elemanların davranışının anlaşılabilmesi için kesit davranışının bilinmesi gereklidir. Kesit davranışı en gerçekçi olarak moment-eğrilik ilişkisinden izlenebilir. Betonarme kesitin sünekliği, dayanımının ve rijitliğinin çeşitli evrelerde nasıl değiştiği, sargı etkisi, kabuk ve çekirdek betonlarında ezilmenin başlayıp başlamadığı ve boyuna donatının pekleşmesinin eleman davranışı üzerindeki etkisi gibi olaylar ancak moment-eğrilik ilişkisinden gözlenebilir.

Bir betonarme kesitte moment-eğrilik ilişkisi çeşitli ve karmaşık iterasyon yöntemleri kullanılarak tespit edilebilmektedir. Bu iterasyon yöntemlerinin el ile yapılması ve uygulaması çok pratik olmayıp, ancak hazır paket programlar kullanılarak elde edilebilmektedir.

Bu çalışmada, eksenel kuvvet ve eğilme momenti etkisi altındaki betonarme kare kesitlerin moment-eğrilik ilişkisi için basit bir formülasyon önerilmiştir. Betonarme kesitlerin moment-eğrilik ilişkisinin belirlenmesinde sargı etkisi ve donatının pekleşmesi de dikkate alınmış ve bu formülasyonun geliştirilmesinde genetik programlama yönteminden yararlanılmıştır. Önerilen formülasyon, XTRACT programları ile bulunan moment-eğrilik sonuçları ile karşılaştırılmış ve elde edilen moment-eğrilik ilişkisi performansının çok iyi olduğu belirlenmiştir.

**Anahtar Kelimeler:** Betonarme kesit, Moment-eğrilik, Genetik programlama

**Abstract:** In order to be able to understand the behavior of reinforced concrete members, cross sectional behavior should be known. Cross sectional behavior can be best evaluated by moment-curvature relationship. Ductility, change of rigidity and strength in different phases, confinement effect, whether the crushing has started on confined and unconfined sections, effect of strain hardening on cross sectional behavior on longitudinal bars can be observed from moment-curvature relationship.

On a reinforced concrete cross section moment-curvature relationship can be determined by some complicated iteration methods. Making these iterations manually is very difficult and not practical. Some spread sheet programs can be used for this purpose.

In this study, some simple formulas have been proposed for moment-curvature relationship of square reinforced concrete sections under axial loading and bending moment. Confinement and strain hardening effect of reinforcement have been taken into account. Genetic programming method have been used to develop that formulas. Proposed formulas have been verified with the results of XTRACT and they have provided great accuracy.

**Keywords:** Reinforced concrete cross section, Moment curvature, Genetic programming

## Giriş

Betonarme yapıların doğru tasarlanabilmesi betonarme elemanların davranışının doğru anlaşılabilmesine bağlıdır. Eleman davranışını ise kesit davranışı belirlemektedir. Kesit davranışı kesitte kullanılan malzeme ve kesitin geometrisine bağlı olup, bu davranışın izlenmesinin en gerçekçi yollarından birisi kesitin moment-eğrilik ilişkisinin bilinmesidir. Moment-eğrilik ilişkisinin izlenmesi ile betonarme kesitin sünekliği, sargı etkisi, kesit mukavemeti ve rijitliğinin değişimi, kabuk ve çekirdek betonlarında oluşacak ezilmeler ve boyuna donatının pekleşmesinin eleman davranışı üzerindeki etkisi gibi konular hakkında bilgi edinilebilir.

Bir betonarme kesitte moment-eğrilik ilişkisi çeşitli ve karmaşık iterasyon yöntemleri kullanılarak tespit edilebilmektedir. Bu iterasyon yöntemlerinin el ile yapılması ve uygulaması çok pratik olmayıp, hazır paket programlar kullanılarak elde edilebilmektedir.

Bu çalışmada, moment-eğrilik ilişkisinin iterasyon yöntemleri kullanılarak elle tespit edilmesinin zorluğu ve pratikte hazır paket programların temini ve kullanımında karşılaşılabilecek sıkıntılar nedeniyle, kullanımı kolay, basit ve alternatif bazı ampirik formüller geliştirilmiştir. Bu çalışmada önerilen bu formüller geliştirilirken genetik programlamadan yararlanılmıştır. Genetik programlama, evrimsel gelişime dayalı optimizasyon algoritmaları arasında yer almakta ve son yıllarda mühendislik çalışma alanlarında da yaygın olarak kullanılmaya başlanmıştır (Kara, 2011; Pala ve diğ. 2009; Gray at al, 1998; Tsai ve Pan, 2012; Amir at al, 2010; ve Chen at al; 2012).

Önerilen ampirik formüller ile XTRACT programının sonuçları karşılaştırılmış ve oldukça başarılı sonuçlar elde edilmiştir. Elde edilen bu sonuçlar, önerilen formüller ile gerçekçi sonuçlara ulaşılabildiğini ve herhangi bir bilgisayar programı kullanmak zorunda kalmadan kolaylıkla kesit davranışının belirlenebildiğini göstermektedir.

## Moment-Eğrilik

Eğilme ve aksenal yük veya yalnız eğilme altındaki betonarme bir kesitin davranışı en iyi moment-eğrilik ilişkisinden izlenebilir. Bir kesitin moment-eğrilik ilişkisi gerçekçi olarak deneyler ile elde edilebilir. Ancak bu hem pratik hem de ekonomik açıdan uygun değildir. Bu nedenle, deney sonuçlarından yararlanılarak analitik olarak moment-eğrilik ilişkisinin elde edilmesine çalışılmıştır. Yapılacak analitik yaklaşımlarda kullanılan malzeme modelleri de, gerçekçi sonuçlar elde edebilmek için oldukça önemlidir.

Eğrilik, kesitteki deformasyonu simgeleyen geometrik bir parametre olup, birim dönme açısı olarak tanımlanır. Eğrilik, bir elastik eğrideki iki komşu nokta arasındaki açının, bu noktalar arasındaki mesafeye bölünmesi ile elde edilir.

$$Eğrilik = \kappa = \frac{d\phi}{dx} = \frac{d^2y}{dx^2} = \frac{1}{\rho}$$

$$\kappa = \frac{M}{EI}$$

EI: eğilme rijitliği

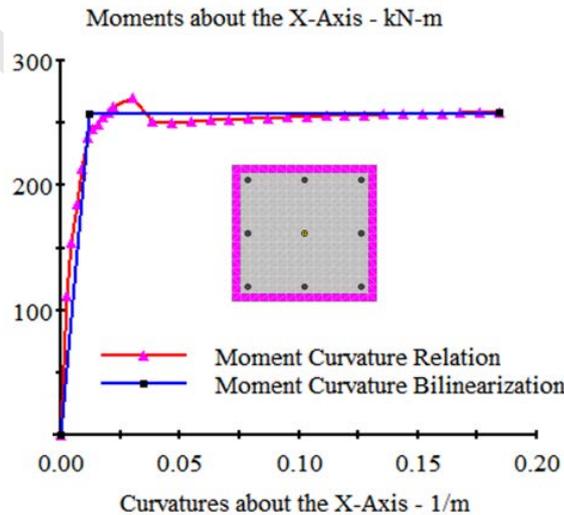
Betonarme kesit iki ayrı malzemeden oluştuğu için homojen olmayıp, moment-eğrilik ilişkisinin tespit edilmesi kolay değildir. Betonarmeyi oluşturan malzemelerden betonun deformasyon özellikleri doğrusal elastik olmayıp, basınç ve çekme altında farklılık göstermektedir.

Bir betonarme kesitin moment-eğrilik ilişkisi, denge koşullarının sağlanması, uygunluk koşullarının sağlanması ve malzemeler için gerilme-şekil değiştirme ilişkilerinin belirlenmesi olmak üzere üç aşamalı bir çözümleme ile elde edilebilir. Günümüzde bu çözümler çok zaman alması nedeniyle bilgisayar programları kullanılarak yapılabilmektedir.

Bu çalışmada, analizlerde kullanılan betonarme kesitlerin moment-eğrilik ilişkileri XTRACT programı yardımıyla elde edilmiştir. Moment-eğrilik ilişkisinden elde edilen grafikler yine aynı program kullanılarak idealize edilerek hesaplamalarda kullanılmıştır.

XTRACT programı yapısal elemanların kesit bazlı analizlerini yapan bir program olup, bir kesitin moment-eğrilik, aksenal kuvvet-moment ve kapasite yörüngesi analizlerini yapmaktadır. Bir kesitin geometrik özellikleri ve kesitte bulunan malzemelerin modelleri girilerek istenilen analizler yapılabilmektedir.

Şekil 1 de XTRACT programında oluşturulmuş betonarme bir kesit ve analiz sonucu bulunan moment-eğrilik ilişkisini gösteren grafik ve idealize edilmiş hali gösterilmiştir.



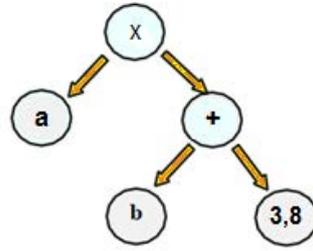
Şekil 1: XTRACT programında analiz sonucu elde edilmiş bir moment-eğrilik grafiği

## Genetik Programlama (GEP)

1992 yılında John Koza tarafından geliştirilen Genetik Programlama, ele alınan problemin yapı taşlarından oluşturulan muhtemel ilkel çözüm tarzlarının belirli bir uyum kriterine göre evrilerek mükemmelleşmesini amaçlayan evrimsel algoritma tekniğidir (Koza, 1992; Koza, 1994). Genetik programlama evrimsel gelişime dayalı optimizasyon algoritmaları arasında yer almaktadır.

Genetik programlama metodolojisinin temeli genetik algoritmaya dayanmakla birlikte, kromozom gösterimi ve genetik operatörler açısından farklılık göstermektedir. Genetik programlama bireyleri değişken boyuta sahip hiyerarşik ağaç yapısındadır. Genetik programlama değişken boyuttaki ağaç yapısında bireyler üzerinde evrimsel gelişimi sağlamak amacıyla genetik operasyonları gerçekleştirir.

GEP de bireyleri oluşturabilmek için iki farklı sınıftan gelen nesnelere kullanılır. Bu nesnelere terminaller ve fonksiyonlardır. Terminaller problemin tanımlanmasında doğrudan etkin olan değişkenler veya sabitlerdir. Fonksiyonlar ise terminalleri belli bir işlem mantığına göre birleştirmeye yarayan nesnelere dir. Fonksiyonlar ve terminallerin hiyerarşik bir anlayış içinde anlamlı bir yapı oluşturacak şekilde birleştirilmesi sonucunda bireyler oluşur (Langdon ve Poli, 2002). Oluşan bireylerin boyutu derinlik olarak ifade edilen ve içerisindeki fonksiyon sayılarının toplanması ile oluşan bir büyüklükle ölçülür. Genellikle başlangıç birey havuzu (popülasyonu) için rasgele oluşan yeni bireyler 3, 5 ya da 7 derinliğinde olmaktadır.



Şekil 2: Bir bireyin ağaçsal yapısı (x ve + fonksiyonları; a, b ve 3,8 terminalleri)

Yeniden üretim, çaprazlama ve mutasyon genetik işlemcileri ile değişikliğe uğramış bir popülasyondan bir sonraki popülasyona hangi bireylerin aktarılacağı seçim ile belirlenir. Seçilen bireylerden bazılarının genetik bir işlemci tarafından değişikliğe uğramadan yeni popülasyona aktarılmasına yeniden üretim denilir. Havuzdaki bazı bireylerin (ebeveynlerin) seçilerek eşleştirilmesi ve ebeveynlerin gen bilgilerini içeren yeni bireylerin (çocukların) üretilmesi çaprazlama işlemcisinin görevidir. Böylece her çocuğun bazı genleri ebeveynlerinden birisi ile aynı olacaktır. Popülasyon içinden rastgele seçilenlerin bazı gen değerlerinin rastgele değiştirilmesi mutasyon işlemcisi tarafından yapılır (Göloğlu ve Arslan, 2006).

Genetik programlamanın çeşitli uygulamaları ile elde edilen sonuçları, Koza, 1994 ve Langdon, 1998' de ayrıntılı bir biçimde yer almaktadır.

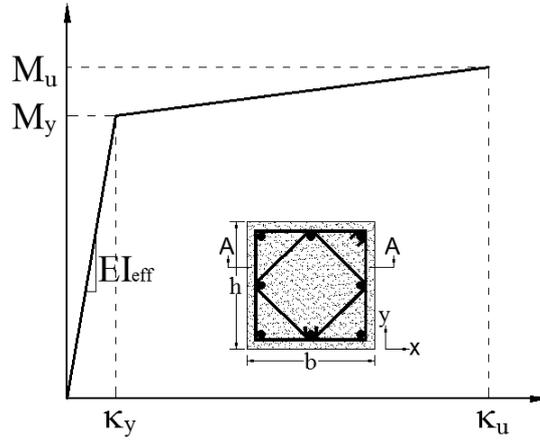
## Sayısal Çalışma

Bu çalışmada, farklı boyutta ve/veya farklı donatı oranlarına sahip betonarme kare kesitlerin moment-eğrilik ilişkisinin belirleyen ampirik formüller geliştirilmiştir (Şekil 3). Seçilen kesitlerin boyutları, donatı çap ve donatı oranları TS500 ve TDY-2007 de verilen sınırlamalar dikkate alınarak seçilmiştir. Kesitlere etkiyen aksenal kuvvet;

$$N_{dm} \leq 0,5 A_c f_{ck} \quad (\text{TDY - 2007}) \quad (1)$$

$$N_d \leq 0,6 A_c f_{ck} \quad (\text{TS - 500}) \quad (2)$$

koşullarını sağlayacak şekilde belirlenmiştir.



**Şekil 3:** Moment-Eğrilik grafiğinin ve betonarme kesitlerin genel yapısı

Bu çalışmada kullanılan tüm kesitlerde beton kalitesi C25 ve donatı çeliği S420 olarak alınmıştır. Moment-Eğrilik ilişkisinin tespitinde betonun yatay donatılarla sarılmış çekirdek bölgesi ve sargısız kabuk kısmı için Mander, 1988 beton modeli kullanılmıştır. Donatı çeliği için literatürde genel kabul görmüş deney sonuçlarından elde edilen gerilme-birim şekil değiştirme eğrilerinden faydalanılmıştır.

Beton ve donatı arasında tam aderans olduğu, kesitlerin şekil değişiminden sonra, şekil değişiminden önceki gibi düzlem olarak kaldıkları varsayılmıştır.

Moment-eğrilik ilişkisinin belirleyen ampirik formüllerin geliştirilmesi için genetik programlama (GEP) dan yararlanılmış ve GeneXproTools programı kullanılmıştır. Bu aşamada GEP’te kullanılmak üzere eğitim ve test setleri oluşturulmuştur. Bu amaçla, geometrik özellikleri ve donatı oranları farklı toplam 140 adet betonarme kesit seçilmiş ve bu kesitlerin moment-eğrilik ilişkileri XTRACT programı kullanılarak belirlenmiştir. Bu betonarme kesitlerin 116 tanesi eğitim (makalenin sayfa sayısını fazla arttırmamak için verilmemiştir) ve 24 tanesi test seti (Tablo 1) olarak seçilmiştir.

**Tablo 1:** Test dosyası verileri

| Kesit No | h=b (m) | $\rho_t$ (%) | $\rho_{w,x}=\rho_{w,y}$ (%) | N (kN) | $EI_{eff}$ (kNm <sup>2</sup> ) | $\kappa_y$ (rad/m) | $M_y$ (kN-m) | $\kappa_u$ (rad/m) | $M_u$ (kN-m) |
|----------|---------|--------------|-----------------------------|--------|--------------------------------|--------------------|--------------|--------------------|--------------|
| 1        | 0.40    | 0.01005      | 0.006732                    | 500    | 17500                          | 0.010550           | 185.0        | 0.3349             | 199.2        |
| 2        | 0.40    | 0.01005      | 0.006732                    | 1100   | 20200                          | 0.012010           | 243.0        | 0.1817             | 238.2        |
| 3        | 0.40    | 0.01005      | 0.006732                    | 1900   | 28100                          | 0.009758           | 274.0        | 0.1216             | 253.1        |
| 4        | 0.40    | 0.01272      | 0.006732                    | 700    | 20400                          | 0.011280           | 230.4        | 0.2387             | 242.2        |
| 5        | 0.40    | 0.01272      | 0.006732                    | 1500   | 24900                          | 0.011510           | 286.5        | 0.1328             | 273.7        |
| 6        | 0.40    | 0.01571      | 0.006732                    | 300    | 19900                          | 0.010910           | 217.1        | 0.3411             | 244.1        |
| 7        | 0.40    | 0.01571      | 0.006732                    | 1300   | 24600                          | 0.012240           | 301.3        | 0.1477             | 295.8        |
| 8        | 0.40    | 0.01571      | 0.006732                    | 1700   | 28500                          | 0.010980           | 312.6        | 0.1260             | 298.7        |
| 9        | 0.40    | 0.01901      | 0.006732                    | 500    | 23200                          | 0.011460           | 266.3        | 0.2500             | 292.8        |
| 10       | 0.40    | 0.01901      | 0.006732                    | 900    | 24600                          | 0.012290           | 302.5        | 0.1830             | 312.0        |
| 11       | 0.40    | 0.01901      | 0.006732                    | 1700   | 30000                          | 0.011200           | 336.2        | 0.1256             | 325.0        |
| 12       | 0.40    | 0.01005      | 0.004308                    | 500    | 17700                          | 0.010430           | 184.8        | 0.2979             | 195.8        |

|    |      |         |          |      |       |          |       |        |       |
|----|------|---------|----------|------|-------|----------|-------|--------|-------|
| 13 | 0.40 | 0.01272 | 0.004308 | 300  | 18000 | 0.010410 | 187.9 | 0.3408 | 208.4 |
| 14 | 0.40 | 0.01571 | 0.004308 | 700  | 22500 | 0.011480 | 257.8 | 0.1977 | 263.5 |
| 15 | 0.40 | 0.01901 | 0.004308 | 100  | 21000 | 0.010800 | 226.7 | 0.3553 | 261.0 |
| 16 | 0.40 | 0.02262 | 0.004308 | 500  | 25700 | 0.011620 | 298.3 | 0.2192 | 322.0 |
| 17 | 0.35 | 0.01005 | 0.005417 | 400  | 9767  | 0.012090 | 118.1 | 0.2560 | 111.8 |
| 18 | 0.35 | 0.01005 | 0.005417 | 1200 | 13700 | 0.011490 | 156.9 | 0.1307 | 115.6 |
| 19 | 0.35 | 0.01313 | 0.005236 | 400  | 11200 | 0.012570 | 140.6 | 0.2392 | 137.1 |
| 20 | 0.35 | 0.01313 | 0.005236 | 1200 | 14800 | 0.012100 | 178.7 | 0.1314 | 141.2 |
| 21 | 0.35 | 0.01662 | 0.005236 | 600  | 13000 | 0.013610 | 176.3 | 0.1799 | 161.7 |
| 22 | 0.35 | 0.01662 | 0.005236 | 1400 | 17100 | 0.011290 | 193.5 | 0.1237 | 156.3 |
| 23 | 0.35 | 0.02052 | 0.020520 | 600  | 14100 | 0.014020 | 197.8 | 0.1646 | 182.1 |
| 24 | 0.35 | 0.02052 | 0.020520 | 1000 | 15500 | 0.013550 | 209.6 | 0.1434 | 180.9 |

**Tablo 2:** Problemin değişkenleri ve GEP programı kodları

| Giriş değişkenleri                | Program kodu | Açıklama                  |
|-----------------------------------|--------------|---------------------------|
| $h=b$                             | d0           | Kesit Boyutu (m)          |
| $\rho_t$                          | d1           | Boyuna donatı oranı (%)   |
| $\rho_{w,x}=\rho_{w,y}$           | d2           | Yatay donatı oranı (%)    |
| $N$                               | d3           | Eksenel kuvvet (kN)       |
| $\kappa_y / M_y / \kappa_u / M_u$ | D.V.         | Bulunmak istenen değerler |
| -                                 | c0/c1/c2.... | Üretilen sabit katsayılar |

### Moment-Eğrilik İlişkisi İçin Önerilen Formüller

Önerilen formüllerin performansını belirlemek üzere yakınsama fonksiyonundan yararlanılmıştır. Bu çalışmada yakınsama fonksiyonu olarak  $R^2$  seçilmiştir. Önerilen moment-eğrilik ilişkisini belirleyen ampirik formülleri, yüzde doksanın üzerinde yakınsama ( $R^2 \geq 0.90$ ) ile elde edebilmek amacıyla sayısız ve uzun süreli analizler yapılmıştır. En iyi yakınsama sonuçlarını veren formüller (Tablo 3) ve bu formüllerin ağaç yapıları aşağıda sunulmuştur (Şekil 4~7).

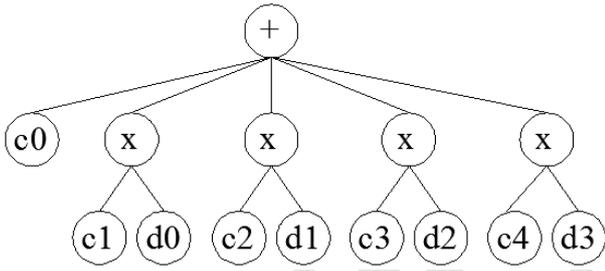
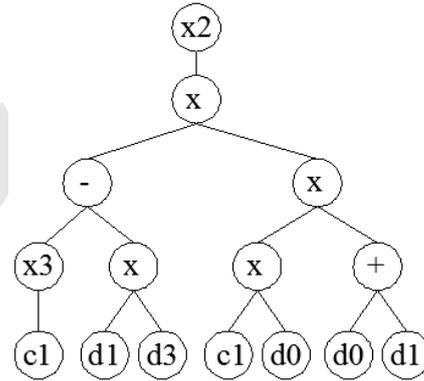
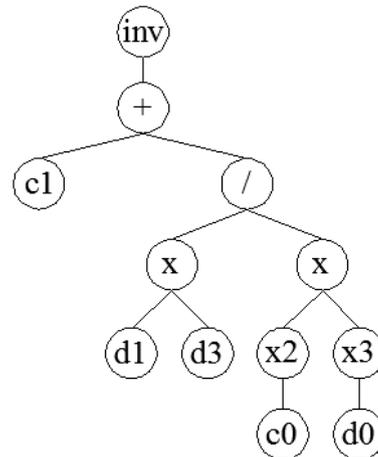
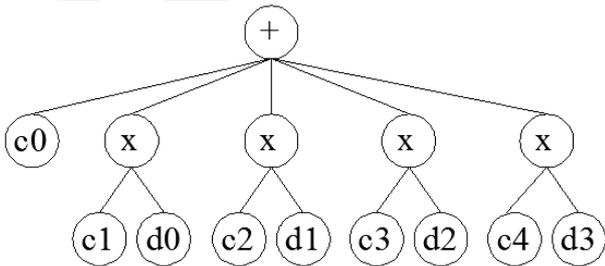
**Tablo 3:** Moment-Eğrilik ilişkisi için önerilen formüller (Birimler: kN ve m)

|  |   |
|--|---|
| $M_y = -544 + 1547 b + 8348 \rho_t - 1254 \rho_w + 0,0682 N$       |   |
| $\kappa_y = \frac{M_y}{EI_{eff}}$ $EI_{eff} = (A + B)^2$           | $A = -155,2 - (\rho_t N)$ $B = -5,374 b (b + \rho_t)$ |
| $M_u = -755 + 2119 b + 9389 \rho_t - 1270 \rho_w + 0,0377 N$       |   |
| $\kappa_u = \left( 2,57 + \frac{\rho_t N}{83,17 b^3} \right)^{-1}$ |   |

$$\rho_t = \frac{A_{st}}{A_c} \quad (3)$$

$$\rho_w = \frac{A_{sw}}{b \cdot s} \quad (4)$$

|          |  |
|----------|--|
| $\rho_t$ | boyuna donatı oranına  |
| $\rho_w$ | herhangi bir doğrultudaki yatay donatı oranı   |
| $A_{sw}$ | hesap yapılan doğrultuda alınan bir kesitte (x eksenı için A-A kesiti), kesite giren toplam yatay donatı alanı |
| $A_{st}$ | toplam boyuna donatı alanı   |
| $A_c$    | kolon en kesit alanı (b*h),  |
| s        | etriye aralığı   |
| b        | hesap yapılan eksen doğrultusundaki kesit boyutu   |
| N        | kesite etkiyen eksenel kuvvet (Normal Kuvvet)  |


 Şekil 4:  $M_y$  için ağaç yapısı ( $R^2=0.962$ )

 Şekil 5:  $\kappa_y$  için  $EI_{eff}$  ağaç yapısı ( $R^2=0.910$ )


**Şekil 6:**  $M_u$  için ağaç yapısı ( $R^2=0.957$ )

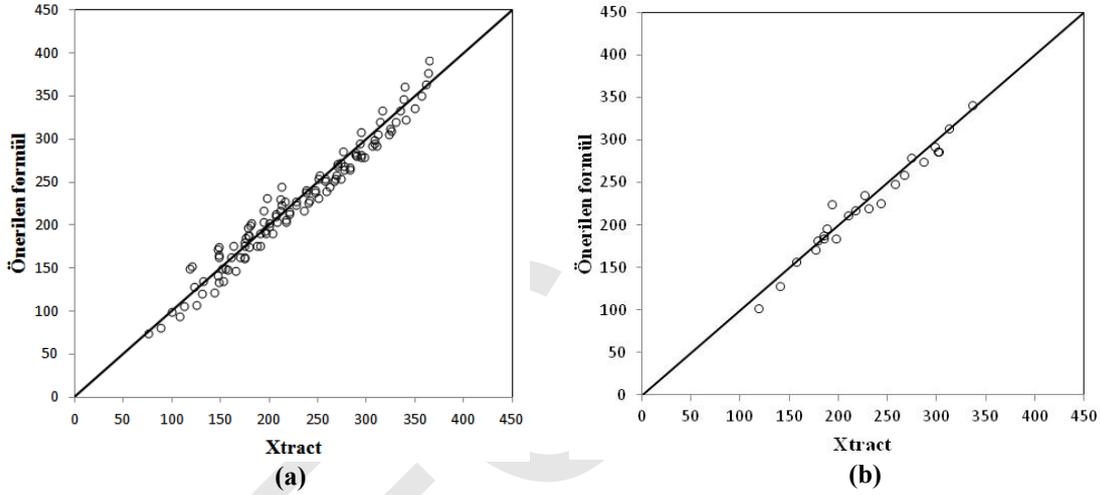
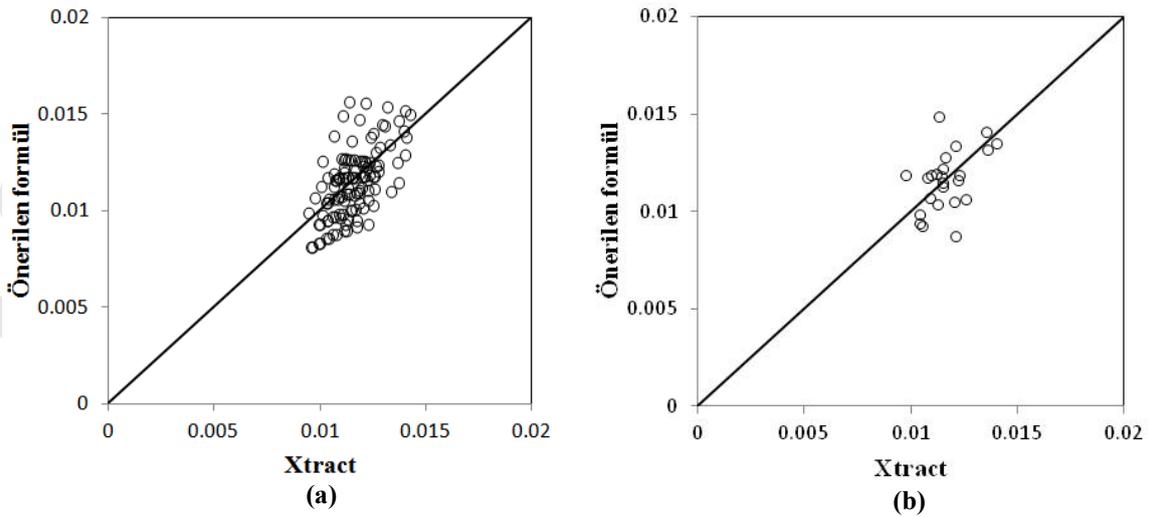
**Şekil 7:**  $\kappa_u$  için ağaç yapısı ( $R^2=0.910$ )

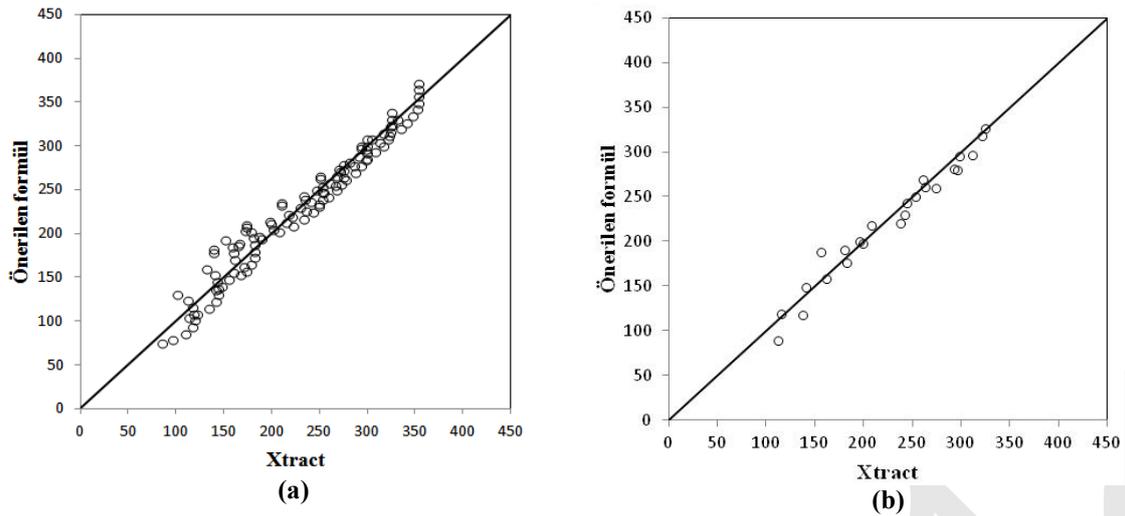
## Sonuçlar ve Tartışma

Bu çalışmada, farklı boyutta ve/veya farklı donatı oranlarına sahip betonarme kare kesitlerin moment-eğrilik ilişkisinin belirleyen ampirik formüller geliştirilmiş ve sonuçlar karşılaştırılarak önerilen formüllerin performansı belirlenmiştir. Eğitim verileri için önerilen formül sonuçları ile XTRACT programı çıktıları karşılaştırıldığında, önerilen formüllerin moment-eğrilik ilişkisini %90'nın üzerinde hatta %96'ya varan oranlarda yakalayabildiği gözlenmiştir (Şekil 8-11).

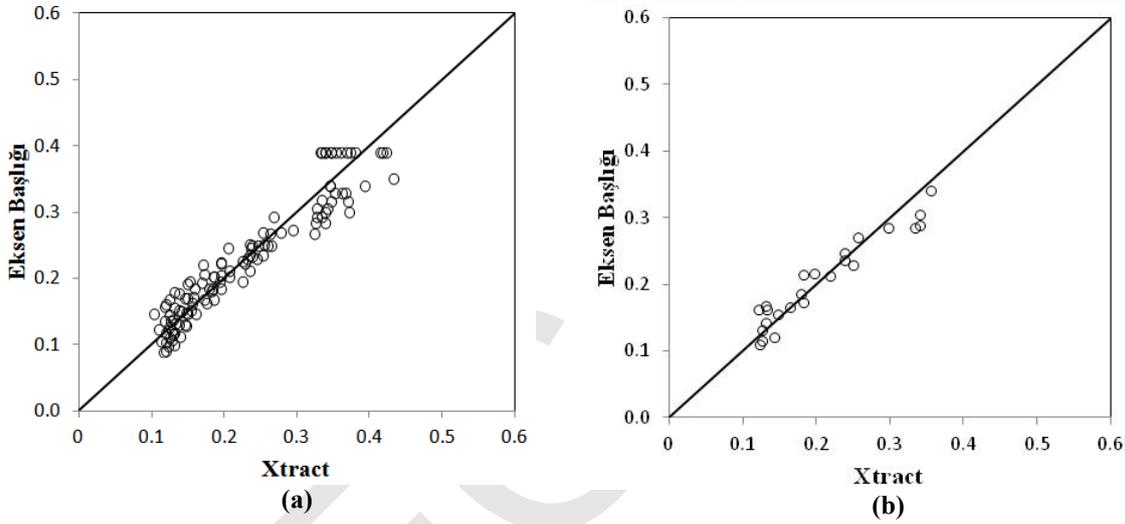
Bu çalışmada önerilen bu basit ampirik formüller ile, betonarme kare kesitlerin moment-eğrilik ilişkileri, uzun iterasyon yöntemleri kullanılmadan ve herhangi bir bilgisayar programına ihtiyaç duyulmadan kolaylıkla belirlenebilmektedir. Bir betonarme yapı tasarlanırken betonarme kesitlerin ve dolayısıyla betonarme elemanların davranışının bilinmesi ve anlaşılması oldukça büyük önem taşımaktadır. Dolayısıyla bu çalışma, betonarme yapıların davranışının daha iyi anlaşılmasına önemli bir katkı sağlayacaktır.

Bu çalışma, devam etmekte olan bir çalışmanın bir bölümünü oluşturmaktadır. Yapılmakta olan çalışmanın genelinde, daire, kare ve dikdörtgen betonarme kesitlerin moment-eğrilik ilişkisinin belirleyen ampirik formüller geliştirilmektedir.


**Şekil 8:** Önerilen  $M_y$  formülünün performansı a) eğitim seti b) test seti

**Şekil 9:** Önerilen  $\kappa_y$  formülünün performansı a) eğitim seti b) test seti



Şekil 10: Önerilen  $M_u$  formülünün performansı a) eğitim seti b) test seti



Şekil 11: Önerilen  $\kappa_u$  formülünün performansı a) eğitim seti b) test seti

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# BİLGİSAYAR VE ÖĞRETİM TEKNOLOJİLERİ EĞİTİMİ BÖLÜMÜ ÖĞRENCİLERİNİN FATİH PROJESİ HAKKINDAKİ GÖRÜŞ VE BEKLENTİLERİ

## OPINIONS AND EXPECTATIONS ABOUT FATİH PROJECT OF STUDENTS FROM DEPARTMENT OF CEIT

Ahmet Tekin  
Fırat Üniversitesi  
Eğitim Fakültesi BÖTE Bölümü  
Elazığ / Türkiye  
atekin@firat.edu.tr

Ebru Polat  
MEB  
Karakoçan Fatih İ.Ö.O.  
Elazığ/ Türkiye  
ebruspolat@gmail.com

**Özet:** Fırsatları Arttırma ve Teknolojiyi İyileştirme Hareketi (FATİH) Projesi, Bilişim Teknolojileri (BT) araçlarının eğitim-öğretim sürecinde daha etkin kullanımı, eğitim materyallerinin BT araçlarına uygun olarak değişmesi ve eğitimde fırsat eşitliğini sağlamak için geliştirilen bir projedir. BT araçlarının etkin kullanılması FATİH Projesi'nin başarıya ulaşmasında önemli bir etkidir. Öğretmenler ise bu BT araçlarının, eğitim-öğretimde kullanılmasında aktif rol alacak kişilerdir. Bilgisayar ve Öğretim Teknolojileri Eğitimi (BÖTE) Bölümü, ilk ve orta dereceli eğitim kurumlarına Bilişim Teknolojileri Öğretmenleri yetiştirmektedir. Bu çalışmada, BÖTE Bölümü öğrencilerinin FATİH Projesi hakkındaki görüş ve beklentilerinin belirlenmesi amaçlanmaktadır. Bu amaca yönelik olarak Fırat Üniversitesi BÖTE Bölümü 2,3 ve 4. sınıf öğrencilerine, araştırmacılar tarafından geliştirilen "FATİH Projesi Hakkındaki Görüş ve Beklenti Anketi" uygulanmış ve sonuçları değerlendirilmiştir. Ankette öğrencilerin; FATİH projesi hakkındaki genel düşünceleri, e-İçerik geliştirme, BT araçlarının kullanımı ve sorun çözme becerileri ile ilgili maddeler bulunmaktadır. Anket sonuçlarına göre BÖTE Bölümü öğrencileri FATİH Projesi Hakkındaki Görüş ve Beklenti Anketine "Kısmen Katılıyorum" ve "Katılıyorum" aralığına denk gelen cevaplar vermişlerdir.

**Anahtar Kelimeler:** FATİH Projesi, BÖTE Bölümü, görüşler ve beklentiler

### Summary

The Project of the movement to increase opportunities and improve technology in the education (FATİH) is a project that was improved for more effective using Information Technology (IT) tools in teaching-learning process, changing of educational materials in accordance with IT tools and ensuring equality of opportunity in education. The effective use of IT tools is an important factor in the success of FATİH Project. As to the teachers, they are people who take actively a part in using of these tools in education and training. Computer Education and Instructional Technologies (CEIT) Department trains Information Technology Teachers of primary and secondary educational institutions. In this study, it is aimed to determine Opinions and Expectations about FATİH Project of Students from Department of CEIT. For this purpose, "Opinions and Expectations Survey on FATİH Project" developed by researches has been implemented to 2, 3 and 4 grade students from Department of CEIT at Fırat University and its result has been evaluated. In the survey, there are items related to students' general views about FATİH Project, e-content development, the use of IT tools and their problem-solving skills. According to the survey results, the students from Department of CEIT gave responses in the range of "I partly agree" and "I agree" to "Opinions and Expectations Survey on FATİH Project."

**Keywords:** FATİH Project, Department of CEIT, opinions and expectations

## 1. GİRİŞ

Fırsatları Arttırma ve Teknolojiyi İyileştirme Hareketi (FATİH) Projesi, eğitim - öğretimde fırsat eşitliğini sağlamak ve okullarda teknoloji entegrasyonunu arttırmak amacıyla geliştirilen bir projedir (Odabaşı, 2011). Alkan vd. (2011) FATİH Projesi isimli çalışmalarında, FATİH Projesi'nin her bir bileşenin büyük bir proje olduğunu belirterek, projenin bileşenlerini şöyle sıralamıştır: Donanım ve Yazılım Altyapısının Sağlanması, Eğitsel e-İçeriğin Sağlanması ve Yönetilmesi, Öğretim Programlarında Etkin BT Kullanımı, Öğretmenlerin Hizmet içi Eğitimi, Bilinçli, Güvenli, Yönetilebilir ve Ölçülebilir BT Kullanımının sağlanması. Demire vd. (2011), yaptıkları çalışmada, Bilişim

Teknolojileri öğretmen adaylarına FATİH Projesi'yle ilgili yarı yapılandırılmış sorular yöneltilmiştir. Çalışma sonucunda Bilişim Teknolojileri (BT) öğretmen adaylarının FATİH Projesi'yle ilgili yeterli bilgiye sahip olmadıkları belirlenmiştir. Öğretmen adayları projenin başarıya ulaşabilmesi için öğretmenlerin teknoloji kullanım yeterlikleri konusunda hizmet içi eğitimden geçirilerek, iyi birer teknoloji okur-yazarı olmaları gerektiği üzerinde durmuşlardır.

Bilici vd. (2011) Eğitimde FATİH Projesinin Sağlaması Öngörülen Fayda ve Sosyal Etkiler isimli çalışmalarında, FATİH Projesi'yle toplumdaki çeşitli sosyo-kültürel ortamlardan gelen bireylerin bilgi ve iletişim teknolojilerine erişim ve kullanımdan çıkan farklılıkların azaltılacağını, bilişim teknolojileri ve internet kullanımının ülke genelinde artırılarak bölgeler arasındaki farklılığın giderilebileceği sonucuna ulaşmışlardır. İnci ve Erten (2011), FATİH Projesi ve projenin eğitim alanındaki yansımalarını araştırmışlardır. Bu amaç doğrultusunda Elazığ ili Alacakaya ilçesinde akıllı tahta, projeksiyon sistemi ve internet bağlantısının bulunduğu okullardaki öğrenci ve öğretmenlerle mülakatlar yapmışlardır. Mülakat sonuçlarına göre, öğrencilerin sistemi çok sevdiği öğretmenlerin ise hizmet içi eğitimlerle daha iyiye gidecek bir eğitim- öğretim sürecine ulaşabilecekleri sonucuna ulaşmışlardır.

Kayaduman vd.(2011), yaptıkları çalışma İnci ve Erten'i destekleyici niteliktedir. Eğitimde FATİH Projesinin Öğretmenlerin Yeterlik Durumları Açısından İncelenmesi isimli çalışmalarında, öğretmenlere yönelik yüz yüze veya çevrim-içi hizmet-içi eğitimler sunulmasından ve bu eğitimlerin sürekli olmasından bahsetmektedirler. Böylelikle, FATİH Projesi'yle sınıflara sağlanan donanımın alt yapısının, eğitsel olarak oluşturulan e-içeriğin ve bilişim teknolojileriyle uyumlu hale getirilen öğretmen kılavuzlarıyla birlikte öğretmenlerin teknolojiyi etkin bir şekilde kullanabilmeleri mümkün olabileceğini belirtmişlerdir. Aynı zamanda Milli Eğitim Bakanlığı (MEB ) e-içeriklerin geliştirilmesi sürecinde öğretmenlere yardımcı olması amacıyla e-içerik (Elektronik İçerik) ve z-kitap (Zenginleştirilmiş Kitap) Hazırlama ve İnceleme Kriterlerini belirlemiş ve bunları yayınlamıştır (<http://fatihprojesi.meb.gov.tr/icerikeklenti/e061211115313.pdf>).

Projenin temel hedeflerinden biri BT araçlarının en verimli şekilde kullanılmasını sağlamaktır (Akgün, 2011). BT araçlarını en verimli kullanacak olan kişiler de öğretmenlerdir. Çuhadar ve Dursun'a (2010) göre BÖTE bölümünün temel amacı BT öğretmenlerini yetiştirmek ve çağdaş öğretim teknolojilerini kullanarak öğrenme-öğretme etkinliklerini geliştirmektir. Bilgisayar ve Öğretim Teknolojileri Eğitimi (BÖTE) Bölümü ilk ve orta dereceli okullarda okutulan "Bilgisayar" derslerini verecek öğretmenler yetiştirmektedir (Karal ve Timuçin, 2009).

Bu çalışmada, BÖTE bölümü öğrencilerinin FATİH Projesi hakkındaki görüşlerini ve beklentilerini belirlemek amacıyla, araştırmacılar tarafından geliştirilen "FATİH Projesi Hakkındaki Görüş ve Beklenti Anketi", Fırat Üniversitesi BÖTE Bölümü 2,3 ve 4. sınıf öğrencilerine uygulanmıştır. Elde edilen anket verileri istatistik programlarıyla değerlendirilmiştir ve sonuçlar verilmiştir.

## 1.1. Araştırmanın Amacı ve Problem

Bu çalışmanın amacı BÖTE Bölümü öğrencilerinin FATİH Projesi hakkındaki görüş ve beklentilerinin belirlenmesidir.

Bu amaç doğrultusunda araştırmada aşağıdaki sorulara cevap aranmıştır.

1. BÖTE Bölümü öğrencilerinin FATİH Projesi hakkındaki görüş ve beklentileri nelerdir?
2. BÖTE Bölümü öğrencilerinin cinsiyetlerine göre FATİH Projesi hakkındaki görüş ve beklentilerinde anlamlı farklılık var mıdır?
3. BÖTE Bölümü öğrencilerinin sınıflar arasına göre FATİH Projesi hakkındaki görüş ve beklentilerinde anlamlı farklılık var mıdır?

## 1.2. Sayıtlar

Evrenden seçilen örneklemin evreni temsil ettiği varsayılmaktadır. Veri toplama aracı kapsam geçerliliği açısından yeterlidir. FATİH Projesi Hakkındaki Görüş ve Beklenti Anketine, öğrenciler gerçek düşüncelerini yansıtmışlardır.

## 2. YÖNTEM

### 2.1. Araştırma Modeli

Araştırmada tarama modelinin bir türü olan genel tarama modeli kullanılmıştır. Karasar'a göre (2011) genel tarama modeli, çok sayıda kişiden oluşan bir evrende, evren hakkında genel bir yargıya varmak amacıyla, evrenin tümü ya da evrenden alınacak bir örneklem üzerinde yapılan tarama düzenlemeleridir. Bu çalışmada, BÖTE Bölümü öğrencilerinin FATİH Projesi hakkındaki görüş ve beklentileri araştırıldığı için bu model kullanılmıştır.

## 2.2. Evren ve Örneklem

Çalışmanın evrenini Fırat Üniversitesi Eğitim Fakültesi BÖTE Bölümü öğrencilerini oluşturmaktadır. Çalışmanın örneklemini ise, Fırat Üniversitesi Eğitim Fakültesi BÖTE Bölümü 2. 3. 4. sınıf öğrencilerinden, seçkisiz yöntemle belirlenmiş 260 öğrenci oluşturmaktadır. Ancak tutarsız ve eksik doldurulan 26 anket, çalışmanın örnekleminde çıkarılmıştır ve 234 öğrenci verisi üzerinden analiz yapılmıştır.

## 2.3. Veri Toplama Aracı

Veri toplama aracı olarak araştırmacılar tarafından geliştirilen ve 31 maddeden oluşan "FATİH Projesi Hakkındaki Görüş ve Beklenti Anketi" kullanılmıştır. Geliştirilen ankette ilk 4 madde ankete katılan öğrencilerin demografik bilgileriyle ilgili olarak, son 27 madde ise FATİH Projesi hakkındaki görüş ve beklentilerine yönelik hazırlanmıştır. Anketin iç tutarlık katsayısı Cronbach Alpha katsayısı ile hesaplanarak 0,90 olarak bulunmuştur.

## 2.4. Verilerin Çözümlemesi

Örneklemden hesaplanan istatistiklere dayalı olarak evren hakkında doğru kestirimlerin yapılmasını sağlayan yöntemle kestirimsel istatistikler denir (Büyüköztürk, 2011). Bu çalışmada örneklem üzerinde çalışılması nedeniyle kestirimsel istatistik kullanılmıştır. Elde edilen istatistiksel veriler, istatistiksel veri çözümleme programlarıyla çözümlenmiştir. Verilerin betimsel analizi için frekans, yüzde, ortalama, standart sapma; karşılaştırma analizleri için ise bağımsız gruplarda t testi ve varyans analizleri kullanılmıştır. Likert tipi sorular 1 ile 5 arasında derecelendirilmiş, elde edilen ortalamalar aşağıdaki gibi sınıflandırılmıştır:

|             |                         |
|-------------|-------------------------|
| 1,00 – 1,80 | Kesinlikle katılmıyorum |
| 1,81 – 2,60 | Katılmıyorum            |
| 2,61 – 3,40 | Kısmen katılıyorum      |
| 3,41 – 4,20 | Katılıyorum             |
| 4,21 – 5,00 | Kesinlikle katılıyorum  |

## 3. BULGULAR ve YORUMLAR

Bu bölümde ankete katılan BÖTE Bölümü öğrencilerinin demografik bilgileri, "FATİH Projesi Hakkındaki Görüş ve Beklenti Anketi" maddelerinin analizi, anket maddelerinin cinsiyete ve sınıflara göre farklılık analizleri verilmiştir.

### 3. 1. Ankete Katılan BÖTE Bölümü Öğrencilerinin Demografik Bilgileri

Ankete katılan BÖTE Bölümü öğrencilerinin demografik bilgilerine ilişkin bulgular bu bölümde yer almaktadır.

**Tablo 1:** Ankete katılan öğrencilerin cinsiyet dağılımı

| Cinsiyet      | Frekans    | Yüzde %    |
|---------------|------------|------------|
| Erkek         | 123        | 52,60      |
| Kadın         | 111        | 47,40      |
| <b>Toplam</b> | <b>234</b> | <b>100</b> |

Tablo 1'den de anlaşılacağı üzere katılımcılar cinsiyetlerine göre dengeli bir dağılım göstermiştir. **Tablo 2:** Ankete katılan öğrencilerin mezun oldukları lise türü dağılımı

| Cinsiyet                   | Frekans | Yüzde % |
|----------------------------|---------|---------|
| Anadolu Öğretmen Lisesi    | 8       | 3,40    |
| Yabancı Dil Ağırlıklı Lise | 7       | 3,00    |
| Meslek Lisesi              | 54      | 23,10   |

|               |            |            |
|---------------|------------|------------|
| Teknik Lisesi | 39         | 16,70      |
| Anadolu Lise  | 29         | 12,40      |
| Düz Lise      | 87         | 37,20      |
| Diğer         | 10         | 4,30       |
| <b>Toplam</b> | <b>234</b> | <b>100</b> |

Tablo 2'de görüldüğü gibi araştırmaya katılan BÖTE bölümü öğrencilerinin büyük çoğunluğunun Düz Lise (%37,20) mezunu ve Meslek Lisesi (%23,10) Mezunu olduğu görülmektedir. BÖTE bölümü Lisans Yerleştirme Sınavı'nda (LYS) Sayısal alanla öğrenci almaktadır ve Düz Lise mezunu öğrenciler lise öğrenimleri süresince daha fazla sayısal dersler görmektedirler. Meslek Lisesi öğrencilerinin de alan tercihlerinden dolayı ek puan verilmektedir. Bu nedenle BÖTE bölümü öğrencilerinin büyük çoğunluğu Düz Lise ve Meslek Lisesi mezunu öğrencilerden oluştuğu anlaşılmaktadır.

**Tablo 3:** Ankete katılan öğrencilerin öğrenim gördükleri sınıflara göre dağılımı

| Sınıf         | Frekans    | Yüzde %    |
|---------------|------------|------------|
| 2. sınıf      | 94         | 40,20      |
| 3. sınıf      | 71         | 30,30      |
| 4. sınıf      | 69         | 29,50      |
| <b>Toplam</b> | <b>234</b> | <b>100</b> |

Ankete katılan öğrencilerin %40,20'si (94 kişi) 2. sınıf öğrencilerinden, %30,30'u (71 kişi) 3. sınıf öğrencilerinden ve %29,50'si (69 kişi) 4. sınıf öğrencilerinden oluştu Tablo 3'ten görülmektedir.

**Tablo 4:** Ankete katılan öğrencilerin öğrenim gördükleri öğretim türlerine göre dağılımı

| Öğretim Türü  | Frekans    | Yüzde %    |
|---------------|------------|------------|
| 1. Öğretim    | 116        | 49,60      |
| 2. Öğretim    | 118        | 50,40      |
| <b>Toplam</b> | <b>234</b> | <b>100</b> |

Ankete yanıt veren öğrencilerin Öğretim türlerine göre dağılımı Tablo 4'te görülmektedir. Ankete katılan BÖTE bölümü öğrencilerinin %49,60'ı (116 kişi) 1. öğretim ve %50,40'ı (118 kişi) 2. öğretim türündedir.

### 3. 2. Ankete Katılan Öğrencilerin FATİH Projesi Hakkındaki Görüş ve Beklenti Bilgileri

Ankete katılan BÖTE bölümü öğrencilerinin FATİH Projesi hakkındaki görüş ve beklentileri bu bölümde yer almaktadır.

**Tablo 5:** Ankete Katılan Öğrencilerin FATİH Projesine İlişkin Genel Görüş ve Beklentileri

| FATİH Projesine İlişkin Genel Görüş ve Beklentileri Anketi Maddeleri |   | □    | Cevap Aralığı      |
|--|---|------|--------------------|
| 1.   | FATİH Projesi hakkında bilgi sahibiyim  | 3,52 | Katılıyorum        |
| 2.   | FATİH Projesi'nin eğitim açısından yararlı olacağını düşünüyorum  | 3,73 | Katılıyorum        |
| 3.   | FATİH Projesi'nin başarılı olacağını düşünüyorum  | 3,59 | Katılıyorum        |
| 4.   | FATİH Projesiyle eğitimde fırsat eşitliğinin gerçekleşebileceğini düşünüyorum   | 3,43 | Katılıyorum        |
| 5.   | FATİH Projesiyle okullara dağıtılan BT araçlarının eğitimde etkin bir şekilde kullanılacağını düşünüyorum   | 3,24 | Kısmen Katılıyorum |
| 6.   | FATİH projesiyle okullara dağıtılacak olan donanım ve yazılımların uygun biçimde kullanma becerileri için, Öğretmenlere hizmet içi eğitim verilmesi gerektiğini düşünüyorum | 4,17 | Katılıyorum        |
| 7.   | Bilişim Teknolojileri Öğretmenleri dışındaki öğretmenlerin, FATİH projesiyle okullara dağıtılacak olan donanım ve yazılımları kullanmada zorluk çekeceklerini düşünüyorum   | 4,00 | Katılıyorum        |
| 8.   | FATİH projesi ile eğitimcilerimizin de bilişim okuryazarlığının artacağını düşünüyorum  | 3,88 | Katılıyorum        |

|     |   |      |                    |
|-----|---|------|--------------------|
| 9.  | FATİH projesi sayesinde gelişmiş ülkeler ile ülkemiz arasındaki, Bilişim Teknolojileri araçlarının kullanımıyla ilgili farklılıkların azalacağını düşünüyorum | 3,75 | Katılıyorum        |
| 10. | FATİH projesi kapsamında eğitim görüp, mezun olan ortaöğretim öğrencilerinin, iletişim teknolojilerini yeterli düzeyde kullanabileceğimi düşünüyorum          | 3,66 | Katılıyorum        |
| 11. | Eğitim içerikli derslerde FATİH projesinin önemi vurgulanmıştır   | 3,07 | Kısmen Katılıyorum |
| 12. | Teknik içerikli derslerde FATİH projesinin önemi vurgulanmıştır   | 3,14 | Kısmen Katılıyorum |

Tablo 5’de BÖTE Bölümü öğrencilerinin FATİH Projesi hakkındaki genel görüş ve beklentileri anketi verilerinin analizleri yer almaktadır. Ankete katılan BÖTE bölümü öğrencileri bu maddelerden, “FATİH Projesi’yle okullarda dağıtılan BT araçlarının eğitimde etkin bir şekilde kullanılacağını düşünüyorum”, “Eğitim içerikli derslerde FATİH projesinin önemi vurgulanmıştır” ve “Teknik içerikli derslerde FATİH projesinin önemi vurgulanmıştır” maddelerine "Kısmen Katılıyorum" aralığına denk gelen cevaplar vermişlerdir. Öğrencilerin, BT araçlarının eğitimde etkin bir şekilde kullanılması konusunda kaygılarının olduğu ve gerek eğitim gerekse teknik içerikli derslerde FATİH projesinin öneminin yeterince vurgulanmadığı anlaşılmıştır.

**Tablo 6:** Ankete Katılan Öğrencilerin Yazılım ve Donanım Bileşenine İlişkin Genel Görüş ve Beklentileri

| Yazılım ve Donanım Bileşenine İlişkin Genel Görüş ve Beklentileri |  | □    | Cevap Aralığı |
|---|--|------|---------------|
| 13.   | FATİH Projesiyle okullarda kullanılacak olan yazılımları kullanabileceğimi düşünüyorum                       | 3,91 | Katılıyorum   |
| 14.   | FATİH Projesiyle okullarda kullanılacak olan yazılımlarda meydana gelen sorunları çözebileceğimi düşünüyorum | 3,59 | Katılıyorum   |
| 15.   | FATİH projesiyle okullara dağıtılacak donanımların neler olduğu hakkında bilgi sahibiyim                     | 3,45 | Katılıyorum   |
| 16.   | FATİH Projesiyle okullarda kullanılacak olan donanımları kullanabileceğimi düşünüyorum                       | 3,92 | Katılıyorum   |
| 17.   | FATİH Projesiyle okullarda kullanılacak olan donanımlarda meydana gelen sorunları çözebileceğimi düşünüyorum | 3,62 | Katılıyorum   |
| 18.   | FATİH projesiyle okullara dağıtılacak olan Etkileşimli Tahta’yı kullanabileceğimi düşünüyorum                | 4,01 | Katılıyorum   |
| 19.   | FATİH projesiyle okullara dağıtılacak olan çok amaçlı fotokopi makinesini kullanabileceğimi düşünüyorum      | 3,87 | Katılıyorum   |
| 20.   | FATİH projesiyle okullara dağıtılacak olan doküman kamerayı kullanabileceğimi düşünüyorum                    | 3,90 | Katılıyorum   |
| 21.   | FATİH projesiyle okullara dağıtılacak olan tablet bilgisayarları kullanabilirim                              | 4,14 | Katılıyorum   |

Ankete katılan öğrenciler, yazılım ve donanım bileşenine ilişkin maddelere "Katılıyorum" aralığına denk gelen cevaplar vermişlerdir. Anketin uygulandığı çalışma grubunun BÖTE bölümü öğrencilerinden oluşması ve bu bölümde okuyan öğrencilerin donanım ve diğer BT temelli dersleri yoğun bir şekilde görmeleri anket maddelerine "Katılıyorum" aralığına denk gelen cevaplar vermelerinde etkili olduğu düşünülmektedir. Anket sonuçlarına göre araştırmanın örneklemini oluşturan öğrenciler, BT cihazlarını ve yazılımları daha etkin kullanabilecekleri, meydana gelen sorunları çözebilecekleri anlaşılmaktadır.

**Tablo 7:** Ankete Katılan Öğrencilerin E-İçerik Bileşenine İlişkin Genel Görüş ve Beklentileri

| E-İçerik Bileşenine İlişkin Genel Görüş ve Beklentileri |  | □    | Cevap Aralığı      |
|---|--|------|--------------------|
| 22.   | FATİH Projesi'nin bir bileşeni olan e-İçerik geliştirme hakkında bilgi sahibiyim | 3,12 | Kısmen Katılıyorum |
| 23.   | Bilgisayar kullanım bilgimin e-İçerik düzenlemek için yeterlidir                 | 3,38 | Kısmen Katılıyorum |
| 24.   | Etkileşimli bir e-İçerik tasarlayabilirim  | 3,23 | Kısmen Katılıyorum |
| 25.   | Eğitsel kazanımları destekleyici nitelikte e-İçerik geliştirebilirim             | 3,71 | Katılıyorum        |

|     |  |      |             |
|-----|--|------|-------------|
| 26. | Temel tasarım ilkelerine ve elemanlarına uygun, özgün, özenli ve estetik e-<br>içerik geliştirebilirim                             | 3,39 | Katılıyorum |
| 27. | Dersin değerlendirilmesi için, ders kitaplarındaki mevcut soruları etkileşimli<br>hale getirecek şekilde e-içerik geliştirebilirim | 3,42 | Katılıyorum |

Ankete katılan BÖTE Bölümü öğrencileri 22, 23 ve 24 numaralı anket maddelerine “Kısmen Katılıyorum”, 25, 26 ve 27 numaralı maddelere ise “Katılıyorum” aralığına denk gelen cevaplar vermişlerdir. 23 ve 24 numaralı maddeler bilgisayar dersleri ile ilgili, 25, 26, 27 numaralı maddeler ise eğitim ve bilgisayar dersleriyle ilgilidir. Ankete katılan öğrencilerden, 2. ve 3. sınıf öğrencileri katılımcıların çoğunluğunu oluşturmaktadır. 2. sınıf öğrencileri ilk 3 dönemde ağırlıklı olarak eğitim dersleri aldıklarından, 3. sınıf öğrencileri ise 4. sınıf öğrencilerine göre daha az bilgisayar dersi aldıklarından, analiz sonucunu etkileyerek bilgisayarla ilgili olan 23 ve 24 numaralı maddelerin “Kısmen Katılıyorum” aralığına denk gelmesini sağladığı söylenebilir.

### 3. 3. FATİH Projesi Hakkındaki Görüş ve Beklentilerinin Cinsiyete Göre Karşılaştırma

#### Analizi

Bu bölümde ankete katılan BÖTE bölümü öğrencilerinin FATİH Projesi Hakkındaki Görüş ve Beklentilerinin cinsiyete göre anlamlı bir farklılık göstermemektedir. Bu sonuç cinsiyetin FATİH Projesi Hakkındaki Görüş ve Beklentileri üzerinde etkisi olmadığını göstermektedir.

### 3. 4. FATİH Projesi Hakkındaki Görüş ve Beklentilerin Sınıflara Göre Karşılaştırma Analizi

Ankete katılan BÖTE Bölümü öğrencilerinin sınıflara göre karşılaştırmaları yapılmıştır ve bu bölümde karşılaştırma sonuçları Tablo 8 ve Tablo 9’da verilmiştir.

**Tablo 8:** Ankete Katılan Öğrencilerin Sınıflara Göre Karşılaştırma Analizi

| Madde   | Grup          | N   | $\bar{x}$ | SS   | Varyansın Kaynağı | Kareler Toplamı | sd  | Kareler Ortalaması | F    |
|---|---------------|-----|-----------|------|-------------------|-----------------|-----|--------------------|------|
| 3-FATİH Projesi'nin başarılı olacağını düşünüyorum  | 2. Sınıf      | 94  | 3,94      | 1,03 | Gruplarasası      | 24,79           | 2   | 12,39              | 9,75 |
|   | 3. Sınıf      | 71  | 3,56      | 1,14 | Gruplariçi        | 293,44          | 231 | 1,70               |      |
|   | 4. Sınıf      | 69  | 3,15      | 1,23 | Toplam            | 318,23          | 233 |                    |      |
|   | <b>Toplam</b> | 234 | 3,59      | 1,16 |                   |                 |     |                    |      |
| 5-FATİH Projesiyle okullara dağıtılan BT araçlarının eğitimde etkin bir şekilde kullanılacağını düşünüyorum   | 2. Sınıf      | 94  | 3,58      | 1,04 | Gruplarasası      | 19,46           | 2   | 9,73               | 7,59 |
|   | 3. Sınıf      | 71  | 3,12      | 1,22 | Gruplariçi        | 296,15          | 231 | 1,28               |      |
|   | 4. Sınıf      | 69  | 2,91      | 1,14 | Toplam            | 315,62          | 233 |                    |      |
|   | <b>Toplam</b> | 234 | 3,24      | 1,16 |                   |                 |     |                    |      |
| 6-FATİH Projesiyle okullara dağıtılacak olan donanım ve yazılımların uygun biçimde kullanma becerileri için, Öğretmenlere hizmet içi eğitim verilmesi gerektiğini düşünüyorum | 2. Sınıf      | 94  | 4,40      | 0,90 | Gruplarasası      | 12,67           | 2   | 6,33               | 5,94 |
|   | 3. Sınıf      | 71  | 3,84      | 1,16 | Gruplariçi        | 246,48          | 231 | 1,06               |      |
|   | 4. Sınıf      | 69  | 4,18      | 1,04 | Toplam            | 259,16          | 233 |                    |      |
|   | <b>Toplam</b> | 234 | 4,17      | 1,05 |                   |                 |     |                    |      |
| 8-FATİH Projesi ile eğitimcilerimizin de bilişim okuryazarlığının artacağını düşünüyorum  | 2. Sınıf      | 94  | 4,02      | 0,91 | Gruplarasası      | 6,44            | 2   | 3,22               | 3,87 |
|   | 3. Sınıf      | 71  | 3,63      | 0,92 | Gruplariçi        | 192,20          | 231 | ,83                |      |
|   | 4. Sınıf      | 69  | 3,94      | 0,88 | Toplam            | 198,65          | 233 |                    |      |
|   | <b>Toplam</b> | 234 | 3,88      | 0,92 |                   |                 |     |                    |      |
| 9-FATİH projesi sayesinde gelişmiş ülkeler ile ülkemiz arasındaki, Bilişim Teknolojileri araçlarının kullanımıyla ilgili farklılıkların azalacağını düşünüyorum               | 2. Sınıf      | 94  | 3,96      | 0,98 | Gruplarasası      | 7,23            | 2   | 3,61               | 3,39 |
|   | 3. Sınıf      | 71  | 3,57      | 1,09 | Gruplariçi        | 245,88          | 231 | 1,06               |      |
|   | 4. Sınıf      | 69  | 3,65      | 1,02 | Toplam            | 253,11          | 233 |                    |      |
|   | <b>Toplam</b> | 234 | 3,75      | 1,04 |                   |                 |     |                    |      |

$p < 0.05$

Tablo 8'deki maddeler sınıflar arasında anlamlı farklılık göstermektedir. Bunun dışındaki maddelerde anlamlı bir farklılık görülmemiştir. Bu farklılık tüm maddelerde 2. sınıf öğrencilerinin lehinedir. 2. sınıf öğrencileri, 3. ve 4. sınıf öğrencilerine göre daha pozitif yaklaşmışlardır. 4. sınıf öğrencileri, 2. ve 3. sınıf öğrencilerine göre öğretmenlik mesleğine daha yakındırlar. Özellikle Okul Deneyimi dersi kapsamında okullara giderek; okullardaki idare, öğretmenler, öğrenci, mevcut altyapı, BT araçları, bu araçların kullanımı vs. gibi durumları yerinde gözlediklerinden tablo 8'deki soruları cevaplarken biraz daha deneyimli yaklaştıkları düşünülebilir.

**Tablo 9:** Ankete Katılan Öğrencilerin Sınıflara Göre Karşılaştırma Analizi

| Madde  | Grup          | N   | $\bar{x}$ | SS   | Varyansın Kaynağı | Kareler Toplamı | sd  | Kareler Ortalaması | F     |
|--|---------------|-----|-----------|------|-------------------|-----------------|-----|--------------------|-------|
| 22-FATİH Projesi'nin bir bileşeni olan e-çerik geliştirme hakkında bilgi sahibiyim | 2. Sınıf      | 94  | 2,80      | 1,12 | Gruplararası      | 23,69           | 2   | 11,84              | 10,58 |
|  | 3. Sınıf      | 71  | 3,11      | 1,03 | Gruplarıçi        | 258,46          | 231 | 1,11               |       |
|  | 4. Sınıf      | 69  | 3,57      | 0,97 | Toplam            | 282,15          | 233 |                    |       |
|  | <b>Toplam</b> | 234 | 3,12      | 1,1  |                   |                 |     |                    |       |
| Madde  | Grup          | N   | $\bar{x}$ | SS   | Varyansın Kaynağı | Kareler Toplamı | sd  | Kareler Ortalaması | F     |
| 23-Bilgisayar kullanım bilgimin e-çerik düzenlemek için yeterlidir                 | 2. Sınıf      | 94  | 3,30      | 1,09 | Gruplararası      | 6,76            | 2   | 3,38               | 3,64  |
|  | 3. Sınıf      | 71  | 3,22      | 0,91 | Gruplarıçi        | 214,39          | 231 | 0,96               |       |
|  | 4. Sınıf      | 69  | 3,63      | 0,80 | Toplam            | 221,15          | 233 |                    |       |
|  | <b>Toplam</b> | 234 | 3,38      | 0,97 |                   |                 |     |                    |       |
| Madde  | Grup          | N   | $\bar{x}$ | SS   | Varyansın Kaynağı | Kareler Toplamı | sd  | Kareler Ortalaması | F     |
| 24-Etkileşimli bir e-çerik tasarlayabilirim  | 2. Sınıf      | 94  | 3,09      | 1,03 | Gruplararası      | 8,12            | 2   | 4,06               | 4,19  |
|  | 3. Sınıf      | 71  | 3,14      | 0,98 | Gruplarıçi        | 214,39          | 231 | ,96                |       |
|  | 4. Sınıf      | 69  | 3,52      | 0,90 | Toplam            | 232,07          | 233 |                    |       |
|  | <b>Toplam</b> | 234 | 3,23      | 0,99 |                   |                 |     |                    |       |

$p < 0.05$

Tablo 9'da verilen maddeler sınıflar arasında anlamlı farklılık olduğunu göstermektedir ve bu farklılık tüm maddelerde 4. sınıf öğrencilerinin lehinedir. Bunun dışındaki maddelerde anlamlı bir farklılık görülmemiştir. 4. sınıf öğrencilerin lehine sonuç veren bu maddeler FATİH Projesi'nin bir bileşeni olan e-çerik geliştirme, e-çerik düzenlemek için yeterli bilgiye sahip olma ve etkileşimli bir e-çerik tasarlayabilme ile ilgilidir. 4. sınıfa kadar gelen öğrenciler; Eğitimde Materyal Tasarımı ve Kullanımı, Eğitimde Grafik ve Canlandırma, Öğretim Tasarımı, Eğitsel Web Sayfası Tasarımı, Eğitsel Bilgisayar Oyunları Tasarımı, İnternet Tabanlı Programlama, Çoklu Ortam Tasarımı ve Üretimi, İçerik ve Öğrenme Yönetim Sistemi Yazılımları, Eğitimde Materyal Geliştirme, Çevrimiçi Eğitim Uygulamaları gibi dersler aldıkları için e-çerik geliştirme ve düzenleme konusunda kendilerine daha fazla güvendikleri anlaşılmaktadır.

#### 4. SONUÇ

BT araçlarının eğitim sistemimizle bütünleşmesi ve verimli bir şekilde kullanılması FATİH Projesinin başarıya ulaşmasında büyük öneme sahip olduğu düşünülmektedir. Uygulanan anket sonuçlarına göre ankete katılan BÖTE bölümü öğrencileri FATİH Projesi Hakkındaki Görüş ve Beklenti Anketine "Kısmen Katılıyorum" ve "Katılıyorum" aralığına denk gelen cevaplar vermişlerdir. Araştırmaya katılan BÖTE Bölümü öğrencileri FATİH Projesi, FATİH Projesi'yle kullanılacak BT araçlarının kullanımı, e-çerik ve e-çerik geliştirme hakkında bilgi sahibi oldukları söylenebilir. Ancak BÖTE Bölümü öğrencileri BT araçlarının eğitimde etkin kullanımı, e-çerik geliştirme ve düzenleme konusunda kaygılarının oldukları anlaşılmaktadır. Ayrıca BÖTE bölümü öğrencilerinin FATİH Projesiyle okullarda kullanılacak olan donanım ve yazılımları kullanabileceği, oluşabilecek problemleri de çözebilecekleri söylenebilir. FATİH Projesi Hakkındaki Görüş ve Beklenti Anketi, sınıflara göre anlamlı farklılıklar göstermektedir. 4. sınıf öğrencileri, 2. ve 3. sınıf öğrencilerine göre daha fazla eğitim ve BT dersleri gördüklerinden dolayı e-çerik geliştirme konusunda kendilerine daha fazla güvendikleri anket sonuçlarından anlaşılmaktadır. FATİH Projesi'nin uygulanmasında ve başarıya ulaşmasında, BÖTE öğretmenlerinin yanı sıra diğer branşlardaki öğretmenlerin de etkisinin

olacağı düşünülmektedir. Bu nedenle, gelecek çalışmada FATİH Projesi Hakkındaki Görüş ve Beklenti Anketi Eğitim Fakültesinde okuyan diğer öğrencilere de uygulanarak anket sonuçları değerlendirilecektir.

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# BİLİŞİM TEKNOLOJİLERİ ÖĞRETMEN ADAYLARININ BİLGİSAYAR VE İNTERNET BAĞIMLILIĞINA İLİŞKİN GÖRÜŞLERİ

## OPINIONS OF TEACHER CANDIDATES OF INFORMATION TECHNOLOGIES ABOUT COMPUTER AND INTERNET ADDICTION

Ferhat BAHÇECİ  
Fırat Üniversitesi, Eğitim Fakültesi  
BÖTE Bölümü,  
Elazığ/Türkiye  
ferhatbahceci@hotmail.com

Oğuzhan ÖZDEMİR  
Fırat Üniversitesi, Eğitim Fakültesi  
BÖTE Bölümü,  
Elazığ/Türkiye  
oguzhan@firat.edu.tr

**Özet:** Çağımızda gelişen teknolojilerin en önemlilerinden olan internet ve bilgisayar teknolojileri hayatımızın her alanında kullanılmaktadır. Özellikle internet ve buna bağlı teknolojiler hayatımızın vazgeçilmez bir parçası haline gelmiştir. Artık insanlar gününün büyük bir bölümünü internette iş ve alışveriş yaparak, e-postalarını okuyarak, sosyal ağlarda vakit geçirerek ya da amaçsızca gezinerek geçirmektedir. İnternet kullanımının her geçen gün artarak her türlü bilgiye kolaylıkla ve herhangi bir denetim olmadan ulaşılması beraberinde birçok olumsuz sonucu da getirmektedir. Günümüzde bazı insanlar internet kullanımını kontrol dışı ve bağımlı bir boyutta yaşamaktadırlar. İnsanlar bilgisayar ve internet kullanımı yüzünden duygusal sorunlar, yoksunluk (nete giremediğinde yoğun girme isteği ve merak), sosyal ilişkilerin azalması ya da kesilmesi gibi sorunlarla karşılaşarak neredeyse internet bağımlısı haline gelmiştir. Özellikle sosyal paylaşım ağları ve online oyunların söz konusu olması dolayısı ile üniversite öğrencileri internet bağımlılığında en yüksek riski taşımaktadır. Bu araştırma bilişim teknolojileri öğretmen adaylarının internet bağımlılığı ile ilgili görüşlerini ortaya çıkarmak amacıyla yapılmıştır. Bu amaca ulaşmak için 25 maddelik bir anket formu geliştirilmiştir. Anket formu Fırat Üniversitesi Teknik Eğitim Fakültesi Bilgisayar Öğretmenliği ile Eğitim Fakültesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümünde (BÖTE) okuyan toplam 150 öğrenciye uygulanmıştır, veriler istatistiksel olarak çözümlenip sonuca ulaşılmıştır.

**Anahtar Kelimeler:** İnternet bağımlılığı, internet, bilgisayar, öğretmen adayları

**Abstract:** Being the most significant advancing technologies in our era, internet and computer technologies are used in every field of the life. Especially internet and related technologies have become an indispensable part of the life. Now people spend majority of the day by working and shopping on the internet, reading their emails, spending time on social networks, or surfing with no purpose. Increasing internet usage every passing day and reaching every kind of information easily and without any supervision bring along many adverse results, as well. Nowadays some people experience internet usage in an uncontrolled and addicted way. People have become almost internet addicted by encountering problems such as emotional problems, deprivation (feeling a profound desire to connect to the internet and curiosity, when not connected to the internet), decrease or interruption in social relations, due to computer and internet usage. University students have the highest risk for internet addiction, especially because of social networks and online games. This study was conducted to introduce opinions of teacher candidates of information technologies about internet addiction. A questionnaire form with 25 items was developed to achieve this purpose. The questionnaire was conducted to a total of 150 students attending at the Department of Computer and Instructional Technologies in Faculty of Education and Department of Computer Teaching in Faculty of Technical Education in Fırat University. The data were statistically analyzed and then conclusion was reached.

**Key words:** Internet addiction, internet, computer, teacher candidates

## GİRİŞ

Bilişim çağı olarak adlandırılan günümüzde gelişen teknolojiler, avantajları olduğu gibi dezavantajları da beraberinde getirmektedir. Yeni teknolojiler, hayatımızı bir yandan kolaylaştırırken bir yandan da olumsuz olarak etkilemektedir. Örneğin gelişen teknolojilerin en önemlilerinden olan internet sayesinde zaman ve mekân fark etmeden iletişim, haberleşme, eğitim, bankacılık işlemleri vb. gibi ihtiyaçlarımızı giderme şansına sahip bulunmaktayız. Ancak

internet kullanımının araç olarak değil de bir amaç halinde kullanılmaya başlanması durumunda hayatımızı olumsuz yönde etkileyerek bir bağımlılık haline gelebilir (Karaman, 2009; Cengizhan, 2008).

Köknel(1998)'a göre insan ve insanın kişiliği bedensel, ruhsal, toplumsal yapıların, işlevlerin birleşip bütünleşmesinden oluşur. Bu bütünlük içinde değişik katmanlarda yer alan yapılar ve işlevler bulunur. Normal davranış bu katmanlarda bulunan yapıların ve işlevlerin dengeli, düzenli ve uyumlu olması sonucunda; anormal davranış ise dengesiz, düzensiz ve uyumsuz olması sonucunda ortaya çıkmaktadır. Bu durumda bağımlılığı anormal bir davranış olarak tanımlamak mümkündür ya da bireyin fiziksel, biyolojik ve ruhsal işlevleri üzerinde sorun yaratarak, bireyin dengesini ve düzenini bozan davranışların bütünüdür şeklinde de tanımlamak mümkündür. İlgili literatür incelendiğinde bağımlılığın iki temel düzeyde ele alındığı görülmektedir. Bunlardan ilki madde bağımlılığı ikincisi ise bir davranışa olan bağımlılıktır. Çay, kahve, sigara, çikolata, uyuşturucu maddeler, vs. gibi maddelere bağımlılık genel olarak madde bağımlılığı kavramı altında incelenmektedir. Bir davranışa bağımlılık ise, belirli bir davranışın, anormal düzen ve sıklıkla sergilenmesi sonucu bireyin bedensel, psikolojik ve toplumsal yapı ve işlevlerinde dengesini yitirmesi, düzeninin bozulması ve ortama uyum sağlayamaması şeklinde tanımlanabilecek bağımlılık türüdür. Bu nedenle günümüzde gelişen teknoloji ve farklılaşan davranışsal değişiklikler de bağımlılık olarak düşünülmeye başlanmıştır(Grohol, 1999; King Storm, 1996).

Bilişim çağı olarak adlandırılan günümüzde en hızlı şekilde gelişen teknolojik yenilikler olarak bilgisayar ve interneti gösterilmektedir. Bundan 10 yıl evvel bilgisayar kullanmayı bilmek bireylerin isteklerine bağılıken bugün bilgisayar kullanmayı bilmek bir zorunluluk haline gelmiştir. Çünkü bilgisayar ve internet teknolojileri günlük yaşantımızda her an karşımıza çıkmaktadır. Toplumun her kesiminden bireyler bir şekilde bilgisayar ve interneti günlük yaşantılarında kullanmak zorunda kalmaktadırlar. Kısacası, ortaya çıkan yenilikler ve gelişen teknolojiler bireylerin hayatına ve yaşam biçimlerine değişik ve yeni bir boyut kazandırmakta ve kişilere farklı seçenekler sunmaktadır (Nakilcioğlu, 2007).

Teknolojinin giderek daha da hızlı geliştiği ve yaygınlaştığı bu dönemde toplumun gelişmesinde ve yeniliklere uyum sağlamasında ve ayrıca ortaya çıkabilecek olumsuz sonuçların önüne geçilmesinde en büyük görevin eğitimcilere düştüğünü söyleyebiliriz. Bu nedenle bu çalışmada gelecekteki eğitimcilerin, öğretmen adaylarının internet bağımlılığı ile ilgili görüşlerini ortaya çıkarmak ve internet bağımlısı olup olmadıklarını öğrenmek amaçlanmıştır (Karaman, 2009; Suler, 1996).

## Problem Durumu

İnternet; insanların günlük hayatında her geçen gün daha da fazla kullanılmaya başlanan bir teknolojidir. Ancak interneti kullanım oranı ve zamanı arttıkça, kontrollü bir şekilde interneti kullanmak oldukça zorlaşmaktadır. Bu durum interneti hayatımızdan çıkarmamız anlamına kesinlikle gelmediği gibi böyle bir şey mümkün de değildir. Önemli olan interneti de kontrollü bir şekilde kullanmaktır. Bilgisayar ve internet günümüzde hemen hemen herkes tarafından belirli oranlarda kullanılmaktadır. Ancak bu durum özellikle bilişim teknolojileri alanındaki insanlar için biraz daha farklı olmaktadır. Özellikle bu alandaki kişiler gerek günlük işlerinde gerekse mesleki durumları itibarı ile bilgisayar ve interneti daha yoğun bir şekilde kullanmaktadır. Bilgisayar ve interneti bu yoğun kullanım şekli insanların fiziksel olarak da birçok rahatsızlıklara yakalanmasına sebep olmakla birlikte ciddi bir bağımlılığa da sebep olmaktadır. Bu nedenle bilişim teknolojileri öğrencilerinin bilgisayar ve internet bağımlılığı hakkında bilgi sahibi olmaları onların fiziksel ve psikolojik sağlıkları açısından son derece önemlidir.

## Araştırmanın Amacı

Bu araştırmanın amacı bilgisayarı ve interneti oldukça fazla kullanan Bilişim Teknolojileri öğretmen adaylarının bilgisayar ve internet bağımlılığı ilişkin görüşlerini belirlemektir.

Bu genel amaca dayalı olarak aşağıdaki alt amaçlar geliştirilmiştir.

- Bilgisayar Öğretmenliği Öğrencilerinin Mezuniyet Bilgisi ve genel düşünceleri nelerdir?
- Öğrencilerinin Bilgisayar ve İnternet Ortamı ile ilgili genel düşünceleri nelerdir?
- Öğrencilerinin İnternet Ortamında Oyun oynaması ile ilgili genel düşünceleri nelerdir?
- Öğrencilerinin Sohbet ve Sosyal Paylaşım Siteleri ile ilgili genel düşünceleri nelerdir?
- Öğrencilerinin Aile ve Sosyal Çevre ile ilgili genel düşünceleri nelerdir?
- Öğrencilerinin İnternet Güvenliği ile ilgili genel düşünceleri nelerdir?

## Sayıtlar

Bu çalışmada; öğrencilerin bilgisayarı kullanma yetenekleri ve internete ilişkin bilgi durumları, çalışma grubunun oluşturulmasında yeterli kabul edilmektedir. Öğrencilerin veri toplama aracını doğru ve samimi cevapladıkları, bununla birlikte Fırat Üniversitesi, Teknik Eğitim Fakültesi, Bilgisayar Öğretmenliği ve Eğitim Fakültesi, Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü (BÖTE) 3 ve 4. sınıf öğrencilerinin, tüm Bilgisayar Öğretmenliği 3 ve 4. sınıf öğrencilerini temsil edebilen bir parça olarak düşünülmüştür.

## Sınırlılıklar

Bu araştırma, aşağıda belirtilen özellikler açısından sınırlandırılmıştır:

1. 2011-2012 öğretim yılı ile sınırlıdır.
2. Çalışma grubu Fırat Üniversitesi, Teknik Eğitim Fakültesi, Bilgisayar Öğretmenliği ve Eğitim Fakültesi, BÖTE bölümündeki 3. ve 4. sınıf öğrenci ile sınırlıdır.
3. İstatistiksel analizde kullanılacak veriler, çalışmada kullanılan veri toplama aracı ile toplanan verilerle sınırlıdır.

## YÖNTEM

Bu bölümde; tespit edilen problem ışığında gerçekleştirilmesine karar verilen bu çalışmanın amaçlarına ulaşabilmesi için kullanılan yöntemler açıklanmıştır. Araştırma mevcut durumu var olduğu şekliyle betimlemeyi amaçladığından betimsel tarama modeli kullanılmıştır.

### Araştırma Grubu

Bu araştırma 2011-2012 öğretim yılı bahar döneminde, Fırat Üniversitesi, Teknik Eğitim Fakültesi, Bilgisayar Öğretmenliği ve Eğitim Fakültesi, Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü (BÖTE) 3 ve 4. sınıf öğrencileri ile yürütülmüştür. Çalışma grubunun belirtilen fakülte ve bölümlerden oluşturulmasının nedeni ise bu bölüm öğrencilerinin bilgisayar ve internet kullanım seviyelerinin diğer bölüm öğrencilerine nazaran daha fazla olması araştırmanın bu bölümlerde gerçekleştirilmesi açısından önemli bir etkiye sahiptir. Çalışma grubundaki veri toplama aracını cevaplamayı kabul etmeyenler ve hatalı cevaplayanlar ayrıştırıldıktan sonra kalan 150 öğrenci araştırma grubunu oluşturmuştur.

Araştırma grubunun genel profili tablo 1’de görülmektedir.

**Tablo 1: Araştırma Grubunun Profili**

| Cinsiyet      | N          | %             |
|---------------|------------|---------------|
| Erkek         | 86         | 57,33         |
| Kadın         | 64         | 42,67         |
| Öğrenim Türü  |            |               |
| I. Öğretim    | 82         | 54,66         |
| II. Öğretim   | 68         | 45,34         |
| Sınıf         |            |               |
| 3.Sınıf       | 71         | 47,33         |
| 4.Sınıf       | 79         | 52,64         |
| <b>Toplam</b> | <b>150</b> | <b>100,00</b> |

Tablo 1’den de anlaşılacağı gibi katılımcıların cinsiyet, öğrenim türü ve sınıf verilerine göre dengeli bir dağılım göstermiştir.

### Verilerin Toplanması

İlgili literatür taramasından elde edilen veriler ve öğrencilerle yapılan görüşmeler neticesinde 6’sı kişisel bilgi ve 25’i likert tipi sorulardan oluşan toplam 31 soruluk bir anket formu geliştirilmiştir. Geliştirilen veri toplama aracı araştırma grubuna üç haftalık bir süreç içerisinde uygulanmış ve tüm sonuçlar elektronik ortama aktarılmıştır.

### Verilerin Analizi

Veri toplama aracının araştırma grubuna uygulanmasıyla elde edilen veriler istatistiksel analize tabi tutulmuş bu amaca yönelik olarak istatistiksel veri analizi paket programlarından faydalanılmıştır. Verilerin çözümlenmesinde; frekans, yüzde, ortalama ve standart sapma analizleri kullanılmıştır. Kullanıcıların bilgisayar ve internet bağımlılığına ilişkin verilerinin çözümlenmesi ve yorumlanması için beşli ölçek aralıkları aşağıdaki şekliyle belirlenmiştir.

|                         |               |
|-------------------------|---------------|
| Kesinlikle katılıyorum  | : 4.20 - 5.00 |
| Katılıyorum             | : 3.40 - 4.19 |
| Kısmen Katılıyorum      | : 2.60 - 3.39 |
| Katılmıyorum            | : 1.80 - 2.59 |
| Kesinlikle katılmıyorum | : 1.00 - 1.79 |

## BULGULAR VE YORUMLAR

Araştırmanın bu bölümünde veri toplama aracı ile elde edilen ve problem durumunu destekler nitelikte olan alt amaçlar ile bu alt amaçlara ait istatistiksel bulgulara yer verilmiştir.

### Bilgisayar Öğretmenliği Öğrencilerinin Mezuniyet Bilgisi ve genel düşünceleri

Katılımcıların mezun oldukları liseyi ve genel düşüncelerini belirtmeleri için geliştirilen veri toplama aracında “Mezun olduğunuz Lise” şeklindeki soruya öğrencilerin % 30’luk bölümü “Anadolu Meslek Lisesi”, %24’lük bölümü “Anadolu Lisesi” ve “Düz Lise”, %16’lık kısmının ise “Endüstri Meslek Lisesi”nden geldiği, %2’lik “Fen Lisesi” mezunlarının ise bölümü en az tercih eden lise kategorisinde olduğu görülmektedir. Bu soruya ait veriler Tablo 2’de görülmektedir.

**Tablo 2:** Bölümü Tercih Edenlerin Mezun Olduğu Lise

| Lise                   | N          | %             |
|------------------------|------------|---------------|
| Fen Lisesi             | 3          | 2,00          |
| Anadolu Lisesi         | 36         | 24,00         |
| Endüstri Meslek Lisesi | 24         | 16,00         |
| Anadolu Meslek Lisesi  | 45         | 30,00         |
| Düz Lise               | 36         | 24,00         |
| Diğer Liseler          | 6          | 4,00          |
| <b>Toplam</b>          | <b>150</b> | <b>100,00</b> |

Öğrencilerin Bilgisayar Öğretmenliği bölümünü tercih etmelerini etkileyen faktörler aşağıdaki soruyla belirlenmeye çalışılmıştır. Bu bölümü tercih etme nedeniniz ile ilgili soruda öğrencilere birden fazla seçim yapma hakkı verilmiştir.

**Tablo 3:** Bölümü Tercih Etmeyi Etkileyen Faktörler

| Tercih Nedeni              | N           | %             |
|----------------------------|-------------|---------------|
| Yoğun İlgim                | 66          | 24,09         |
| İş olanaklarının Fazlalığı | 78          | 28,47         |
| Çevremdekilerin Etkisi     | 40          | 14,59         |
| Aile Etkisi                | 58          | 21,17         |
| Diğer                      | 32          | 11,68         |
| <b>Toplam</b>              | <b>274*</b> | <b>100,00</b> |

\* Bu sorularda katılımcılar birden fazla seçenek işaretleyebilmişlerdir.

Tablo 3’teki veriler incelendiğinde öğrencilerin daha çok kendi ilgilerinin ve iş olanaklarının fazla olması dolayısı ile bölümü tercih ettikleri görülmektedir. Öğrencilerin bilgisayar öğretmenliği bölümünü tercih etmelerinde ailelerinin de önemli bir etkiye sahip olduğu görülmektedir. Çevrenin ve diğer etkilerinin ise daha azınlık bir değer olarak etkisinin olduğu söylenebilir. İş garantisinin olması ve öğretmenlik mesleğini sevmeleri azımsanamayacak oranlarda işaretlenmiştir. Bu durum öğrencilerin ve ailelerin Bilgisayar Öğretmenliği bölümünden haberdar oldukları ve bu bölümü tercih etmek için yeterince bilgi sahibi olduklarını göstermektedir.

Katılımcıların Bilgisayar Öğretmenliği bölümünden mezun olduktan sonraki hedefiniz ile ilgili soruya verdikleri cevaplara ait veriler tablo 4’te görülmektedir. Tablodan da anlaşılacağı gibi öğrencilerin büyük bir çoğunluğu mezun olduktan sonra öğretmen olmak istediklerini belirtmiştir.

**Tablo 4:** Bölümden mezun olduktan sonraki hedefiniz

| Hedefiniz                  | N          | %             |
|----------------------------|------------|---------------|
| Akademik Personellik       | 9          | 6,00          |
| Öğretmen olmak             | 90         | 60,00         |
| Özel bir şirkette çalışmak | 39         | 26,00         |
| Diğer                      | 12         | 8,00          |
| <b>Toplam</b>              | <b>150</b> | <b>100,00</b> |

### Öğrencilerinin Bilgisayar ve İnternet Ortamı ile ilgili genel düşünceleri

Öğrencilerin, bilgisayar kullanımı ve internet ortamında geçirdikleri zaman ile ilgili likert tipindeki sorulara verdikleri cevaplara ait veriler tablo 5’de görülmektedir.

**Tablo 5:** Öğrencilerin internet ortamıyla ilgili dereceli cevapları

| Maddeler   | Ort  | SS   | Cevap aralığı      |
|--|------|------|--------------------|
| İnternet ortamında kalabileceğim süre ve zamanı belirleyebiliyorum | 3,80 | 1,04 | Katılıyorum        |
| İnternetsiz bir gün düşünemiyorum                                  | 2,88 | 1,12 | Kısmen Katılıyorum |

|  |      |      |              |
|--|------|------|--------------|
| İnternet ile tanıştıktan sonra, ders notlarım oldukça düştü.                           | 2,46 | 1,08 | Katılmıyorum |
| Uzun süre bilgisayar başında kaldığımda, kendimi fiziksel olarak rahatsız hissediyorum | 3,70 | 1,10 | Katılıyorum  |
| Bilgisayarımın kendi odamda olmasını tercih ederim.                                    | 4,08 | 0,95 | Katılıyorum  |

Tablo 5'den anlaşılacağı gibi öğrencilere internet ortamında kalabilecekleri süre veya zamanı belirleyebilmekte ancak uzun bir süre de bilgisayar ve internet başında zaman geçirdiklerinde kendilerinde fiziksel olarak rahatsızlık hissetmektedirler. Ayrıca öğrenciler internetsiz bir günü düşünemedikleri konusuna kısmen katılırken, bilgisayarlarının kendilerine ait bir alanda olmasını da tercih etmektedirler.

### Öğrencilerinin İnternet Ortamında Oyun oynaması ile ilgili genel düşünceleri

Katılımcıların, internet ortamında oyun oynaması veya boş zamanlarının değerlendirilmesi konusundaki düşüncelerini belirlemek için 5 adet likert tipi soru bulunmaktadır. Bu sorulara verilen cevaplara ait veriler tablo 6'da verilmiştir.

**Tablo 6:** Öğrencilerin internette oyun ve zaman geçirmeyle ilgili dereceli cevapları

| Maddeler   | Ort  | SS   | Cevap aralığı      |
|--|------|------|--------------------|
| İnternette şans oyunları oynamayı seviyorum                | 2,76 | 1,35 | Kısmen Katılıyorum |
| İnternette genellikle savaş oyunları oynamayı seviyorum.   | 2,52 | 1,28 | Katılmıyorum       |
| Yapacak bir işim olmadığı zamanlarda internete giriyorum.  | 3,28 | 1,11 | Kısmen Katılıyorum |
| İnternet başında zamanım çok hızlı geçiyor                 | 3,80 | 1,08 | Katılıyorum        |
| Beni internetin başında kaldırdıklarında moralim bozuluyor | 2,64 | 1,16 | Kısmen Katılıyorum |

Tablo 6'dan anlaşılacağı gibi öğrenciler internet ortamında iken zamanın çok hızlı geçtiğini belirtmiş ancak internet ortamında oyun oynama, boş vakitlerini geçirme ve internet başından kaldırıldığında morallerinin bozulması konusuna kısmen katıldıklarını belirtmişlerdir. Özellikle savaş tarzı oyunları oynamayı ise sevmediklerini belirtmişlerdir.

### Öğrencilerinin Sohbet ve Sosyal Paylaşım Siteleri ile ilgili genel düşünceleri

Öğrencilerin, sohbet ve sosyal paylaşım siteleri ile ilgili likert tipindeki dereceli sorulara verdikleri cevaplara ait veriler tablo 7'de görülmektedir. Katılımcıların, sohbet ve paylaşım siteleri konusundaki düşüncelerini belirlemek için 8 adet likert tipi soru bulunmaktadır.

**Tablo 7:** Öğrencilerin Sohbet ve Sosyal Paylaşım siteleri ile ilgili dereceli cevapları

| Maddeler   | Ort  | SS   | Cevap aralığı      |
|--|------|------|--------------------|
| İnternette zamanımın büyük bir bölümünü sohbet sitelerinde geçiriyorum                                   | 2,86 | 1,33 | Kısmen Katılıyorum |
| Sohbet sitelerindeki insanlarla yaptığım sohbetin tadını hiçbir şey vermiyor.                            | 2,04 | 1,04 | Katılmıyorum       |
| İnternette tanıştığım insanlarla, gerçek hayatta da görüşüyorum  | 2,80 | 1,17 | Kısmen Katılıyorum |
| Sohbet sitelerinde kendimi, olduğumdan farklı tanıtıyorum  | 2,18 | 1,01 | Katılmıyorum       |
| İnternette tanıştığım insanların, kişisel özellikleri (yaş, cinsiyet, mesafe vb.) beni ilgilendirmiyor.  | 3,02 | 0,97 | Kısmen Katılıyorum |
| İnternette yazışırken bazı kısaltmaları (ok, mrb, slm, nbr, vb.) kullanıyorum                            | 3,78 | 1,04 | Katılıyorum        |
| İnternet ortamında her türlü insanla istediğim gibi iletişim kurduğum için kendimi güvende hissediyorum. | 2,84 | 1,12 | Kısmen Katılıyorum |
| İnternette edindiğim arkadaşlıkları gerçek hayatta bulamıyorum   | 2,06 | 1,01 | Katılmıyorum       |

Tablo 7'den anlaşılacağı üzere öğrenciler sohbet sitelerinde yapmış oldukları sohbetin memnuniyetine ve internet ortamında edindikleri arkadaşlıkların gerçek hayatta bulunmadığına dair düşüncelere katılmadıkları belirtmişlerdir. Bu iki durumun öğrenciler açısından güven vermeyen bir durum olduğu ortaya koyulmuştur. Ayrıca katılımcılar zamanımın büyük bir bölümünü sohbet sitelerinde geçirme, bu kişilerle gerçek hayatta görüşme, bu kişilerin kişisel özellikleri ve kurulan iletişimin güvenliği konusuna kısmen katıldıklarını belirtmişlerdir.

## Öğrencilerinin Aile ve Sosyal Çevre ile ilgili genel düşünceleri

Öğrencilerin, internet ortamının aile ve sosyal çevre üzerindeki etkisini belirlemek için 4 adet likert tipi soru bulunmaktadır. Bu sorulara verilen cevaplara ait veriler tablo 8’de verilmiştir.

**Tablo 8:** Öğrencilerin Aile ve Sosyal Çevreye yönelik dereceli cevapları

| Maddeler   | Ort  | SS   | Cevap aralığı       |
|--|------|------|---------------------|
| İnternet evimize girdikten sonra, ailemizdeki tartışma ve sohbet sayısında azalma oldu | 2,58 | 1,13 | Katılmıyorum        |
| İnternet ile tanıştıktan sonra, arkadaşlarımla sayıları baya azaldı.                   | 2,26 | 1,14 | Katılmıyorum        |
| İnternet ile tanıştıktan sonra kitap okuyamıyorum.                                     | 3,00 | 1,04 | Kısmen Katılmıyorum |
| İnternetle uğraşırken, eve gelen arkadaşlarımla atlatıp, geri gönderiyorum             | 1,94 | 0,92 | Katılmıyorum        |

Kullanıcılar, internet ortamının ailedeki sohbet ve tartışma sayısında azalma meydana getirmesi ve arkadaş sayısında azalma olması durumuna katılmıyorum düzeyinde cevap vermiş olsalar da internet ve bilgisayar ortamının bu maddelere önemli ölçüde etki ettiği de görülmektedir. Özellikle katılımcıların internet ile tanışmadan sonra kitap okumada ciddi bir eksikliğin doğması göze batmaktadır.

## Öğrencilerinin İnternet Güvenliği ile ilgili genel düşünceleri

Katılımcıların, internet güvenliği ve yasaklı siteler konusundaki düşüncelerini belirlemek için 3 adet likert tipi soru bulunmaktadır. Bu sorulara verilen cevaplara ait veriler tablo 9’da verilmiştir.

**Tablo 9:** Öğrencilerin internet güvenliğine yönelik dereceli cevapları

| Maddeler   | Ort  | SS   | Cevap aralığı      |
|--|------|------|--------------------|
| İnternetimin çeşitli filtreleme programlarıyla erişimin kısıtlanmasını istemiyorum | 3,52 | 1,20 | Katılıyorum        |
| İnterneti kullanırken, dikkat etmem gereken güvenlik kurallarını biliyorum         | 3,68 | 1,03 | Katılıyorum        |
| Bazı internet sitelerine kesinlikle girmiyorum                                     | 3,32 | 1,29 | Kısmen Katılıyorum |

Tablo 9’dan anlaşılacağı üzere öğrenciler çeşitli filtreleme programları ile erişimin kısıtlanması ve dikkat edilmesi gereken güvenlik kuralları hakkında bilgi sahibi olduklarına dair düşüncelere katılıyorum düzeyinde cevap vermişlerdir. Ayrıca yasaklı ve erişimi kısıtlanmış sitelere girme konusundaki düşüncelere ise kısmen katılıyorum düzeyinde görüşlerini bildirmişlerdir.

## SONUÇLAR VE TARTIŞMA

Araştırmadan elde edilen bulgulara göre aşağıdaki sonuçlara ulaşılmıştır:

- Araştırma grubunda bulunan öğrenciler internet ortamında kalabilecekleri süre veya zamanı belirleyebilmekte ancak uzun bir süre de bilgisayar ve internet başında zaman geçirdiklerinde kendilerinde fiziksel olarak rahatsızlık hissettiklerini belirtmişlerdir. Ayrıca öğrenciler internetsiz bir günü düşünemedikleri konusuna kısmen katılırken, bu kategorideki öğrenciler interneti veya bilgisayarı bağımlı denecek düzeyde kullanmaktadır. Ayrıca internetin kendileri için olmazsa olmaz düşüncesindeki öğrenciler özellikle bilgisayarlarının kendilerine ait bir alanda olmasını da tercih etmektedirler.
- Katılımcıların belirli bir kısmı internet başından kaldırdıklarında morallerinin bozulduğunu, ayrıca yapacak işleri olmadığı zamanlarda ve şans oyunları oynamak için interneti kullandıklarını belirtmişlerdir. Şans oyunlarının insanları zamanla kumar oynamaktan çekinmeyen ve risk almayı seven insanlar haline getirmesi ayrıca boş zamanlarını amaçsızca geçirmeleri bu kişileri başarısız insanlar haline getirmekle birlikte farkında olmadan internet bağımlısı haline de getirmektedir.
- Öğrencilerin bazıları internette edindiği arkadaşlıkları gerçek hayatta bulamadıklarını belirtmişlerdir. Böyle bir durum bu kişilerin sosyal yönden zayıf insanlar olduğunu, gerçek hayatta edinemediği arkadaşlıkları, internette tanıştığı insanlarla gerçekleştirmeye çalıştığını ortaya koymaktadır
- Öğrencilerin büyük bir çoğunluğu internetlerinin çeşitli filtreleme programları ile filtrelenmesini istememektedir. Genel olarak istedikleri her siteye girmek istediklerini ifade etmişlerdir.
- Öğrencilerin bir kısmı da internette tanıştığı insanlarla yaptığı sohbetin tadını hiçbir şeyden alamadıklarını ifade etmiştir. Bu da onların tamamen internetteki insanlara yoğunlaşmasına ve sosyal olarak gerçek hayattan uzaklaşmasına neden olmaktadır.
- Öğrenciler internette görmediği, tanımadığı insanlarla, canlarının istediği gibi sınırsız bir iletişim kurdukları için kendilerini güvende hissetmelerine kısmen katıldıklarını ifade etmişlerdir.
- Öğrencilerin büyük bir çoğunluğu bilgisayarının kendi odasında olmasını istemektedir. Bu da gösteriyor ki

- insanların büyük bir çoğunluğu ailelerinin görmesini istemediği sitelerde zaman geçirmektedir.
- Öğrencilerin bazılarının internet ile tanıştıktan sonra ders notları eskisinden daha kötü bir duruma geldiği ifade etmiştir. Bu da onların internette kendilerine yararlı olmayacak sitelerde fazlaca vakit geçirdiğini göstermektedir.
  - Öğrencilerden bazıları internette tanıştığı insanlarla gerçek hayatta da görüştüğünü ifade etmiştir. Bu durum son derece tehlikelidir. Tanımadığımızı ve sadece internet ortamında tanıştığımız insanlar kötü niyetli veya zarar verici kişiler olabilirler. Günümüzde bu olayın uygulaması oldukça da fazladır.
  - Öğrencilerin bazıları internetin evlerine girmesiyle aile içerisinde iletişimin azaldığını belirtmektedir. Bu da aile içerisinde birbirinden kopuk bireyler olarak yetişmemize ortam sağlamaktadır.
  - Öğrencilerin bir kısmı internette tanıştığı insanların kişisel özelliklerini bilmeden kim olursa olsun arkadaşlık etmektedir. Bu da onların zararlı insanlarla tanışmalarına ortam sağlayıp kendilerini bu insanların ortamında bulmasına neden olabilmektedir.
  - Öğrencilerin bazıları da internet ile tanıştıktan sonra artık kitap okuyamadıklarını ifade etmiştir. Bu nedenle aşırı bir internet kullanımı veya bağımlılık en önemli alışkanlıklarımızı da engelleyebilmektedir.
  - Öğrencilerin büyük bir çoğunluğu internette yazışırken çeşitli kısaltmaları kullanarak öz Türkçe kelimeleri katletmektedirler. Bu da zamanla yabancı kelimelerini Türkçe'de yer almasına ve dilimizin bozulmasına neden olacaktır. Bilindiği gibi bir milletin millet olması için mutlaka kendisine ait bir dilinin olması gerekmektedir.

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## BİR LMS DEĞERLENDİRMESİ: MOODLE

Aslıhan Babur Yılmaz  
Amasya Üniversitesi Teknik Bilimler MYO  
Bilgisayar Programcılığı Programı  
Amasya  
aslihan.babur@amasya.edu.tr

**Abstract** Amasya Üniversitesi Teknik Bilimler Meslek Yüksek Okulu Bilgisayar Programcılığı Programı I. Ve II. öğretim I. ve II. sınıf öğrencilerinin çevrim içi ortamda ya da ders esnasında MOODLE ortamını kullanmadıkları hatta bu ortamı bilmedikleri fark edilmiştir. Bu durum, ders esnasında MOODLE ortamının kullanılmasına ve öğrenenlerin MOODLE ile tanışmasına ortam hazırlamıştır. Bu araştırmanın ilk amacı, eğitim amacıyla kullanılan Modüler Nesne Yönelimli Dinamik Öğrenim Ortamının (MOODLE), yazılım değerlendirme ölçütleri dikkate alınarak eğitsel nitelikte bir ders yazılımı olup olmadığının öğrenenler açısından değerlendirmektir. Araştırmanın bir diğer amacı ise yazılımla ilgili mevcut durumu ortaya koymak ve eksiklikler, ihtiyaçlar varsa bunları gidermeye çalışmaktır. Araştırmanın örneklemini MOODLE yazılımını kullanmayan, bu yazılım hakkında fikir sahibi olmayan Amasya Üniversitesi Teknik Bilimler Meslek Yüksek Okulu Bilgisayar Programcılığı Programı I. Ve II. öğretim I. Ve II. sınıf öğrencilerinden oluşmaktadır. Yaklaşık üç ay boyunca MOODLE ortamında içerik, etkinlik, duyurular vb. paylaşımlarla senkron ve asenkron ortamda konu anlatımı gerçekleştirilmiştir. Amaca yönelik olarak, tarama modeli kullanılmış; öğrenenlere geçerlilik ve güvenilirlik çalışması yapılmış olan Ateş' in (2010) geliştirdiği Yazılım Değerlendirme Ölçeği uygulanarak veriler elde edilmiştir. Elde edilen verilere göre ölçekte Moodle ortamına uygun olmayan maddeler faktör analizi yapılarak uygulama dışında bırakılmıştır. Yapılan ölçek sonuçları SPSS 16.0 programında aktarılmış ve sonuçlar analiz edilmiştir. Analiz sonuçları MOODLE ortamının öğrenenlere göre, eğitim yazılımlarının sahip olması gereken özelliklerden eğitsel özellikleri, görsel tasarım özellikleri, içerik özellikleri, yönlendirme ve yardım özellikleri, kurulum ve kullanım özellikleri bakımından yeterli olduğu ancak çoklu ortam özellikleri bakımından geliştirilmesi gerektiği belirlenmiştir.

**Anahtar Kelimeler:** MOODLE, Eğitsel Yazılım, Eğitsel Ortam, Yazılım Değerlendirme

### Giriş

Günümüzde bilgiye ulaşma, bilgiyi kullanma, yorumlama ve değerlendirme, yeni bilgi oluşturma ve bu bilgiyi paylaşma konusunda büyük gelişmeler yaşanmaktadır. Bu gelişmeler eğitimin gelişmesini desteklemekte ve dolayısıyla toplumların gelişimine büyük katkı sağlamaktadır. Eğitimi etkileyen teknolojik yenilikler ve buluşlar, her defasında bir önceki sisteme göre üstünlükler sağlamakta, yeni kavramların ortaya çıkmasına neden olmaktadır. Bu yenilikler, eğitimi örgün eğitim anlayışının dışına çıkartmıştır.

Eğitim ve teknoloji insan yaşamının daha etken duruma getirilmesinde önemli rolü olan iki temel öğedir. Her iki öğe de insanın doğal ve sosyal çevresine egemen olma yolunda gösterdiği çabalarda başvurduğu iki temel araç olmuştur (Alkan, 1998). Teknolojiyle birlikte eğitimde farklı ortamlar kullanılarak eğitim öğretim süreci uygulanmaya başlanmış ve bunun sonucunda yaştan, meslekten, ilden, kültürden, ülkeden bağımsız olarak her birey istediği eğitime ulaşabilecekleri yaşam boyu eğitim, sürekli eğitim gibi birçok yeni kavram ortaya çıkmıştır.

Bu kavramlardan uzaktan eğitimi inceleyecek olursak, farklı kaynaklarda değişik tanımlarla karşılaşmak mümkündür. Örneğin, United States Distance Learning Association (USDLA 2004)'ın tanımı şu şekildedir:

"Uzaktan eğitim uydu, video, ses, grafik, bilgisayar, çoklu ortam teknolojisi gibi araçların yardımıyla, eğitimin uzaktaki öğrencilere ulaştırılmasıdır. USDLA, öğretmen ve öğrencinin birbirlerinden coğrafi olarak uzak olduğunu belirterek bu eğitim programında elektronik araçların ya da yazılı materyal ve matbu malzemelerinin kullanılması gerektiğinin altını çizer. Uzaktan eğitim; öğretmenleri içine alan öğretim ile öğrencileri içine alan öğrenim olmak üzere iki temel bölümden oluşmaktadır."

Yalın' a (2012, s.202) göre de uzaktan eğitim, fiziksel olarak ayrı mekânlarda olan öğretmen ve öğrencilerin teknoloji yoluyla etkileşimde buldukları bir sistemdir.

Uzaktan eğitim, farklı ortamlarda bulunan öğrenci ve öğretmenlerin, öğrenme – öğretme faaliyetlerini, iletişim teknolojilerini ve posta hizmetleri ile gerçekleştirdikleri bir eğitim sistemi modelini ifade eder. (İşman, 2011, s.591)

Bu tanımların ortak özellikleri farklı yerlerde bulunan öğrenci ve öğretmenin senkron ya da asenkron olarak iletişimde kurarak eğitim öğretim faaliyetlerini gerçekleştirmeleridir. Uzaktan eğitimde asıl amaç zamanı ve kaynakları etkin ve ekonomik kullanabilmektir.

İşman' a (2011) göre bilişim ve iletişim teknolojilerinin sağladığı faydalar, günümüzde eğitim faaliyetleri için özelleşmiş web araçlarının kullanımını arttırmaktadır. Uzaktan eğitimin yaygınlaşmasıyla Web 2.0 teknolojileri, çeşitli yazılımlar, içerik yönetim sistemleri, öğretim yönetim sistemleri (Joomla, Moodle, aTutor, Dokeos, ILIAS vb.) ve eğitim yazılımları yaygınlaşmıştır. Başlangıçta uzaktan eğitim amacıyla kullanılan öğretim yönetim sistemlerinin (ÖYS), ders destek ortamı olarak kullanımı yaygınlaşmaktadır. Ayrıca içerik paylaşımı, öğrenci-öğrenci, öğrenci – öğretmen, öğretmen – öğretmen, öğretmen – veli iletişimini sağlamak, değerlendirme yapmak, bilgileri raporlaştırmak gibi çeşitli amaçlarla kullanılabilirler.

Günümüzde çoğu kurum kendi alanıyla ilgili eğitim vermekte ya da eğitim veren kurumlardan destek almaktadır. Uzaktan eğitimle eğitim materyallerini internet ortamına aktararak, öğrencileriyle paylaşmak için programlar hazırlamaktadırlar. Eğitim içeriklerinin internet ortamına aktarılması, programların başarılı bir şekilde işleyebilmesi ve etkin bir eğitimin sağlanabilmesi için yeterli değildir. Eğitim içeriklerini internet ortamına hazır hale getirmek ve yayınlamak önemli bir aşama olsa da, içeriklerin ve diğer tüm işlemlerin kontrolü ve denetimini yapacak bir sisteme ihtiyaç vardır. Öğrenim Yönetim Sistemi (Learning Management System - LMS) de bu noktada ortaya çıkan bir kavramdır. Bir öğrencinin programa kayıt aşamasından, öğrenimin tamamlandığı süreye kadar geçen süreçlerin etkin ve güvenli bir şekilde yürütülmesinden Öğrenim Yönetim Sistemi sorumludur.

Uzaktan eğitimin gelişimi eğitimin sistemimizi de etkileyerek sistemde bir takım değişikliklerin yapılmasına neden olmuş, yeni teknolojilerin eğitimle adaptasyonu sağlanmıştır. Eğitimde yeni teknolojileri kullanmak geleneksel yöntemlere göre daha fazla duyu organına hitap etmeyi beraberinde getirir. Bu da öğrenci ilgisini artırdığı gibi öğretimi kolaylaştırıp, zevkli hale getirerek öğrenmenin hızlanmasını sağlar (Yalın, 2003). Öğrencinin ilgisini arttırmak, öğretime destek sağlamak amacıyla yazılımlar kullanılmaktadır.

Eğitsel çoklu ortam yazılımı ortamında, öğrencinin sadece içerikle ilgilenmediğine aynı zamanda tasarlanmış bir ortamı nasıl kullanacağını, yönlendireceğini, bu ortamla nasıl baş edeceğini de öğrendiğine değinilmiştir (Katz, 2002).

Eğitsel yazılımlar önceden belirlenen kriterlere uygun şekilde geliştirilmeli ve tüm bu kriterleri kapsayan bir yöntem ve araç çerçevesinde değerlendirilmelidir. Yazılım değerlendirme de alan yazına bakıldığında birbiriyle ilişkili değerlendirme kriterleri söz konusudur. Alan yazın incelendiğinde bu kriterler değişebilmektedir. Seferoğlu'na (2006) göre, yazılımları değerlendirilme aşamasında belirlenen kriterler (1) Amaçlara uyumu olması, (2) Doğruluğu, (3) Dilin açık, öz ve anlaşılabilirliği, (4) Motivasyonu sağlayıcı, (5) Katılımı teşvik etme özelliği, (6) Teknik kalitesi, (7) Etkililik derecesi, (8) Önyargılardan arındırılmış olması, (9) Kullanıcı kılavuzu, (10) Yönergelerin açıklığı, (11) Yaratıcılığı teşvik etme özelliği olmak üzere on bir maddeden oluşmaktadır. Kaya (2005) tarafından önerilen yazılım değerlendirme kontrol listesindeki temel kriterler ise ; (1) Kurulum ve işletim, (2) İçerik, (3) Sorgulama teknikleri, (4) İlgi ve sürekliliğin sağlanması, (5) Yaratıcılık, (6) Kullanıcı kontrolü, (7) Dönüt, (8) Değerlendirme ve kayıt tutma, (9) Teknik kalite, (10) Dokümantasyon ve destek olmak üzere on maddeden oluşmaktadır. Şahin ve Yıldırım (1999) ise eğitsel yazılımlarda öğretimsel uygunluk, öğretim programlarıyla olan uygunluk, biçimsel uygunluk ve programlama uygunluğu ile diğerlerinden farklı olarak “öğrencinin stiliyle tutarlılık” ve “öğretmenin stiliyle tutarlılık” ölçütlerine de yer vermiştir.

Şimşek' e (1998, s.113)göre yazılım değerlendirmesinin iki temel nedeni vardır. Birincisi, kendi derslerine uygun yazılımı seçebilmek için var olan seçenekler arasında karar verme gereksinimi, diğeri ise, yazılımın öğretim etkinliklerinde kullanılmaya değer olup olmadığını kestirme gereksinimidir. Ancak bir çok araştırma kriterlere dayandırılmadan yapılan değerlendirmelerin yetersiz olduklarını ve bu nedenle değerlendirmeyi kolaylaştıracak “ders yazılım değerlendirme formu” geliştirilmiştir. Yazılımların, uzmanlar veya öğretmenler tarafından, ders yazılım değerlendirme formları aracılığı ile değerlendirilmesi özel olacağından, sadece bu formların sonuçları ile bu yazılımların öğretime uygun niteliklere sahip olup olmadığına karar vermek çok sağlıklı sonuçlar yaratmaz (Reiser ve Dick 1990; Gill, Dick, Reiser ve Zahner 1992a; Gill, Dick, Reiser ve Zahner 1992b'den aktaran Orhan, 1995). Bu nedenle, kullanılan ortamların öğretmen ve uzmanlar tarafından değerlendirilmesine ek olarak ortamı kullanan öğrenciler tarafından da ortam ile ilgili görüşlerin alınması gerekmektedir. Hazırlanan ortamın istenilen hedeflere ulaşmada etkili bir araç olup olmadığını belirlemek, geliştirilmesi ve düzenlenmesi gereken kısımların bulunup bulunmadığını tespit etmek amacıyla ortamı kullanan öğrencilerin Moodle ortamını değerlendirmesi amaçlanmaktadır.

## Materyal ve Yöntem

Eğitsel yazılım değerlendirme amacıyla yapılan bu çalışmada tarama modeli kullanılmıştır. Araştırmanın örneklemini, yansız örnekleme yoluyla belirlenen, Amasya Üniversitesi 2012–2013 eğitim-öğretim yılı güz dönemi, Teknik Bilimler Meslek Yüksek Okulu Bilgisayar Programcılığı Programı I. Ve II. öğretim I. Ve II. sınıfta öğrenim gören 98 öğrenci oluşturmaktadır. Yaklaşık üç ay boyunca MOODLE ortamında içerik, etkinlik paylaşımı, duyurular vb. paylaşımlarla senkron ve asenkron ortamda konu anlatımı gerçekleştirilmiştir. Amaca yönelik olarak, Ateş (2010) tarafından hazırlanan ve geçerliliği 0.81 olarak hesaplanan Eğitsel Yazılım Değerlendirme Ölçeği uygulanarak veriler elde edilmiştir.

## Bulgular ve Yorumlar

Ateş' in (2010) geliştirmiş olduğu ölçekte iyi bir eğitim yazılımının niteliklerine ilişkin alt boyutlar belirlenmiştir. Bu boyutlar; (1) Eğitsel özellikler, (2) Görsel tasarım özellikleri, (3) Çoklu ortam özellikleri, (4) İçerik, (5) Yönlendirme ve yardım, (6) Kurulum ve kullanım şeklindedir. Yapılan ölçek sonuçları SPSS 16.0 programında aktarılmış ve sonuçlar analiz edilmiştir. Analiz sonuçları MOODLE ortamının öğrenenlere göre, eğitim yazılımlarının sahip olması gereken özelliklerden içerik, kurulum ve kullanım özellikleri ve destek dokümanlar açısından yeterli olduğu belirlenmiştir. Uzmanların değerlendirmeleri alındıktan sonra, puanlayıcı güvenilirliği (inter-rater reliability) hesaplanmıştır. Buna göre, ölçeğin güvenilirliği 0.81 olarak hesaplanmıştır. Alfa güvenilirlik değerinin büyüklüğü konusunda, Nunnely (1998) alfa değerinin 0.70'den büyük olması gerektiğini; George ve Mallery (2003) ise alfanın 0.90'dan büyük olması ölçeğin güvenilirliğinin mükemmel, 0.80- 0.90 arası olması ise iyi olduğu şeklinde ifade edilmiştir (Akt. Şencan, 2005). Buna göre, Ateş(2010) tarafından geliştirilen ölçeğin güvenilirliğinin iyi düzeyde olduğunu söylemek mümkündür.

Yapılan geçerlik ve güvenilirlik çalışmaları sonunda geliştirilen ölçeğin nihai hali 50 maddeden oluşmaktadır. Bu maddeler; eğitsel özellikler (11), görsel tasarım özellikleri (5), çoklu ortam özellikleri (7), içerik (7), yardım ve yönlendirme (5), kurulum ve kullanım özellikleri (15) şeklinde gruplandırılmıştır. Ölçek maddeleri 0 ile 4 (0: 0 puan/Gözlenmedi, 1: 1 puan/Zayıf, 2: 2 puan/Orta, 3: 3 puan/İyi, 4: 4 puan/Çok iyi ) arasında puanlanmaktadır. Ölçekten alınabilecek en düşük puan 0, en yüksek puan ise 200'dür. Bu ölçek örneklem grubuna uygulanmış ve sonuçlar SPSS 16.0 programına girilerek analiz edilmiştir. Ölçekte yer alan bazı maddeler Moodle ortamını desteklemediğinden, öğrencilerin verdikleri cevaplar doğrultusunda tekrar faktör analizi yapılmış ve bazı maddeler ölçekten çıkartılarak tekrar geçerlik ve güvenilirlik çalışması yapılarak, ölçek Moodle ortamını değerlendirebilecek şekilde dönüştürülmüştür. Tekrarlanan geçerlik ve güvenilirlik çalışmaları sonunda geliştirilen ölçeğin nihai hali 35 maddeden oluşmaktadır. Bu maddeler; eğitsel özellikler (8), görsel tasarım özellikleri (4), çoklu ortam özellikleri (6), içerik (6), yardım ve yönlendirme (3), kurulum ve kullanım özellikleri (8) şeklinde gruplandırılmıştır. Ölçek maddeleri 1 ile 5 (1: 1 puan/Gözlenmedi, 2: 2 puan/Zayıf, 3: 3 puan/Orta, 4: 4 puan/İyi, 5: 5 puan/Çok iyi ) arasında puanlanmaktadır. Ölçekten alınabilecek en düşük puan 35, en yüksek puan ise 175' tir.

Verilerin analizinde öğrencilerin verdikleri tepkilerin beşli likert tipi ölçekten elde edilmiş olması nedeniyle, Moodle ortamının yeterlik düzeyini açıklayabilecek puan aralıkları belirlenmiştir. Bunlar;

|                     |                            |
|---------------------|----------------------------|
| 1.00-1.79 Çok Zayıf | } Orta (5-1= 4 / 5 = 0.80) |
| 1.80-2.59 Zayıf     |                            |
| 2.60-3.39           |                            |
| 3.40-4.19 İyi       |                            |
| 4.20-5.00 Çok iyi   |                            |

Örneklem grubunun vermiş oldukları cevap analizine göre hesaplanan ortalama puanlar yukarıda verilen yeterlik düzeyleri ile açıklanmıştır. Bulgular ve yorumlarda her bir madde bu ölçütler dikkate alınarak yorumlanmıştır.

Öğrenciler Moodle ortamını eğitsel özellikler bakımından değerlendirmiş ve değerlendirme sonuçları tabloda gösterilmiştir.

**Tablo 1:** Öğrencilerin Moodle Ortamının Eğitsel Özelliklerine İlişkin Görüşleri

| Eğitsel Yazılımın Özellikleri  | N  | S    | $\bar{X}$ | Toplam |
|--|----|------|-----------|--------|
| Hedef kitlenin öğrenme gereksinimlerine uygunluk   | 98 | 0.74 | 4.15      | 4.27   |
| Hedeflerin uygun biçimde belirtilmesi  |    | 0.63 | 4.26      |        |
| Öğrencilerin önbilgilerini sınaması  |    | 1.06 | 4.06      |        |
| Yönergelerin açık ve anlaşılır olması  |    | 0.82 | 4.22      |        |
| Sayfa başlıklarının konuyu yansıtmaması  |    | 0.76 | 4.47      |        |
| İstenmeyen unsurlardan (ırk, din,dil, şiddet, saldırganlık, korku, cinsiyet ayrımı vb. ) arınık olması |    | 1.00 | 4.59      |        |
| Gereken her durumda öğrenciye geri bildirim vermesi  |    | 0.78 | 4.39      |        |
| Yeterli miktarda alıştırma ve uygulama yapma olasılığı sunması   |    | 0.88 | 4.04      |        |

Öğrenciler Moodle ortamının "Eğitsel Yazılımın Özellikleri" boyutunda hedef kitlenin öğrenme gereksinimlerine uygunluk, öğrencilerin önbilgilerini sınaması, yeterli miktarda alıştırma ve uygulama yapma olasılığı sunması açısından 4.04-4.15 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterlik düzeyi açısından "İYİ" olarak kabul edilmiştir. Hedeflerin uygun biçimde belirtilmesi, yönergelerin açık ve anlaşılır olması, sayfa başlıklarının konuyu yansıtmaması, istenmeyen unsurlardan (ırk, din,dil, şiddet, saldırganlık, korku, cinsiyet ayrımı vb. ) arınık olması, gereken her durumda öğrenciye geri bildirim vermesi açısından 4.22-4.59 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterlik düzeyi açısından " ÇOK İYİ" olarak kabul edilmiştir.

İlgili tablo incelendiğinde öğrencilerin Moodle ortamını eğitsel yazılımın özellikleri bakımından “ÇOK İYİ” olduğu düşüncesinde birleştiklerini göstermektedir. ( $X=4.27$ ).

Öğrenciler Moodle ortamını görsel tasarım özellikleri bakımından değerlendirmiş ve değerlendirme sonuçları tabloda gösterilmiştir.

**Tablo 2:** Öğrencilerin Moodle Ortamının Görsel Tasarım Özelliklerine İlişkin Görüşleri

| Görsel Tasarım Özellikleri                       | N  | S    | $\bar{X}$ | Toplam |
|--|----|------|-----------|--------|
| Metinlerin gereğinden az veya fazla olması       | 98 | 1.01 | 3.81      | 3.97   |
| Menülerin uygun tasarlanması                     |    | 0.99 | 4.12      |        |
| Düğmelerin (buton) uygun tasarlanması            |    | 1.02 | 4.00      |        |
| Sayfa başlıklarının yerleşim açısından uygunluğu |    | 0.95 | 3.97      |        |

İlgili tablo incelendiğinde Moodle ortamını görsel tasarım özellikleri bakımından öğrencilerin değerlendirmelerinin 3.81-4.12 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterlik düzeyi açısından “İYİ” olduğu düşüncesinde birleştiklerini göstermektedir. ( $X=3.97$ ).

Öğrenciler Moodle ortamını görsel tasarım özellikleri bakımından değerlendirmiş ve değerlendirme sonuçları tabloda gösterilmiştir.

**Tablo 3:** Öğrencilerin Moodle Ortamının Çoklu Ortam Özelliklerine İlişkin Görüşleri

| Çoklu Ortam Özellikleri   | N  | S    | $\bar{X}$ | Toplam |
|---|----|------|-----------|--------|
| Kullanılan çoklu ortam öğelerinin (ses, video, metin, animasyon, simülasyon, resim, vb.) amaca uygunluğu    | 98 | 1.35 | 3.11      | 2.51   |
| Tüm işitsel unsurların (ses, müzik, konuşma vb.) olması   |    | 1.23 | 2.44      |        |
| Yeterince görsel unsurun (resim, video, grafik) olması  |    | 1.29 | 2.67      |        |
| Yeterince canlandırmanın (animasyon) olması   |    | 1.12 | 2.21      |        |
| Video gibi görsel unsurlar için durdurma, ileri, geri, yeniden oynatma özelliklerinin etkin çalışması       |    | 1.40 | 2.36      |        |
| Ses, müzik gibi işitsel unsurlar için durdurma, ileri, geri, yeniden oynatma özelliklerinin etkin çalışması |    | 1.39 | 2.29      |        |

Öğrenciler Moodle ortamının “Çoklu Ortam Özellikleri” boyutunda tüm işitsel unsurların (ses, müzik, konuşma vb.) olması, yeterince canlandırmanın (animasyon) olması, video gibi görsel unsurlar için durdurma, ileri, geri, yeniden oynatma özelliklerinin etkin çalışması, ses, müzik gibi işitsel unsurlar için durdurma, ileri, geri, yeniden oynatma özelliklerinin etkin çalışması açısından 2.21-2.44 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterlik düzeyi açısından “ZAYIF” olarak kabul edilmiştir. Yeterince görsel unsurun (resim, video, grafik) olması, kullanılan çoklu ortam öğelerinin (ses, video, metin, animasyon, simülasyon, resim, vb.) amaca uygunluğu açısından 2.67-3.11 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterlik düzeyi açısından “ORTA” olarak kabul edilmiştir.

İlgili tablo incelendiğinde Moodle ortamını çoklu ortam özellikleri bakımından öğrencilerin değerlendirmelerinin 2.21-3.11 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterlik düzeyi açısından “ORTA” olduğu düşüncesinde birleştiklerini göstermektedir. ( $X=2.51$ ).

Öğrenciler Moodle ortamını görsel tasarım özellikleri bakımından değerlendirmiş ve değerlendirme sonuçları tabloda gösterilmiştir.

**Tablo 4:** Öğrencilerin Moodle Ortamının İçerik Özelliklerine İlişkin Görüşleri

| İçerik Özellikleri  | N  | S    | $\bar{X}$ | Toplam |
|---|----|------|-----------|--------|
| İçerikte doğru bilgilere yer verilmesi                          | 98 | 1.12 | 4.33      | 3.83   |
| İçerikte güncel bilgilere yer verilmesi                         |    | 0.93 | 4.28      |        |
| Konunun diğer derslerle ilişkilendirilmesi                      |    | 1.09 | 3.78      |        |
| Konunun gerçek yaşamla ilişkilendirilmesi                       |    | 1.01 | 3.38      |        |
| İçeriğin basitten karmaşığa, somuttan soyuta doğru düzenlenmesi |    | 0.90 | 3.53      |        |
| Yazılım içeriğine ait bir “Kaynakça” bölümünün olması           |    | 1.16 | 3.70      |        |

Öğrenciler Moodle ortamının “İçerik Özellikleri” boyutunda hedef kitlenin İçerikte doğru bilgilere yer verilmesi, İçerikte güncel bilgilere yer verilmesi açısından 4.28-4.33 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterli düzeyi açısından “ ÇOK İYİ” olarak kabul edilmiştir. Konunun diğer derslerle ilişkilendirilmesi, içeriğin basitten karmaşığa, somuttan soyuta doğru düzenlenmesi ve yazılım içeriğine ait bir “Kaynakça” bölümünün olması açısından 3.53-3.78 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterli düzeyi açısından “İYİ” olarak kabul edilmiştir. Diğer bir madde olan konunun gerçek yaşamla ilişkilendirilmesi açısından “ORTA” olarak kabul edilmiştir. İlgili tablo incelendiğinde öğrencilerin Moodle ortamını içerik özellikleri bakımından “İYİ” olduğu düşüncesinde birleştiklerini göstermektedir. ( $X=3.83$ ).

Öğrenciler Moodle ortamını yönlendirme ve yardım özellikleri bakımından değerlendirmiş ve değerlendirme sonuçları tabloda gösterilmiştir.

**Tablo 5:** Öğrencilerin Moodle Ortamının Yönlendirme ve Yardım Özelliklerine İlişkin Görüşleri

| İçerik Özellikleri   | N  | S    | $\bar{X}$ | Toplam |
|--|----|------|-----------|--------|
| Sayfalar arası bağlantıların (ileri, geri, ana sayfa) yeterli olması | 98 | 1.04 | 4.16      | 3.63   |
| Yazılımda, işlevsel bir yardım menüsünün olması                      |    | 1.08 | 3.65      |        |
| Etkileşimli bir yazılım haritasının olması                           |    | 1.26 | 3.09      |        |

Öğrenciler Moodle ortamının “İçerik Özellikleri” boyutunda sayfalar arası bağlantıların (ileri, geri, ana sayfa) yeterli olması ve yazılımda, işlevsel bir yardım menüsünün olması açısından 3.65-4.16 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterli düzeyi açısından “İYİ” olarak kabul edilmiştir. Diğer bir madde olan etkileşimli bir yazılım haritasının olması açısından “ORTA” olarak kabul edilmiştir.

İlgili tablo incelendiğinde öğrencilerin Moodle ortamını içerik özellikleri bakımından “İYİ” olduğu düşüncesinde birleştiklerini göstermektedir. ( $X=3.63$ ).

Öğrenciler Moodle ortamını kurulum ve kullanım özellikleri bakımından değerlendirmiş ve değerlendirme sonuçları tabloda gösterilmiştir.

**Tablo 6:** Öğrencilerin Moodle Kurulum ve Kullanım Özelliklerine İlişkin Görüşleri

| Kurulum ve Kullanım Özellikleri  | N  | S    | $\bar{X}$ | Toplam |
|--|----|------|-----------|--------|
| Yazılımın otomatik olarak kurulması  | 98 | 0.74 | 3.68      | 3.78   |
| Yazılımın ekran boyutunun kullanıcının isteğine göre değiştirilebilmesi                                |    | 0.63 | 3.76      |        |
| İstendiğinde yazılımın ayarlarını değiştirebilmesi   |    | 1.06 | 3.64      |        |
| Yazılımın kullanıcı komutlarına kısa sürede yanıt vermesi (mesaj gönderme, yorum yazma vb.)            |    | 0.82 | 3.64      |        |
| İstenmeyen unsurlardan (ırk, din,dil, şiddet, saldırganlık, korku, cinsiyet ayrımı vb. ) arınık olması |    | 0.76 | 4.30      |        |
| Kullanım kılavuzunda yazılımın yüklenmesi ve çalıştırılması ile ilgili yönergelerin yeterli olması     |    | 1.00 | 3.80      |        |
| Kullanım kılavuzunda yazılımın çalışması için gerekli minimum sistem gereksinimlerinin olması          |    | 0.78 | 3.68      |        |
| Kullanım kılavuzunda yazılım üreticileriyle iletişim bilgilerinin olması                               |    | 0.88 | 3.81      |        |

Öğrenciler Moodle ortamının “Kurulum ve Kullanım Özellikleri” boyutunda İstenmeyen unsurlardan (ırk, din, dil, şiddet, saldırganlık, korku, cinsiyet ayrımı vb. ) arınık olması açısından 4.30 ortalama değeri ile “ÇOK İYİ” olarak kabul edilmiştir. Bu madde haricinde yer alan maddelerin 3.64-3.80 arasında değiştiği görülmektedir. Bu özelliklere ilişkin ortalama puanlar yeterli düzeyi açısından “İYİ” olarak kabul edilmiştir. İlgili tablo incelendiğinde öğrencilerin Moodle ortamını eğitsel yazılımın özellikleri bakımından “İYİ” olduğu düşüncesinde birleştiklerini göstermektedir. ( $X=3.78$ ).

## Sonuç ve Öneriler

Bu çalışmada Ateş (2010) tarafından geliştirilmiş olan Eğitim Yazılımı Değerlendirme Ölçeği ile belirlenen örneklem grubu tarafından Moodle ortamı değerlendirilmiştir. Bu değerlendirme sonucunda hazırlanan Moodle

ortamının eksikleri belirlenmiş olup aynı zamanda eğitim aracı olarak etkisi araştırılmıştır. Ölçek altı alt bölümle incelenmiştir.

İlk bölümde Moodle ortamı eğitsel özellikleri bakımından incelenmiş ve genel olarak  $X=4.27$  değeri ile “ÇOK İYİ” olduğu sonucuna ulaşılmıştır. Bu durum hazırlanan Moodle ortamının Tablo1 de yer alan özellikleri desteklediğini göstermektedir.

İkinci bölümde Moodle ortamı görsel tasarım özellikleri bakımından incelenmiş ve genel olarak  $X=3.91$  değeri ile “İYİ” olduğu sonucuna ulaşılmıştır. Bu durum hazırlanan Moodle ortamının Tablo2 de yer alan özellikleri desteklediğini göstermektedir.

Üçüncü bölümde Moodle ortamı çoklu ortam özellikleri bakımından incelenmiş ve genel olarak  $X=2.51$  değeri ile “ZAYIF” olduğu sonucuna ulaşılmıştır. Bu sonuca göre öğrenciler hazırlanan Moodle ortamının Moodle ortamının Tablo3 de yer alan özellikleri tam olarak desteklemediğini göstermektedir. Bu sonuca göre, içerikte yeteri düzeyde çoklu ortam öğesi kullanılmamış ya da içerik animasyon, video, grafik vb. çoklu ortam öğesine uygun olmayabileceği söylenebilir. Dolayısıyla ortamın geliştirilmesi ya da ölçeğin düzenlenmesi gerekebilir.

Dördüncü bölümde Moodle ortamı içerik özellikleri bakımından incelenmiş ve genel olarak  $X=3.83$  değeri ile “İYİ” olduğu sonucuna ulaşılmıştır. Bu durum hazırlanan Moodle ortamının Tablo4’ te yer alan özellikleri desteklediğini göstermektedir.

Beşinci bölümde Moodle ortamı yönlendirme ve yardım özellikleri bakımından incelenmiş ve genel olarak  $X=3.63$  değeri ile “İYİ” olduğu sonucuna ulaşılmıştır. Bu durum hazırlanan Moodle ortamının Tablo5’ te yer alan özellikleri desteklediğini göstermektedir.

Altıncı bölümde Moodle ortamı kurulum ve kullanım özellikleri bakımından incelenmiş ve genel olarak  $X=3.78$  değeri ile “İYİ” olduğu sonucuna ulaşılmıştır. Bu durum hazırlanan Moodle ortamının Tablo6 da yer alan özellikleri desteklediğini göstermektedir.

Öğrenci değerlendirmesine göre Moodle kullanılarak hazırlanmış olan ortamın iyi düzeyde olduğunu ancak bazı maddelerin dikkate alınarak ortamın geliştirilmesi gerektiğini söylemek mümkündür. “İYİ” düzeyinin altında olan maddeler incelenerek, ortam bu maddeleri destekleyecek biçimde geliştirilerek, öğrenci değerlendirilmesine tekrar sunulabilir.

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# BİRİKİMLİ (CUMULATİVE) LOGİT MODELİ İLE DEVLET ÜNİVERSİTELERİNDE ÇALIŞAN KADINLARIN TÜKENMİŞLİK DÜZEYLERİNİN İNCELENMESİ

Nilgün Özgül, Hülya Çıngı, Hacettepe Üniversitesi İstatistik Bölümü, Türkiye

e-posta: [nozgul@hacettepe.edu.tr](mailto:nozgul@hacettepe.edu.tr)

[hcingi@hacettepe.edu.tr](mailto:hcingi@hacettepe.edu.tr)

**Özet** Bu çalışmada, Gazi Üniversitesi'nde akademik ve idari kadrolarda görev yapan kadın çalışanların duygusal tükenme, duyarsızlaşma, düşük kişisel başarı duygusu boyutlarında yaşadıkları tükenmişlik düzeylerine etki eden faktörler belirlenmeye çalışılmıştır. Akademik ve idari kadrolarda görev yapan 3287 çalışan kadından "Tabakalı Sistemik Örnekleme" yöntemi kullanılarak 298 çalışan kadın örnekleme seçilmiştir. Örnekleme "Kişisel Bilgi Formu" ile birlikte Maslach ve Jackson (1981) tarafından geliştirilen ve Ergin (1992) tarafından Türkçeye uyarlanan "Maslach Tükenmişlik Envanteri" uygulanmıştır. Çalışma sonucunda çalışan kadınların tükenmişlik düzeylerine etki eden faktörler birikimli logit modeli ile belirlenmiştir. Çalışma, devlet üniversitelerinde çalışan kadınların sorunlarının daha iyi tanınmasına, işlerinde verimli ve başarılı olmalarına katkıda bulunması açısından önem taşımaktadır.

**Anahtar Kelimeler:** Tükenmişlik, Birikimli Logit Model, Maslach Tükenmişlik Envanteri, Tabakalı Sistemik Örnekleme

**Abstract:** Determination of Burnout Levels of Working Women in Public Universities in Turkey with Cumulative Logit Model

In this study, factors that affect the burn-out levels of women who are working in academic and administrative staff in Gazi University are investigated. Burnout is defined by the three interrelated parts: emotional exhaustion, depersonalization and diminished personal accomplishment. 298 women are selected with "Stratified Systematic Sampling" method from 3297 women who are working in academic and administrative staff. The personal information form and Maslach Burnout Inventory(MBI) which is developed by Maslach ve Jackson (1981) and is adopted into Turkish by Ergin (1992) is applied to selected women. In the result of the study, the factors that affect the burn-out levels are determined with cumulative logit model. This study is important to recognize the problems of women who are working in public universities and to contribute to be productive and successful in their work.

**Key words:** Burnout level, Cumulative Logit Model, Maslach Burnout Inventory, Stratified Systematic Sampling

# BİTLİS İLİ'NİN DOĞAL AFETLER AÇISINDAN İNCELENMESİ VE ÖNERİLER

## NATURAL DISASTERS ANALYSIS OF BITLIS PROVINCE AND SUGGESTIONS

Ercan IŞIK<sup>1</sup>, Muhammed Hamidullah ÖZLÜK<sup>2</sup>

<sup>1</sup>Bitlis Eren Üniversitesi, Müh.-Mim. Fakültesi, İnşaat Müh. Bölümü, [ercanbitliseren@gmail.com](mailto:ercanbitliseren@gmail.com)

<sup>2</sup>İnş. Müh., Bitlis Eren Üniversitesi, Yapı İşleri Teknik Daire Başkanı, [mhozluk@beu.edu.tr](mailto:mhozluk@beu.edu.tr)

### ÖZET

Ülkemiz jeolojik özellikleri, topografik yapısı ve iklim özellikleri nedeniyle doğal afetleri sıkça yaşayan ülkelerden birisidir. Doğal afetler neden oldukları can kaybı yanında Türkiye için önemli ekonomik kayıplar da meydana getirmektedirler. Bitlis taşıdığı olumsuz jeolojik, topografik ve iklim özellikleri ile doğal afetleri sıkça yaşayan bir ildir. Bunun yanı sıra kış aylarında aşırı kar yağışının olması da doğal afet riskini arttırmaktadır. Bu bağlamda, Bitlis doğal afetler açısından incelenmeye değer bir konumdadır. Doğal afetleri henüz, önceden kestirmenin mümkün olmadığı günümüzde afetlerden dolayı ortaya çıkacak kayıpları en aza indirmek bağlamında Bitlis ilinin doğal afetler açısından incelemesi yapıлып, Bitlis ilinin afet profili çıkarılarak öneriler getirilmiştir. Afet risklerinin bilinmesi, afet öncesi, anı ve sonrasında yapılması gerekenler ve alınacak önlemler ile oluşabilecek can ve mal kayıplarını en aza indirmek açısından önem arz etmektedir. Son zamanlarda modern afet yönetimi, afete hazırlıklı olmakla birlikte afetleri önlemenin önemini vurgulamaktadır. Çünkü, günümüzde, büyük kent merkezlerinde meydana gelebilecek afetlerin doğurabileceği kayıplar, yaralarının dahi sarılmasını mümkün kılmayacak boyutlarda olabilmektedir. Türkiye, afetlere karşı dayanıksız/hazırlıksız ülkelerinden biridir. Yakın geçmişe kadar ülkemizde kuraklık, sel, deprem ve toprak kayması gibi yıkıcı doğal afetlere bir ölçüde seyirci kalınmıştır. Bitlis ili ve ilçelerinde doğal afet veri tabanlarının oluşturulması ile afet boyutlarının ortaya konulması, karşılaştırılması ve afet konusunda zarar azaltma çalışması yapan kişi ve/veya kurumların geçmişe ait verileri de değerlendirerek daha doğru ve uygulanabilir projeler üretmesi sağlanacaktır.

**Anahtar Kelimeler:** Bitlis, doğal afet, deprem, çığ, heyelan, kaya düşmesi, sel

**Abstract:** Our country often suffered from natural disasters due to its the topographic structure , geological and climate characteristics. Addition to loss of life, natural disasters also caused to significant economic losses for Turkey. Bitlis, frequently suffered from natural disasters due to its negative topographic structure , geological and climate characteristics. In addition these negative properties, extreme snowfall during the winter months was increased the risk of a natural disaster. In this situation, Bitlis is worthy to be evaluated by natural disaster. It was not possible to predict natural disaster yet. This paper aimed to give overall figure about natural disaster profile and of Bitlis province and made suggestions. Knowing disaster risks are very important in terms of minimizing the possible economic and life losses and taking necessary precautions for before, during and after the disasters. Recently modern disaster management was emphasized disaster preparedness but also importance of disaster prevention. Because, the losses from natural disasters that may occur in urban centers has been a size that able to roll even. Turkey is one of the countries that was not unvulnerable/unprepared to disasters. Creating of natural disaster databases of Bitlis province will be provided that produce a more accurate and viable projects by evaluating historical data by people and / or institutions who work on disaster mitigation.

**Keywords:** Bitlis, natural disaster, rockfall, earthquake, landslide, avalanche, flood

## 1-GİRİŞ

Kaynağını yerden veya atmosferden alan gerçekleştiği zaman can ve mal kaybına neden olan doğa olaylarına doğal afet denilmektedir. Doğal afetlerin oluşumu engellenememekte, jeolojik, hidrolojik ve meteorolojik kökenli olabilmektedirler (Kadioğlu, 2011).

Ülkemiz jeolojik özellikleri, topoğrafik yapısı ve iklim özellikleri nedeniyle doğal afetleri sıkça yaşayan ülkelerden birisidir. Doğal afetler neden oldukları can kaybı yanında Türkiye için önemli ekonomik kayıplar da meydana getirmektedirler. Bu konudaki istatistikler incelendiğinde, doğal afetlerin her yıl gayri safi milli hasılanın %1'i oranında doğrudan ekonomik kayba yol açtığı görülmektedir. Ancak doğrudan ekonomik kayıpların yanında pazar kaybı, üretim kaybı, işsizlik gibi dolaylı ekonomik kayıplar da göz önünde bulundurulduğunda toplam kaybın gayri safi milli hasılanın %1'inden daha büyük olduğu tahmin edilmektedir (Özmen, 2003).

Çeşitli güç, büyüklük ve genişlikte oluşan doğal afetler alt yapı, ulaşım, haberleşme sistemleri ve yörenin ekonomik yapısını olağan dışı bozmakla beraber doğal afetlerden sonra oluşan onarım masraflarıyla da ayrıca hem yörenin hem de ülkenin gelişmesini doğrudan etkilemektedir.

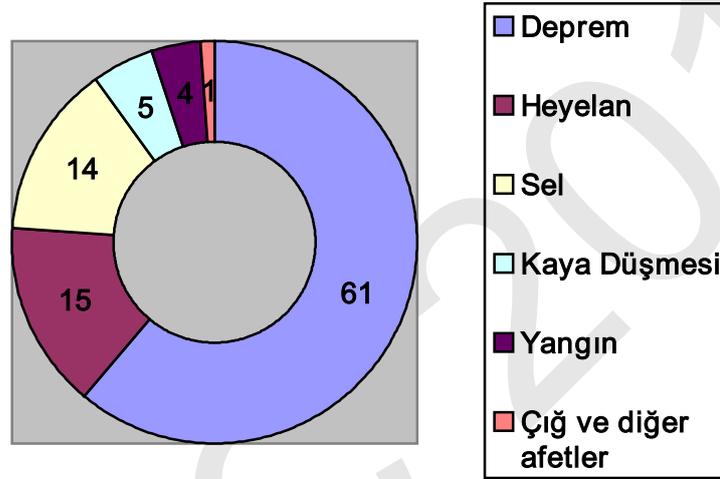
Bunların yanı sıra can kayıpları, sakatlık, öksüz kalma, şok tesiri yaratmaları, bulaşıcı ve salgın hastalıkların oluşmasına sebep vermeleri, eğitim-öğretimin aksaması, barındırma-yedirme- giydirme sorunlarının ortaya çıkması, işsizliğin artması, psikolojik sorunların ortaya çıkması açısından da doğal afetler önem kazanmaktadır.

Bitlis ili ve ilçeleri de taşıdıkları olumsuz jeolojik, topografik faktörler nedeni ile doğal afetlere duyarlı değildir. Bunun yanı sıra kış mevsiminde kar yağışının aşırı derecede olması doğal afet riskini arttırmaktadır. Bu bağlamda Bitlis ili'nin afet profili ayrı bir önem kazanmaktadır.

## 2- DOĞAL AFETLER

Doğal afet kavramını duyunca Ülkemizin acı gerçeği olan ve çoğumuzun ilk olarak aklına gelen depremlerdir. Ancak depremlerin yanı sıra çeşitli büyüklük ve daha küçük alanları etkileyecek olan sel baskını, yangın, kaya düşmesi, volkan patlaması, çığ, kuraklık, fırtına, tsunami, Y.A.S.S. yükselmesi gibi afetlerde unutulmamalıdır.

Ülkemizde meydana gelen doğal afetlerin %61'ini depremler, %15'ini heyelanlar, %14'ünü seller, %5'ini kaya düşmesi, %4'ünü yangınlar, %1'i de çığ ve diğer afetler oluşturmaktadır (Birleşmiş Milletler Kalkınma Programı, 1997) (Şekil 1).



Şekil 1: Türkiye'nin doğal afet dağılımı

Bitlis, Doğu Anadolu'yu Güney Doğu Anadolu'ya bağlayan boğaz geçitleri üzerinde kurulmuş,  $41^{\circ}33'-43^{\circ}11'$  doğu boylamları,  $37^{\circ}54'-38^{\circ}58'$  kuzey enlemleri arasında yer alan, etrafı dağlarla çevrili tarihi bir şehirdir (Şekil2) (Serdar, 2000).



Şekil 2: Bitlis ili ve yer bulduru haritası

### 2.1. Bitlis İlinin Deprem Tehlikesi

Depremler, iç dinamik süreçlerle yer kabuğu içerisinde meydana gelen deformasyonların yarattığı ve jeolojide fay olarak tanımlanan kırılmalar sonucu oluşan yer sarsıntılarıdır. Depremin büyüklüğü (magnitüd), kırılma (faylanma)

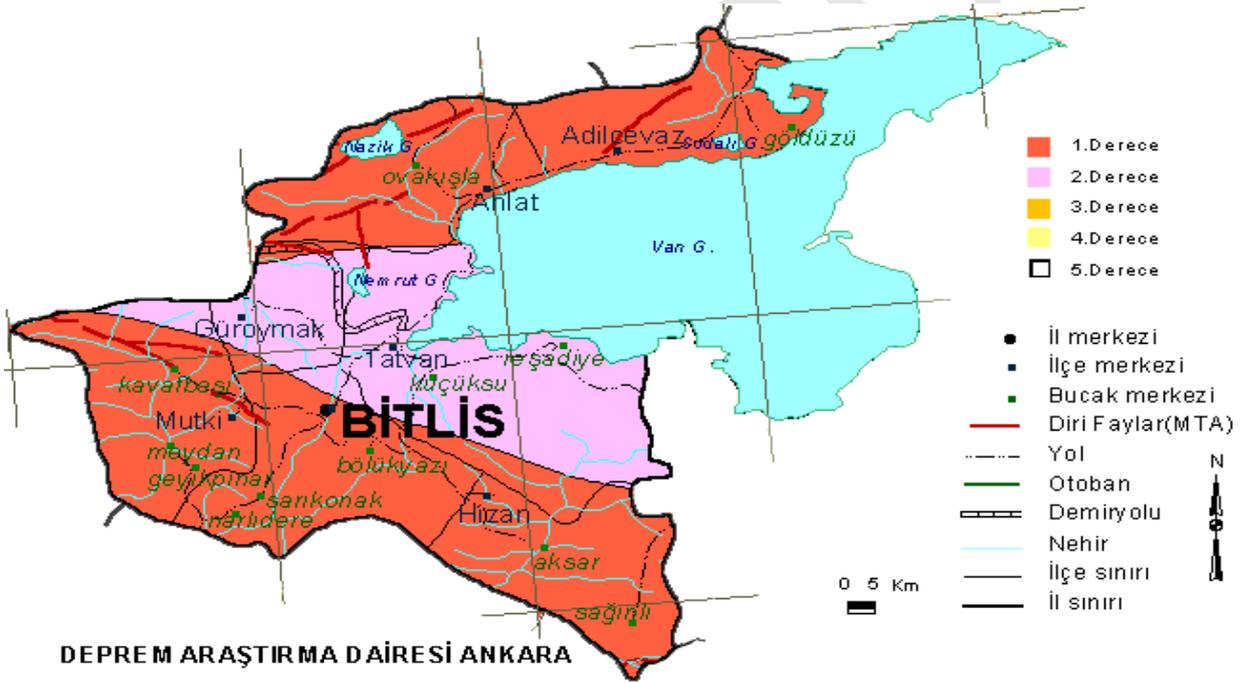
esnasında açığa çıkan enerjinin miktarına bağlı olarak değişir. Genelde, boşalan enerji kırılma merkezinden uzaklaştıkça giderek azalır. Fakat, bazen lokal jeolojik yapı özelliklerinden kaynaklanan olumsuz zemin koşulları bu durumu değiştirebilir ve kaynaktan uzak olmasına rağmen depremin yıkıcı etkisinin beklenenden fazla olmasına yol açabilir. Bu nedenle herhangi bir bölgenin deprem potansiyeli değerlendirilirken depreme yol açan fayların (aktif fay) ve yerel zemin özelliklerinin iyi bilinmesi gerekmektedir (Akdeniz, 2003).

Bitlis ili alanları içerisinde kalan Van Gölü, Doğu Anadolu'da oldukça şiddetli deformasyonlara uğramış bir tektonik yapı içersindedir. Aynı zamanda önemli ve kural dışı neotektonik unsurlar mevcuttur. Bölgenin tektonik açıdan çok aktif olmasından dolayı, deprem aktivitesi havza boyunca ve Van Gölü çevresindeki bölgede çok yüksektir (Horasan, 2007), (Toker, 2007). Van Gölü havzasında meydana gelecek yıkıcı depremler bu havzada bulunan Bitlis il merkezi ve ilçelerini yakından etkileyecektir (Işık, 2010). Bu bağlamda 23 Ekim Van depremi Bitlis ilinde çok şiddetli şekilde hissedilmiş ve ciddi hasarlara yol açmıştır.

Bölgelerin deprem riskleri jeolojik olarak bu fayların belirlenmesi ile elde edilebileceği gibi daha önceki deprem kayıtlarından faydalanılarak ta bulunabilmektedir. Önceden depreme maruz kalmış bölgeler gelecekte de benzer şekilde depremlerden zarar görecektir bölgeler olarak görülmektedir (Celep, 1996).

Yüksek sismik aktiviteye sahip olan bölgelerde depremlerin oluşumlarının ve dönüş periyotlarının tespit edilmesi önem taşımaktadır. Geçmişten günümüze kadar gözlenen ve kaydedilen sağlıklı deprem verileriyle gelecekte meydana gelebilecek depremlerin oluşma olasılıkları ve dönüş periyotları istatistiksel modellerle belirlenebilmektedir. Bu modeller yardımı ile belirli bir zaman aralığı içerisinde hangi büyüklükte ve sıklıkta depremlerin beklenebileceği belirlenebilmektedir (Kalyoncuoğlu, 2005).

Bakanlar Kurulu'nun 18.4.1996 gün ve 96/8109 sayılı kararıyla Türkiye Deprem Bölgeleri Haritası adı altında 1/1.800.000 ölçekli olarak yürürlüğe girmiştir.(Pampal 2007). Bu haritaya göre Bitlis, 1. derece deprem bölgesi içerisinde yer almaktadır (Bay. ve İsk. Bak., 1996)(Şekil 3).



Şekil 3: Bitlis ili ve ilçeleri deprem bölge haritası (Bay. ve İsk. Bak.1996)

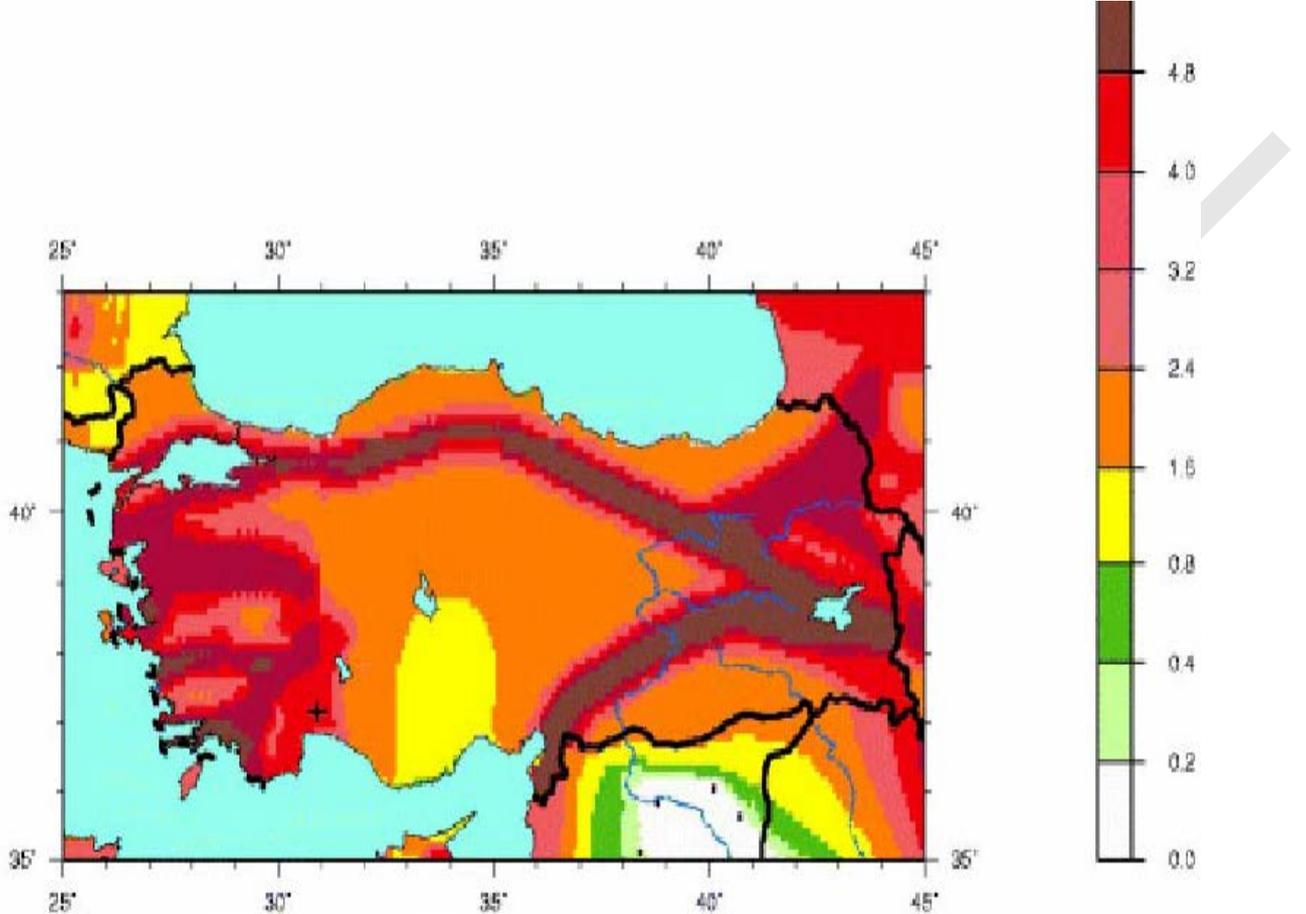
Bitlis ilinin içinde bulunduğu Van Gölü Havzasının bir sıkışma bölgesinde bulunması, daha önce volkanik olayların oluşması ve Van Gölü'nün volkanik hareketlerden etkilenerek oluştuğu düşünüldüğünde Bitlis ve ilçeleri depremsellik açısından oldukça önem kazanmaktadır.

Tarihsel depremler, bir bölgenin gelecekte karşı karşıya kalabileceği bir deprem riskinin hesaplanmasında kullanılacak en önemli verilerdir. Bu bağlamda Bitlis ve civarında oluşmuş tarihsel dönem depremleri olası bir depremin habercisi olarak yorumlanabilmektedir. Suskun bir dönemden geçmekte olan fakat aktif tektoniğini mikro depremlerle devam ettiren Bitlis ve civarı gelecekte oluşabilecek büyük ve şiddetli depremlerin etkisi altındadır. Tarihsel depremler incelendiğinde Bitlis ve civarının sürekli aktif bir tektonik yapıya sahip olduğunu ortaya koymaktadır. Aletsel dönemdeki depremlerin azlığı veya büyüklüklerinin az olması Bitlis ve civarının suskunluğu anlamı taşımaktadır. Ancak bu durum bölgenin deprem tehlikesinin olmayacağı anlamı taşımamalıdır.

Yöre taşıdığı olumsuz jeolojik ve topografik faktörler nedeniyle depreme duyarlı değildir. Bugüne kadar izlenen yapılaşmada depremsellik ögesi büyük ölçüde ihmal edilmiştir. Ancak tektonik olarak son derece hareketli kuşaklar içerisinde kalan sahada yapılaşma esnasında depremsellik faktörü göz önünde bulundurulmalı ve ilgili şartnamelere hassasiyetle uyulmalıdır.

Hasar ve can kaybı yaratabilecek bir depremden kaynaklanan yer hareketinin belirli bir yerde ve belli zaman periyodunda meydana gelme ihtimali deprem tehlikesi olarak tanımlanmaktadır. Deprem riski, deprem nedeni ile hasar, mal ve can kaybı ihtimali olarak tanımlanabilir. Risk şu soruların yanıtlarının toplamıdır: Ne büyüklükte bir deprem, ne kadar uzaklıkta, nasıl bir zeminde, ne tür bir yapıda, ne değerde hasar ve kayba neden olur? 'Ne düzeyde tehlike?' sorusunun yanıtını ararken yapılacak ilk iş nerede deprem olabileceğini deterministik olarak tanımlamak ya da olasılıksal olarak kestirmektir. Deprem tehlikesi, deprem riskinin önemli bir ögesidir (Özmen,2008)(Türkelli, 2008)(Eyidoğan, 2003).

Yapılan sismik araştırmalar Bitlis ilinin deprem tehlikesini ortaya koymaktadır. Bitlis ilinin sismik açıdan risk taşıdığı bir gerçektir (Şekil 4).

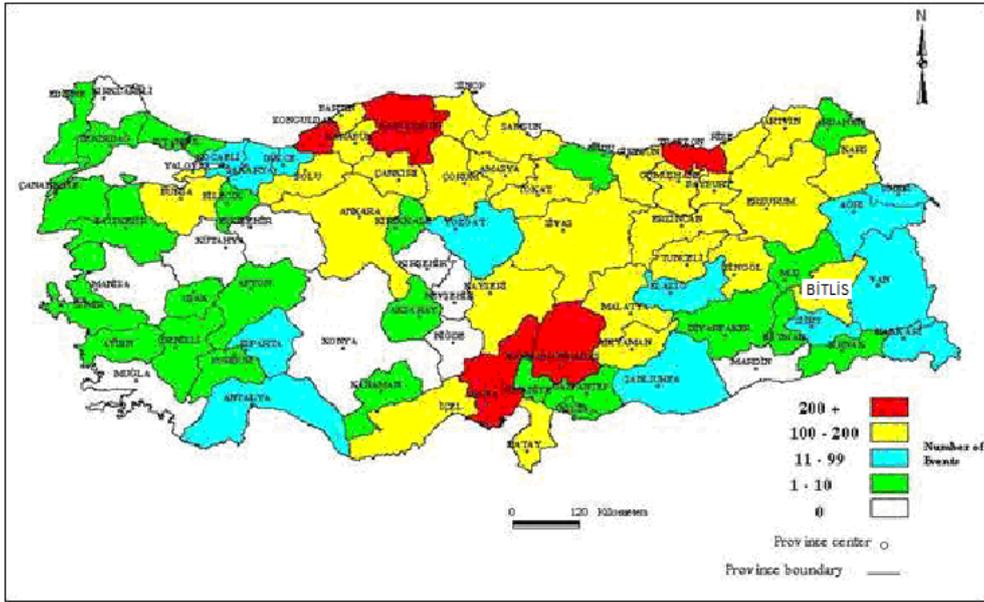


Şekil 4: Türkiye'nin Sismik Risk Haritası (%10 aşılma olasılığı 50 yıl ekonomik ömür için hesaplanan pik yer ivmesi değerleri) (USGS)

## 2.2. Bitlis İlinin Heyelan Tehlikesi

Bir yamaçtaki kaya, toprak zeminin veya molozların yamaç aşağı doğru hareket etmesi sonucu oluşan olaya heyelan denilmektedir (Gökçeoğlu, 2001). Heyelanlar jeolojik, sismolojik topografik, iklim özellikleri ve yağışlar gibi nedenlere bağlı oluşmakta daha çok ulaşım yapılarına zarar vermekte ve diğer afetlere göre daha az can ve mal kaybına sebep olmaktadır. Ülkemizde meydana gelen doğal afetlerin %15 ini heyelanlar oluşturmaktadır.

Bitlis ilinin olumsuz jeolojik, topografik, özelliklerinin yanında aşırı derecede kar yağışı heyelan oluşma riskini artıran faktörlerdir. Bu olumsuz faktörlerden dolayı Bitlis İli heyelan riski taşıyan iller arasında gelmektedir (Şekil 5).



Şekil 5: Türkiye Heyelan Yoğunluk Haritası (Afet İşleri Genel Müdürlüğü, 1998)

Güneydoğu Anadolu bindirme kuşağı üzerinde bulunan Bitlis ilinin batısında Mutki ilçesi ile doğusunda bulunan Hizan ilçelerinde heyelan olayları yoğun olarak gözlenmektedir.

### 2.3. Bitlis İlinin Çığ Tehlikesi

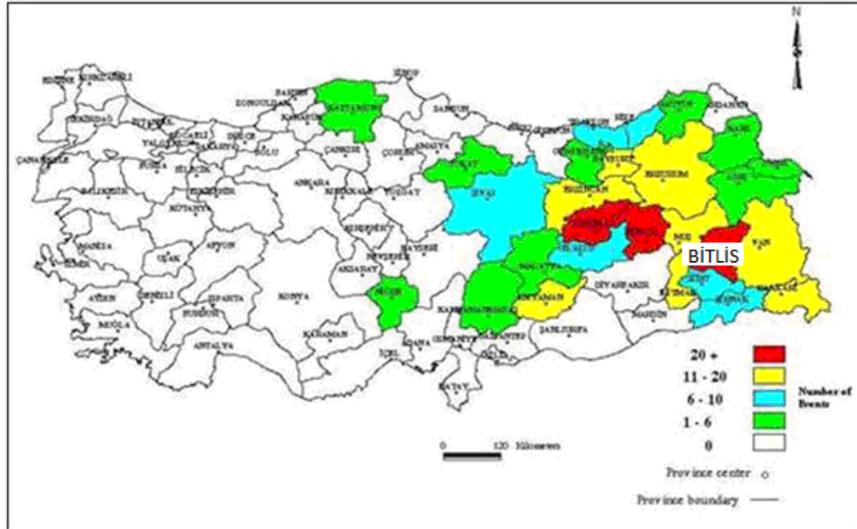
Çığ, genellikle bitki örtüsü olmayan engebeli, dağlık ve eğimli arazilerde, vadi yamaçlarında tabakalar halinde birikmiş olan kar kütlelerinin iç ve/veya dış kuvvetlerin etkisi ile başlayan bir ilk hareket sonucu (tetiklenen), yamaçtan aşağıya doğru hızla kayması olarak tanımlanır (Gürer, 1994).

Çığlar, farklı kalınlıklara sahip kar örtüsünün çeşitli faktörlerin etkisiyle eğim boyunca hareketi sonucunda ortaya çıkar. Çığlar, yerleşim birimleri, dağ spor ve turizm tesisleri, karayolları, köy yolları, demiryolları, haberleşme ve enerji nakil hatları, sanayi, askeri ve diğer benzeri tesisler için büyük tehlikeler oluşturduğu gibi can kayıplarına da neden olurlar. Türkiye’de Doğu ve Güneydoğu Anadolu bölgeleri ve Karadeniz Bölgesi’nin iç kesimlerinde birçok yerde gerçekleşmektedir. Bu bölgelerdeki mezra tipi yerleşim birimlerinin çoğu çığ tehdidi altındadır (Gürer, 2002), (Yavaş 2005).

Bitlis’te aşırı kar yağışlarından dolayı çığ, kar savruntusu, özellikle düz ve toprak çatılarda kar birikimi ve saçaklarda sarkıt buz oluşumu yüzünden yerleşim birimlerinde, hem şehir merkezine hem de kırsal kesimde yaşayan insanların hayatları olumsuz yönde etkilenmekte, ciddi ulaşım sorunları ortaya çıkmakta, ölümlü trafik kazalarına sebebiyet vermekte, enerji hatları tahrip olmaktadır.

1950- 2002 tarihleri arasında Bitlis’te toplam 38 adet çığ meydana gelmiştir. Bu çığlarda 57 kişi hayatını kaybetmiştir. Bu dönem arasında çığlardan dolayı toplam 737 konutun nakline karar verilmiştir (Gürer, 2002).

Kış aylarında görülen aşırı kar yağışları ve dondurucu soğuklar normal hayatı önemli bir ölçüde etkilemektedir. Bitlis çığ düşme tehlikesi ve riskinin en yüksek olduğu üç ilden biridir (Şekil 6).



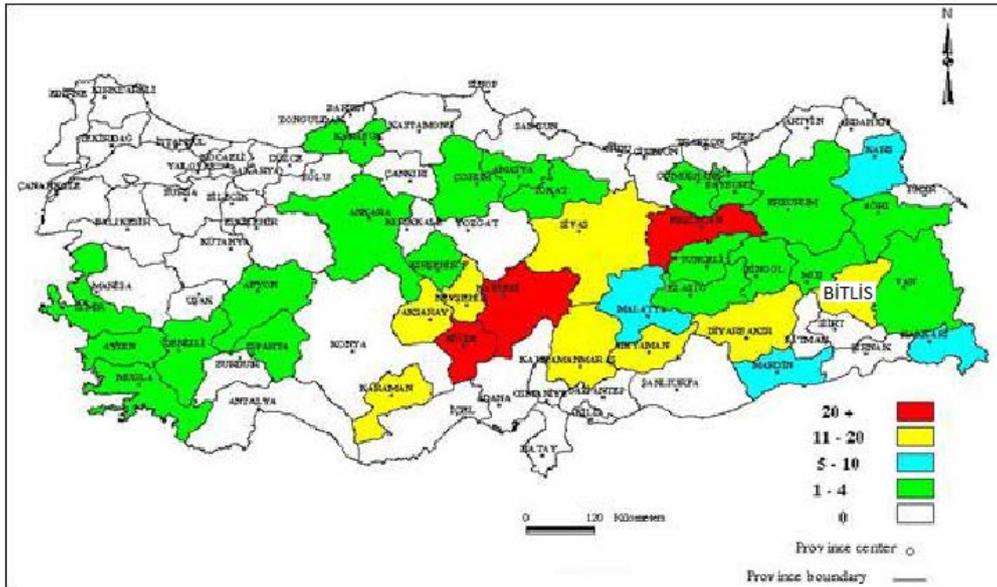
Şekil 6: Türkiye’nin Çığ Dağılım Haritası (Afet İşleri Genel Müdürlüğü, 1998)

Kar yağışı genel olarak Kasım ayı başında başlamakta ve Nisan ayında kar kalkmaktadır. Bu sürenin uzun olması Bitlis'te risk süresini artırmaktadır. İl merkezinde çığ riskine sahip olan iki ilden birisidir. Tatvan ilçe merkezinde de çığ riski mevcuttur. İlin tüm ilçelerine bağlı pek çok köyde ve köy yollarında çığ riski mevcuttur. Bunun yanında, Siirt-Bitlis karayolunda çok büyük ölçekli çığlar meydana gelmektedir.

## 2.4. Bitlis İlinin Kaya Düşmesi Tehlikesi

Yağışlı mevsimlerde ve kar erime dönemlerinde, gece-gündüz ısı farkından dolayı ve yeraltı su tablasının yüzeye yakın olması sebebiyle, özellikle patlatma yapılan yarmalarda yerçekimi etkisiyle kaya düşmesi sorunu ortaya çıkmakta ve özellikle ulaşım yapılarının güvenliğini ve bazen de bina türü yapıları olumsuz olarak etkilemektedir. Ülkemizde meydana gelen doğal afetlerinin %5'ini kaya düşmeleri oluşturmaktadır. Türkiye'de 1958 yılından beri 750 kaya düşmesi olayı meydana gelmiştir (Avcı, 2008)(Ergünay, 2007).

Bitlis ilinde yağışların özellikle kar yağışının çok fazla olması, gece-gündüz ısı farkının çok olması kaya düşmesi riskini artırmaktadır. Bu bağlamda Bitlis kaya düşmesi tehlikesi bakımından ülkemizin 9. ilidir (Şekil 7).



Şekil 7: Türkiye Kaya Düşmesi Yoğunluk Haritası (Afet İşleri Genel Müdürlüğü, 1998)

Kaya düşmesi olayları da yine Güneydoğu Anadolu bindirme kuşağında üzerinde bulunan Merkez, Mutki ve Hizan ilçelerinde gözlenmektedir.

Bitlis şehir merkezinde bulunan Bitlis Kalesi, kaya düşmelerinden dolayı can ve mal güvenliği açısından tehlikeli bir konumdur. Tehlikenin ortada kaldırılabilmesi amacı ile gerekli önlemler alınarak kale restore edilmiştir.

## 2.5. Bitlis İlinin Sel Tehlikesi

Doğal afet olarak sel, bir akarsuyun muhtelif nedenler ile yatağından taşarak, çevresindeki arazilere, yerleşim birimlerine, altyapı tesislerine ve canlılara zarar vermek suretiyle, etki bölgesinde normal sosyo-ekonomik faaliyeti kesintiye uğratabilecek ölçüde bir akış büyüklüğü oluşturması olayı şeklinde ifade edilmektedir. Bu tanımla, deniz sahillerinde mücavir bölgelerdeki dalga hareketlerinden kaynaklanan kıyı taşkınları, göllerdeki seviye değişiklikleri ile dalga etkilerinden kaynaklanan göl taşkınları ve buzul erime ve parçalanmalarından kaynaklanan buz hareketi taşkınları ile genişletmek mümkündür (Uşakay, 2002).

Bitlis topoğrafik ve hidro-meteorolojik özellikleri bakımından, sel felaketleri açısından her zaman hassas bir konumdur. Aşırı yöresel yağışlardan veya toplu kar erimelerinden sonra yaşanan akarsu taşkınları Bitlis ilinde karşılaşılan en yaygın sel olaylarıdır. Bitlis ve ilçelerinde bulunan derelerin yağışlı mevsimlerde taşkın debisinin fazlaşması yer yer tarım arazilerini, kimi yerlerde ise yerleşim birimlerini tehdit etmektedir.

Bitlis en çok taşkın tehlikesine maruz kalan on il arasındadır. Yıllık sıklık oranı 0,132 olmakla birlikte riske maruz nüfus 10.000 olarak belirlenmiştir (JICA, 2004)(Şekil 8).



Şekil 8: Ülkemizin Sel zararı ve tehlike haritası (Afet İşleri Genel Müdürlüğü, 1998)

İl genelinde su baskını olayları yoğun yaşanmakta olup; Merkez, Adilcevaz, Mutki, Güroymak ve Hizan ilçelerinde daha yoğun gözlenmektedir. 30.07.1996 ve 21.10.2005 yıllarında aşırı yağışlar sonucu meydana gelen su baskını ve heyelan olayları bölgesel olarak birçok Merkez ve ilçelerde yerleşim birimlerini etkilemiştir.

Ayrıca Tatvan, Ahlat ve Adilcevaz ilçelerinin sınırı durumunda olan Van Gölü'nün maksimum su kotu 1649,26 olarak belirlenmiş olup, Van Gölü çevresindeki 1655 kotu altında kalan alanlar Bakanlar Kurulu'na 08.06.1995 tarihinde afete maruz bölge olarak ilan edilmiştir. Buna göre 1655 kotu kıyı kenar çizgisi olarak kabul edilmiştir. Yürürlükte olan yönetmeliğe göre belirlenmesi gereken 50m'lik v 100m'lik kıyı şeritleri bu kot temel alınarak belirlenmiştir ( TBMM, 2001).

Van Gölü çevresindeki tarım alanları ve kentsel - kırsal yerleşmeler üzerinde uzun yıllık, yıllık ve mevsimlik seviye değişimleri, büyük etkilerde bulunmuş ve yapılan ölçümlere göre, son 50 yıl içinde (1950-2000) göl seviyesinde yaklaşık 3 m. yükselme meydana gelmiştir. 1993-94 yıllarındaki hızlı yükselme sonucu yüzlerce konut ve binlerce dekar tarım alanı su altında kalmış ve önemli bir çevresel probleme neden olmuştur (Yıldız, 2005).

## SONUÇLAR VE ÖNERİLER

Afet yönetimi, afet öncesinde beklenen afet türünün belirlenmesi ve afete göre önlem alınması, afet anında acil kriz masalarının oluşturulması ve afet sonrasında acil durum müdahalelerinin yapılması ile uzun vadede iyileştirme politikalarının uygulanmasından oluşmaktadır. Bu nedenle, afet yönetiminin oluşturulması ile afete karşı önceden hazırlık yapılabilecek ve zararlar azaltılabilecektir.

Ülkemizde afet yönetimi "Yara Sarma" politikası olarak algılanmaktadır. Bir afet olayından hemen sonra uygulanan kurtarma ve ilkyardım, afetten etkilenen ailelere acil yardımlar ile birlikte yapılan maddi yardımlar ile sınırlı kalmaktadır. Afet yönetiminin etkinliği, yapılan bu çalışmaların başarısı veya başarısızlığı ile değerlendirilmektedir. Afet yönetiminin başlıca görevi can ve mal kaybını azaltmak ve ulusu doğal, teknolojik ve insan faktörlü afetlerden korumaktır. Bunu yaparken hazırlıklı olma, koruma, müdahale, iyileştirme ve zarar azaltma gibi öğeleri içeren riske dayalı, kapsamlı bir afet ve acil durum yönetim sisteminde halka öncülük etmeli ve destek verilmelidir.

Doğal afetlerinin olmayışı veya çok uzun zamandan beri tekrarlanmaması gelecekte de bunun bu şekilde devam edeceği anlamına gelmemektedir. Dolayısıyla doğal afetlerinin her an olabileceği ve engellenmesinin de zor olacağı düşünüldüğünde doğal afetler meydana gelmeden alınacak tedbirlerinin önemini ortaya koymaktadır. Doğal afet bilincinin artması ile toplumun büyük bir kesiminin "bi'sey olmaz" düşüncesinden kurtulup daha rasyonel düşünmeye başlaması sonucunu doğuracaktır. Bunun sonucu olarak da doğal afetlerin meydana getireceği zararlar en alt seviyelere indirilecektir.

Kayıpları azaltmak ve/veya en aza indirmek için doğal afet tehlikesi olan bölgeleri tespit etmek yeterli olmamaktadır. Bu alanlarla ilgili yapılması mümkün ise önlemler hayata geçirilmeli ve daha da önemlisi doğal afetlere karşı bilinçlendirilme amaçlı eğitim çalışmaları yürütülmelidir.

Bitlis taşıdığı olumsuz jeolojik, topografik ve iklim özellikleri ile doğal afetleri sıkça yaşayan bir ildir. Bunun yanı sıra kış aylarında aşırı kar yağışının olması da doğal afet riskini arttırmaktadır. Bitlis doğal afetler açısından incelenmeye değer bir konumdadır. Ancak yeterli araştırma ve etüdün yapılmamış olması riskleri ortadan kaldırmamıştır. Bu bağlamda nüfusun az olması ve buna bağlı olarak yapılaşmanın az olması doğal afetlerden kaynaklanan kayıpların

fazla olmaması belki de arařtırmaların kısıtlı olmasına sebep olmuřtur. Ancak bilinmelidir ki dođal afetlerin oluřmaması veya oluřan kayıpların az olması oluřabilecek dođal afetleri ve bunlara bađlı kayıpları ortadan kaldırmayacaktır.

Çarpık kentleřme, tařkın alanlarının geliřigüzel bina türü yapılarla iřgal edilmesi, il ve ilçeler çevresindeki ormansız alanlarda toprak ve bitki örtüsünün geliřememiř olması gibi nedenler, tařkın alanlarının oluřumunda önemli rol oynamaktadır.

Bitlis ili ve ilçelerinde yađmur rejiminin genelde kısa süreli ve řiddetli olması suların toplanma süresini kısaltmaktadır. Bu yüzden, il ve ilçe çevresine orman dikilmeli, dere ıřlah çalıřmalarına devam edilmeli, yatađı bozulan dereler tekrar dođal haline getirilmeli, dere yataklarına yeterli kadar bent ve gölet (su tutucular) yapılmalıdır.

Yapılařma esnasında özellikle dođal afetlerin her birinin ayrı ayrı incelenmesi hatta bazı durumlarda dođal afetlerin aynı anda meydana gelebileceđi gerçeđi de dikkate alınmalıdır.

Özellikle yeni yerleřim merkezlerinin kurulması ve buna bađlı olarak mevcut yerleřim merkezlerinin de tekrar gözden geçirilmesi hem maddi kayıplar hem de can kayıpları açasından geleceđe daha umutla bakmamızı sađlayacaktır.

Dođal afetler sonucunda yařanan can kayıplarının yanı sıra çok sayıda hayvanın telef olması, binaların yıkılması, ormanların yok olması, elektrik ve haberleřme hatlarının tahribi, yolların kapanması, köprülerin yıkılması, derelerin tıkanıp tařkın tehlikesinin oluřması gibi önemli oranda milli gelir kaybına neden olan sonuçlar doğmaktadır.

Dođal afetler sonrasında kullanılması zorunlu olan mevcut yapılar için detaylı yapısal analizler gerçekleřtirilip ekonomik olması durumunda derhal gerekli güçlendirmeler yapılmalı veya güvenli sonuç vermeyen yapılar bir an önce yıktırılmalıdır. Bu çalıřmalar daha sonra diđer mevcut yapılar için yapılmalıdır.

Bitlis il ve ilçelerinde meydana gelebilecek dođal afetlerden dolayı oluřabilecek can ve mal kayıplarının minimum seviyede tutmak için ne tür bir risk altında olduđunun bilinmesi ve yapılacak çalıřmalara yön verilmesi açasından Bitlis ilinin afet profili önem kazanmaktadır.

Bütün bunlar göstermektedir ki, dođal afetler konusunda problemler hemen çözülebilecek kadar kolay deđildir. Belli bir plan ve yüklü miktarlarda ekonomik güç gereklidir. Ancak, sorunları çözebilmek için de uzun vadeli projeler hazırlayıp bir an önce kararlılıkla uygulamak kaçınılmazdır.

Bitlis ili ve ilçelerinde dođal afet veri tabanlarının oluřturulması ile afet boyutlarının ortaya konulması, karřılařtırılması ve afet konusunda zarar azaltma çalıřması yapan kiři ve/veya kurumların geçmiře ait verileri de deđerlendirerek daha dođru ve uygulanabilir projeler üretmesi, yeni yerleřim alanları ve/veya mevcut alanlarda yapacađı çalıřmalarda gerekli önlemleri almasını sađlayacaktır.

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# BÖTE ÖĞRETMEN ADAYLARININ EĞİTİMDE TEKNOLOJİ KULLANIMINA YÖNELİK ÖZGÜVENLERİ

Arş. Gör. Ebru ALBAYRAK

Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü

Sakarya Üniversitesi

Türkiye

ealbayrak@sakarya.edu.tr

**Özet:** Günümüz eğitim sisteminde teknoloji kullanımının oldukça yaygınlaştığı görülmektedir. Birçok yeni teknolojinin eğitim sistemine entegre edilmesiyle birlikte bu teknolojileri kullanacak olan öğretmen adaylarının teknoloji kullanımı konusunda iyi eğitilmiş olmaları gerekmektedir. Mevcut öğretmenler arasında teknoloji kullanımı bilgilerinin yetersiz olduğu ve teknoloji kullanımına yönelik özgüven eksikliklerinin bulunduğu bilinmektedir. Bu yüzden Bilgisayar ve Öğretim Teknolojileri Eğitimi öğretmen adaylarının eğitimde teknoloji kullanımının sağlanması ve yaygınlaştırılması açısından teknoloji kullanımı konusunda yeterli olmaları gerektiği düşünülmektedir. Bu çalışmada BÖTE bölümü öğrencilerinin eğitimde teknoloji kullanmaya yönelik özgüvenlerini belirleme amaçlanmıştır. Çalışma Sakarya Üniversitesi Eğitim Fakültesi BÖTE bölümünden 189 öğretmen adayı ile yürütülmüştür. Araştırmada genel tarama modellerinden ilişkisel tarama modeli kullanılmış, araştırmanın örnekleme gönüllülük esasında dayalı olarak kolay örnekleme yöntemiyle seçilmiştir. Çalışmada Erdemir, Bakırcı ve Eydurur tarafından hazırlanmış olan “Teknoloji Tutum Ölçeği” kullanılmıştır. Ölçeğin geçerlik-güvenirlik çalışmaları ve çalışmadan elde edilen veriler ortalama, Anova, ChiSquare ve t testi ile analiz edilmiştir. Araştırma sonucunda öğretmen adaylarının eğitimde teknoloji kullanımına yönelik özgüven duydukları sonucuna ulaşılmıştır. Araştırmanın bulguları literatürde bulunan benzer araştırma sonuçlarıyla karşılaştırılmış ve elde edilen sonuçlara yönelik öneriler getirilmiştir.

**Anahtar Kelimeler:** Teknoloji, Eğitimde Teknoloji, Özgüven.

## Giriş

Günümüz dünyasında teknolojide büyük gelişmeler meydana gelmiş ve bu durum yaşamın her alanını etkilemiştir. Zamanla bütün dünyada yaygınlaşan teknoloji eğitim-öğretim faaliyetlerine de katılmakta gecikmemiştir. Teknoloji beraberinde eğitime yeni uygulamalar kazandırmış ve bu sayede eğitim-öğretim sürecine daha kaliteli bir öğretim imkanı sağlamıştır. Akın'a (2007) göre hızla değişen ve gelişen teknoloji eğitim sistemi için görsel ve işitsel öğretim alternatifleri sağlamış ve bu durum öğretim programlarında yenilenme ihtiyacını doğurmuştur. Literatürdeki araştırmalara göre eğitim teknolojileri eğitim sisteminde pozitif yönde değişimler meydana getirebilmektedir. Gök, Turan ve Oyman'a (2011) göre bilgi ve iletişim teknolojileri öğrencilerin farklı duyu organlarına hitap ederek onların aktif bir şekilde eğitim sürecine katılmalarını sağlamaktadır. Bu sayede öğrencilerin derse karşı ilgi ve odaklanma süreleri artabilmektedir. Okullarda teknoloji, ders içeriklerinin öğretilmesinden başka ödev yapma ve çocuklar için oyun oynama gibi etkinliklerde de kullanılmaktadır (MEB, 2003). Ancak bu teknolojilerin eğitimde etkili bir şekilde kullanılması için bazı bilgilere sahip olunması gerekmektedir. Teknolojiyi yakından tanımayan öğretmenler eğitimde teknoloji kullanımı konusunda yetersiz kalabilmektedir. Özellikle bilgisayarların eğitim sistemine girmesi teknoloji kullanımına yönelik bilgi ihtiyacını beraberinde getirmiştir. Teknolojinin gelişimiyle daha fazla teknoloji ürünü eğitim sistemine dahil edilmiş ve zamanla bilgisayar öğretmeni açığı çıkmıştır.

1998 yılında YÖK'ün Eğitim Fakülteleri Öğretmen Yetiştirme Programlarının Yeniden Düzenlenmesi kanunu ile okullarda bilgisayarlar yaygınlaştırılmış ve bilgisayar laboratuvarları kurulmuştur (YÖK, 2007). Kurt ve Sular'a (2010) göre Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümleri bilgisayar öğretmeni açığını kapatacak ve öğretim teknolojilerini kullanılabilecek öğretmenler yetiştirilmesi için kurulmuştur. Bu bölümde okuyan öğrencilerin bu teknolojilerin kullanımına yönelik ne derece özgüven sahibi oldukları sorusu ise bu araştırmanın konusu olmuştur. Feltz'e (1994) göre özgüven, bireyin kendi özelliklerini değerlendirerek hedefi başarabilmek için sahip olduğu performans düzeyine yönelik inancıdır. Eğitimde teknoloji kullanımına yönelik araştırmalara bakıldığında, Çuhada ve Yücel'in 2010 yılında yapmış oldukları çalışmaya göre bilgi teknolojileri hakkında bilgi sahibi olma öğretmen adaylarının teknoloji kullanımına yönelik özgüvenini artırmaktadır. Cüre ve Özdener'in 2008 yılında öğretmenler üzerinde bilgi ve iletişim teknolojilerine yönelik tutumlarının ölçüldüğü araştırmalarında ise öğretmenlerin bilgi ve iletişim teknolojilerini yararlı buldukları ancak bilgi ve beceri gerektirdiğini düşündükleri bulgusu elde edilmiştir. Öğretmenler ayrıca kalabalık sınıflarda teknolojiyi kullanmanın zor olacağını düşünmektedirler.

Bu çalışmada BÖTE bölümü öğrencilerinin cinsiyet, yaş, sınıf, lise türü, bilgisayar sahibi olup olmamaları ve bilgisayar kullanım yılları açısından eğitimde kullanılan teknolojileri kullanmaya yönelik özgüvenlerini belirleme amaçlanmıştır.

Bu nedenle aşağıdaki sorular cevaplandırılmaya çalışılmıştır.

- 1) Öğretmen adaylarının eğitimde kullanılan teknolojileri kullanmaya yönelik özgüvenleri hakkındaki düşünceleri hangi seviyededir?
- 2) Öğretmen adaylarının eğitimde kullanılan teknolojileri kullanmaya yönelik cinsiyet, yaş, sınıf, lise türü, bilgisayar sahibi olup olmamaları ve bilgisayar kullanım yılları açısından eğitimde kullanılan teknolojileri kullanmaya yönelik özgüven düzeyleri arasında farklılık var mıdır?

## Materyal ve Metod

Araştırma, 2012–2013 eğitim-öğretim yılı güz dönemi Sakarya Üniversitesi, Eğitim Fakültesi 2. ve 3. sınıfta öğrenim gören toplam 189 öğretmen adayı ile yürütülmüştür. Örneklem Bilgisayar ve Öğretim Teknolojileri Eğitimi Anabilim Dalı'nda öğrenim gören öğretmen adaylarından oluşmuştur. Çalışmaya katılan adaylardan 119'u erkek, 70'i ise kadındır.

Araştırma betimleyici nitelikte olup, veriler Erdemir, Bakırcı ve Eyduvan'ın (2009) geliştirmiş olduğu tutum ölçeği ile toplanmıştır. Ölçek 29 maddelik beşli Likert tipi Teknoloji Tutum Ölçeği (TTÖ) dir. Kesinlikle katılıyorum ifadesinden, kesinlikle katılmıyorum ifadesine doğru sıralanmış ve bu ifadeler 1 den 5'e doğru kodlanmıştır. Yapılan çalışmada ölçek güvenilirliği .93 bulunmuştur. Bu çalışmada da güvenilirlik .94 bulunmuştur. Büyüköztürk'e (2011) göre psikolojik testlerde güvenilirlik katsayısı için .70 ve üstü o ölçeğin güvenilir olduğunu göstermektedir. Bu durumda .94 değeriyle ölçeğin güvenilir olduğu görülmektedir.

Elde edilen veriler SPSS 19.0 istatistik programı kullanılarak analiz edilmiştir. Her bir maddeden elde edilen verilerin aritmetik ortalama ve standart sapma değerleri bulunmuştur.

Öğretmen adaylarının cinsiyetlerinin eğitimde teknoloji kullanmaya yönelik özgüvene etkisinin olup olmadığı t-testi ile analiz edilmiştir.

Ölçek maddelerinin aralarındaki ilişki gücü Chi-square testi kullanılarak ortaya çıkarılmıştır.

Öğretmen adaylarının yaşlarının eğitimde teknoloji kullanmaya yönelik özgüvene etkisinin olup olmadığı One-way Anova testi ile analiz edilmiştir. Anlamlı farklılığın hani yaşın lehine olduğu bulgusuna ise Tukey testi ulaşılmıştır.

Öğretmen adaylarının sınıf, lise düzeyi, bilgisayar kullanımı ve bilgisayarın varlığına ilişkin bilgileri ile eğitimde teknoloji kullanımına yönelik özgüvenlerinin ilişkisi One-way Anova testi ile analiz edilmiştir.

## Bulgular ve Yorum

Yapılan analizler sonucunda elde edilen bulgu ve yorumlar aşağıda sunulmuştur.

İlk olarak eğitimde teknoloji kullanmaya yönelik özgüvenle ilgili elde edilen veriler cinsiyet açısından t testi ile incelenmiştir.

**Tablo1.** Öğretmen adaylarının eğitimde teknoloji kullanımına yönelik özgüvenlerinin cinsiyet açısından karşılaştırılmasına ilişkin t testi sonuçları

| Cinsiyet | N   | $\bar{x}$ | S    | sd  | t    | P    |
|----------|-----|-----------|------|-----|------|------|
| Erkek    | 119 | 113.49    | 17.0 | 187 | 2.30 | 0.22 |
| Kadın    | 70  | 118.77    | 11.5 |     |      |      |

Bu analiz sonucunda Tablo1'e göre kadınların ( $\bar{x}_k=118.77$ ) eğitimde teknoloji kullanımına yönelik özgüvenleri erkeklere ( $\bar{x}_e=113.49$ ) göre anlamlı derecede daha yüksek bulunmuştur ( $p=.022$ ).

Ölçek maddelerinden internet'te arama motorları (google, altavista gibi) kullanabilme ile ilgili maddenin ortalaması  $\bar{x}_6=4.5$  bulunmuştur. Bu değer karşılığının ise kesinlikle katılıyorum olduğu söylenebilir. Ayrıca maddelerden bilgisayarı ve interneti amaçlarına uygun olarak derste kullanabilme ile ilgili maddelere de öğrenciler  $\bar{x}=4.5$  değerine yakın değerler vermişlerdir ( $\bar{x}_{13}=4.4$ ,  $\bar{x}_{14}=4.3$ ). Buradan öğrencilerin genel anlamda bilgisayar ve internet kullanımı konusunda kendilerine güven duydukları söylenebilir.

Ölçek maddelerinden m1 ( $\bar{x}_e=3.69$ ;  $\bar{x}_k=4.08$ ), m15 ( $\bar{x}_e=4.15$ ;  $\bar{x}_k=4.31$ ), m17 ( $\bar{x}_e=3.97$ ;  $\bar{x}_k=4.10$ ), m18 ( $\bar{x}_e=3.73$ ;  $\bar{x}_k=4.11$ ), m19 ( $\bar{x}_e=3.68$ ;  $\bar{x}_k=3.92$ ), m25 ( $\bar{x}_e=3.82$ ;  $\bar{x}_k=4.25$ )'te kadınlarla erkekler arasında kadınlar lehine anlamlı farklılık bulunmuştur. Bu maddelerin eğitimde teknoloji kullanırken çevre koşulları ve mevcut olanaklar kullanılarak, özgün ve ekonomik açıdan uygun, basit öğrenme materyalleri hazırlayabilme, iletişim teknolojilerini amaçlarına uygun olarak derste kullanabilme, öğretim materyallerini amacına uygunluğu açısından değerlendirebilme, öğretim materyallerini ve araç-gereçlerini tasarım ilkelerine uygunluğu açısından değerlendirebilme, bir öğretim materyalinin nasıl değerlendirileceği ile ilgili plan yapabilme, amaç, hedef, davranış analizi yapılmış bir derste, öğretilecek konuları parçalara ayırabilme ile ilgili olduğu göz önünde bulundurulursa bayanların erkeklere göre eğitimde teknoloji kullanımında materyal hazırlama ve ders planlama aşamalarına yönelik özgüvenlerinin daha yüksek olduğu görülmektedir.

Eğitimde teknoloji kullanımına yönelik özgüven, bir diğer değişken olan yaş açısından Oneway anova testi ile incelenmiştir. Anova testi sonuçları Tablo 2 ve Tablo 3'de yer almaktadır.

**Tablo 2.** Öğretmen adaylarının yaşlarına göre eğitimde teknoloji kullanımına yönelik özgüvenlerine ilişkin ortalama ve standart sapma değerleri

| Yaş    | N   | Xort   | S     |
|--------|-----|--------|-------|
| 19     | 27  | 115,22 | 11,63 |
| 20     | 60  | 116,90 | 15,07 |
| 21     | 49  | 114,14 | 15,01 |
| 22     | 25  | 120,28 | 10,50 |
| 23     | 15  | 115,67 | 21,74 |
| 24     | 3   | 87,00  | 22,34 |
| 24+    | 10  | 109,80 | 18,28 |
| Toplam | 189 | 115,44 | 15,39 |

Tablo 2' de görüldüğü gibi her yaştaki öğretmen adaylarının eğitimde teknoloji kullanımına yönelik özgüvenleri arasında küçük farklılıklar olduğu görülmektedir. Bunlar arasında en yüksek özgüvene sahip olan öğretmen adaylarının 22 ( $\bar{x}_{22}=120,28$ ) en az özgüvene sahip olan öğretmen adaylarının 24 ( $\bar{x}_{24}=87,00$ ) yaşında olduğu görülmektedir.

**Tablo 3.** Öğretmen adaylarının eğitimde teknoloji kullanımına yönelik özgüvenlerinin yaşları açısından karşılaştırılmasına ilişkin Anova testi sonuçları

| Varyansın Kaynağı | Kareler Toplamı | sd  | Kareler Ortalaması | F     | p    |
|-------------------|-----------------|-----|--------------------|-------|------|
| Gruplararası      | 3542,627        | 6   | 590,438            | 2,622 | ,018 |
| Gruplarıçi        | 40986,040       | 182 | 225,198            |       |      |

|        |           |     |  |  |  |
|--------|-----------|-----|--|--|--|
| Toplam | 44528,667 | 188 |  |  |  |
|--------|-----------|-----|--|--|--|

Tek faktörlü Anova testi ile ulaşılan sonuçların yer aldığı Tablo 3’de p değerinden de anlaşılmaktadır ki öğretmen adaylarının eğitimde teknoloji kullanımına yönelik özgüvenleri arasında anlamlı bir farklılık bulunmaktadır. Anlamlı farklılığın hangi yaşta olduğunu içeren Tukey testine bakılmış ve 24 yaşında olan öğretmen adaylarının 19-23 yaş arası olan öğretmen adaylarına göre anlamlı derecede daha düşük düzeyde özgüvene sahip oldukları bulgusuna ulaşılmıştır.

Öğrencilerden farklı sınıflarda olma ( $p=.186$ ), farklı liseden gelme ( $p=.052$ ), bilgisayarlarının varlığı ( $p=.407$ ) ve bilgisayar kullanma yılı ( $p=.151$ ) açısından aralarında anlamlı bir fark bulunmamıştır.

## Tartışma

Araştırma sonucunda görülüyor ki öğrenciler genel olarak eğitimde teknoloji kullanımına yönelik kendilerine güven duymaktadırlar.

Araştırmaya katılan öğretmen adaylarının eğitimde teknoloji kullanmaya yönelik özgüvenlerinin ölçüldüğü sorulardan internet’te arama motorları (google, altavista gibi) kullanabilme ile ilgili maddeye öğrenciler kesinlikle katıldıkları sonucu elde edilmiştir. Bu bulgu Erdemir, Bakırcı, Eyduran’ın (2009) bulgusuyla örtüşmektedir. Yine elde edilen verilere göre öğretmen adayları bilgisayarı ve interneti amaçlarına uygun olarak derste kullanabilme konusunda kendilerin yeterli görmekteyler. Öğretmen adaylarının bilgisayar ve internet kullanımı konusunda kendilerini yeterli görmeleri günümüzde bilgisayarın ve internetin yaygın olarak kullanımına dolayısıyla öğretmen adaylarının bu araçlara aşina olmasına bağlanabilir.

Anket maddelerinden çevre koşulları ve mevcut olanaklar kullanılarak, özgün ve ekonomik açıdan uygun, basit öğrenme materyalleri hazırlayabilmek, iletişim teknolojilerini amaçlarına uygun olarak derste kullanabilmek, öğretim materyallerini amacına uygunluğu açısından değerlendirebilmek, öğretim materyallerini ve araç-gereçlerini tasarım ilkelerine uygunluğu açısından değerlendirebilmek, bir öğretim materyalinin nasıl değerlendirileceği ile ilgili plan yapabilmek, amaç, hedef, davranış analizi yapılmış bir derste, öğretilecek konuları parçalara ayırabilmek ile ilgili maddeler bayanlar lehinde daha yüksek çıkmıştır. Elde edilen bu sonuca göre bayanların erkeklere göre eğitimde teknoloji kullanımında ders materyalleri hazırlayabilme ve ders planlama aşamalarını gerçekleştirmede kendilerine daha fazla güven duydukları söylenebilir.

Araştırmaya göre BÖTE öğretmen adaylarının eğitimde teknoloji kullanımına yönelik özgüvenleri kadınlarda daha yüksektir.

Öğretmen adaylarından 24 yaşında olanlar 19-23 yaş arası olanlara göre daha düşük düzeyde özgüven sahibidirler. Öğretmen adaylarının bilgisayarlarının olup olmaması açısından aralarında anlamlı bir farklılık bulunmamıştır. Can, Yorulmaz ve Kahya’nın (2011) okulöncesi öğretmenler üzerinde yaptıkları araştırmalarında öğretmenlerin bilgisayarlarının olması ile eğitimde bilgisayar kullanımına yönelik tutumları arasında anlamlı bir ilişki bulunamamıştır. Bu bulgu araştırmanın bulgusuyla tutarlıdır.

Öğretmen adaylarından farklı sınıflarda olma, farklı liseden gelme, bilgisayarlarının varlığı ve bilgisayar kullanma yılı açısından aralarında anlamlı bir farklılık bulunmamıştır.

Araştırma sonuçlarına bakıldığında eğitimde teknoloji kullanımı ile ilgili cinsel farklılıkların ortadan kaldırılması için bazı ek etkinlikler yapılması ihtiyacı hissedilmektedir. Bu etkinlikler teknoloji konusunda öğretmen adaylarının eksik bilgilerini ve çekincelerini keşfetme ve ihtiyaç duyulan bilgilerin öğretmen adaylarına verilmesini içermelidir. Bu sayede öğretmen adaylarının özgüvenlerinde olumlu yönde bir değişim elde edilebilir. Ayrıca eğitimde teknoloji kullanımıyla ilgili seminerler verilebilir ve konuyla ilgili sosyal paylaşım ortamları oluşturularak öğretmen adaylarının birbirlerinin tecrübe ve fikirlerinden yararlanmaları sağlanabilir.

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# CEMENT STABILIZATION OF COMPACTED EXPANSIVE CLAY

**Mahamedi Abdelkrim, Khemissa Mohamed**

Geomaterials Development Laboratory, Civil Engineering Department,  
Faculty of Technology, M'sila University, P.O. Box 166 Ichbilia 28000 M'sila, Algeria  
Corresponding Author: khemissa@univ-msila.dz

**Abstract:** This paper presents and analyzes the results of a series of laboratory tests of compaction, penetration and free swelling performed on an expansive clay obtained from a site situated in Sidi-Aissa city (wilaya of M'sila, Algeria), where important disorders frequently appears in the road infrastructures and in the small buildings. Tests results obtained show that the parameters values deduced from these tests are concordant and confirm the bearing capacity improvement of the expansive clay treated with cement.

**Key words:** Expansive clay, stabilization, cement, bearing capacity, Proctor, CBR, free swelling.

## Introduction

Urban areas of the wilaya of M'sila in Algeria nowadays experience a considerable development because of an unceasingly increasing demography, from where its extension towards virgin zones often less favorable than those already urbanized. This wilaya is located in a zone classified as semi-arid, characterized by weak precipitations and significant variations in temperature between winter and summer (cold and wet winters and hot and dry summers). Geology of this zone comprises clays formations characterized by a high variation of volume when the conditions of their equilibrium are modified (natural climatic phenomena due to a prolonged dryness, human activity by modification of the ground water level because of excessive pumping, configuration of constructions in their environment). A former study shows that these natural clays are very over-consolidated, low permeable and very low sensitive to creep (Khemissa et al., 2008); their overconsolidation being due to the phenomenon of shrinkage resulting from a more-or-less thorough desiccation. The use in fills and in base and sub-base courses, in the natural state of this clay, is normally not considered. At dry state, it is very difficult to compact since its consistency varies from hard to very hard and, at wet state, it is very sticking. However, its employment can be possibly decided on the basis of specific treatment with cement.

This paper presents the results of a study carried out on expansive clay obtained from a site situated in Sidi-Aissa city (wilaya of M'sila, Algeria), where significant disorders frequently appear in the road infrastructures and in the small buildings. Study carried out aims at determining the physical and mechanical parameters of this clay treated with an artificial Portland cement locally manufactured in Lafarge Company of Hammam Dalâa (wilaya of M'sila, Algeria). Influence of treatment on its mechanical properties is then analyzed.

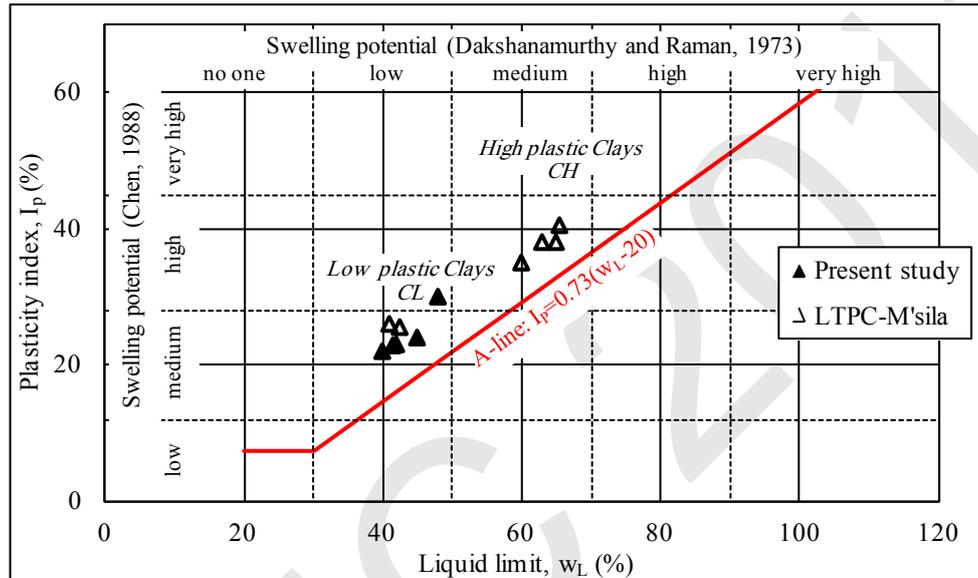
## Brief Description of the Studied Clay

The soil samples used were collected between 1.5 and 2.0 m of depth in a waste area intended to receive a project of 200 residences located in Sidi-Aissa city (wilaya of M'sila, Algeria). Table 1 gives the identification test results carried out on these samples. These low dispersed values for the carried out sampling seem to indicate a homogeneous soil massif. The sieve analysis of soil samples tested indicates that they are composed of 15% sand and 85% fillers (silt+clay), which can be classified, according to Bureau of soils triangular chart for textural classification, as silty clay. The Methylene blue values indicate a muddy-clayey soil with traces of montmorillonite. According to French classification (Magnan, 1980) compatible to the Unified Soil Classification System (USCS), it is about low plastic muddy clay (CL), very consistent with normal activity of its clayey fraction. The modifications of its water content are accompanied by shrinkage or swelling. The Casagrande plasticity chart adapted to expansive soils shows that this clay is characterized by a weak-to-medium swelling potential according to Dakshanamurthy and Raman (1973) and by a medium-to-high swelling potential according to Chen (1988) (Figure 1). Also, classifications of Seed et al. (1962), Ranganatam and Santyanarayana (1965), Williams and Donaldson (1980) and Bigot and Zerhouni (2000) indicate a medium-to-high swelling potential. In addition, Building Research Establishment classification (BRE-UK 1980) led to a medium-to-high shrinkage potential.

**Table 1.** Geotechnical properties for Sidi-Aissa clay (wilaya of M'sila, Algeria)

| Parameters                                       | Range of variation | Mean values |
|--|--------------------|-------------|
| Natural water content, $w_{nat}$ (%)             | 14.63-16.20        | 15.26       |
| Wet unit weight, $\gamma_w$ (kN/m <sup>3</sup> ) | 21.26-21.62        | 21.43       |

|  |             |       |
|--|-------------|-------|
| Dry unit weight, $\gamma_d$ (kN/m <sup>3</sup> ) | 18.49-18.68 | 18.59 |
| Liquid limit, $w_L$ (%)                          | 40.37-48.39 | 43.80 |
| Plastic limit, $w_P$ (%)                         | 18.14-21.00 | 19.04 |
| Plasticity index, $I_P$ (%)                      | 21.87-30.25 | 24.76 |
| Methylene blue value, VBS (%)                    | 5.23-5.80   | 5.56  |
| Over to 0.080 mm                                 | 85.31-86.09 | 85.70 |
| Over to 2 $\mu$ (µm)C                            | 24.2-55.0   | 37.6  |
| Activity of clay, $A_c$                          | 0.4-1.7     | 0.90  |
| Optimum water content, $w_{opt}$ (%)             | -           | 11.1  |
| Maximum dry density, $\gamma_{dmax}$             | -           | 1.93  |
| Swelling pressure, $\sigma_s$ (kPa)              | -           | 195   |
| Free swelling, $\Delta_s$ (%)                    | -           | 18.44 |



**Figure 1.** Classification of Sidi-Aissa clay (wilaya of M'sila, Algeria)

## Experimental Program and Test Procedures

Experimental program comprises modified Proctor compaction tests, California bearing ratio tests and free swelling tests. These tests were performed on untreated soil (control sample) and on treated soil with various contents of an artificial Portland cement called CHAMIL (CPJ-CEM-II/B 32.5 R NA 442). Cement used is locally manufactured in Lafarge Company of Hammam Dalâa (wilaya of M'sila, Algeria). Physical and chemical properties for this cement are given in table 2.

**Table 2.** Physical and chemical properties for CHAMIL cement

| Physical properties                    |                 |
|--|-----------------|
| Normal consistency of the cement paste | 27-31           |
| Blaine Fineness                        | 4550-5500 $\mu$ |
| Initial setting                        | 120-180 min     |
| End setting                            | 200-300 min     |
| Compressive strength at 28 days        | 3.25-5.25 MPa   |
| Chemical composition                   |                 |
| Loss on ignition                       | 12-15 %         |
| Soluble residues                       | 0.8-1.3 %       |
| Sulfates                               | 1.9-2.1 %       |
| Magnesium Oxide                        | 1.7-2.1 %       |
| Chlorides                              | 0.01-0.03 %     |
| Tricalcic Silicates                    | 55-62 %         |
| Content alkalis                        | 6.5-8.2 %       |

Cement contents considered are 0% for untreated sample (control sample), 1%, 2%, 3%, 4%, 5%, 6%, 7% and 8% by weight for treated samples. The samples were made starting from mixture of the necessary quantity of finely crushed dried soil to desired cement content; the whole being intimately mixed at dry then humidified with optimum water content  $w_{opt}$  (i.e. maximum dry density  $\gamma_{d-max}$  corresponding to optimum Proctor). The paste was remixed thoroughly before performing the compaction. All tests were conducted at room temperature.

Experimental procedures followed in each test type were in conformity as much as possible with the usual testing methods. Interpretation techniques of the test results adopted are many inspired from the knowledge obtained on clayey soils throughout the world.

Figure 2 presents the modified Proctor compaction test results conducted on the clay treated with various cement contents under optimum Proctor conditions ( $w_{opt}$  and  $\gamma_{d-max}$  given on untreated soil). These results constitute a pledge of good repeatability of the compaction test and indicate a good reconstitution of the soil under the necessary conditions to which the soil massif is expected to be subjected in the field.

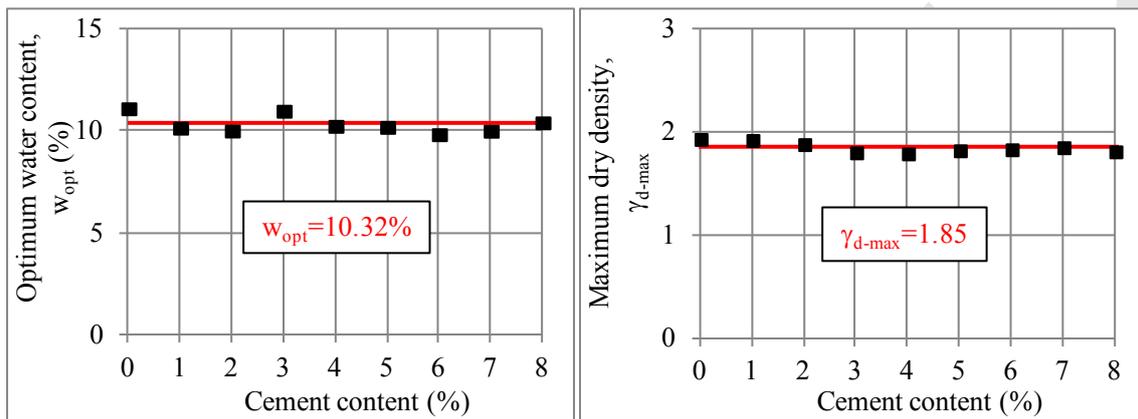


Figure 2. Compaction test results for various cement contents under optimum Proctor conditions

## Test Results and Discussion

Only the principal results interesting the object of this paper are exposed hereafter, i.e. influence of the cement treatment on the strength and deformability properties of compacted expansive clay.

### Characteristics of swelling

Figures 3 and 4 present the evolution curves of the swelling pressure of clay and of the corresponding free swelling according to the cement content.

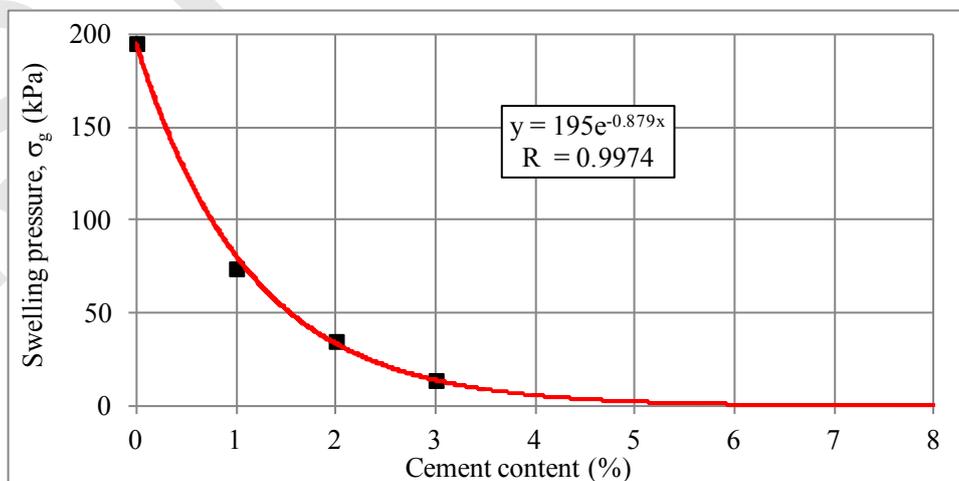
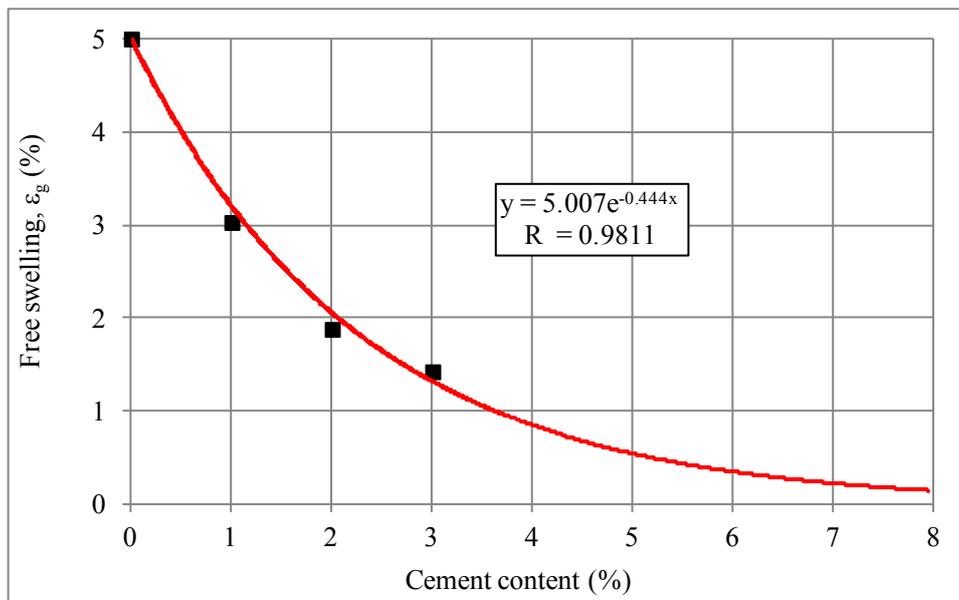


Figure 3. Swelling pressure of the clay versus cement content

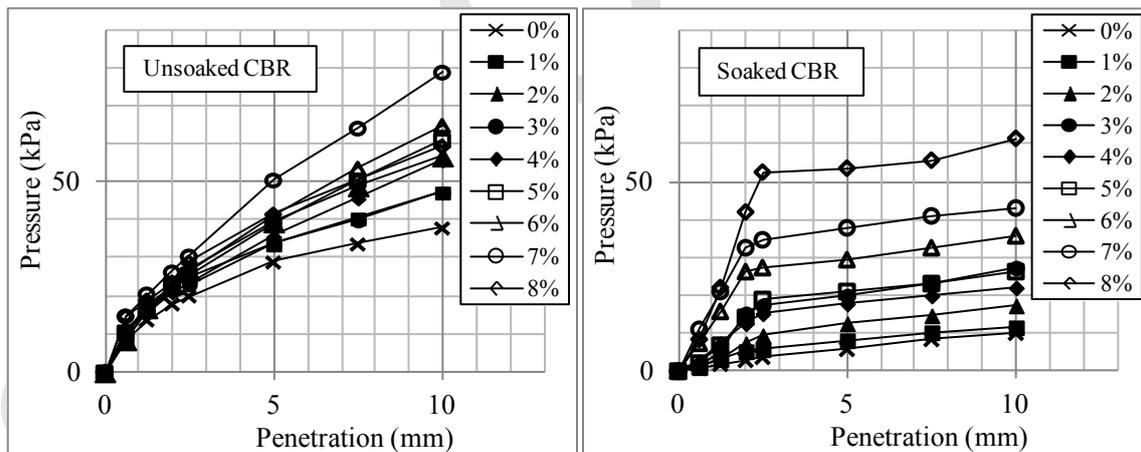


**Figure 4.** Free swelling of the clay versus cement content

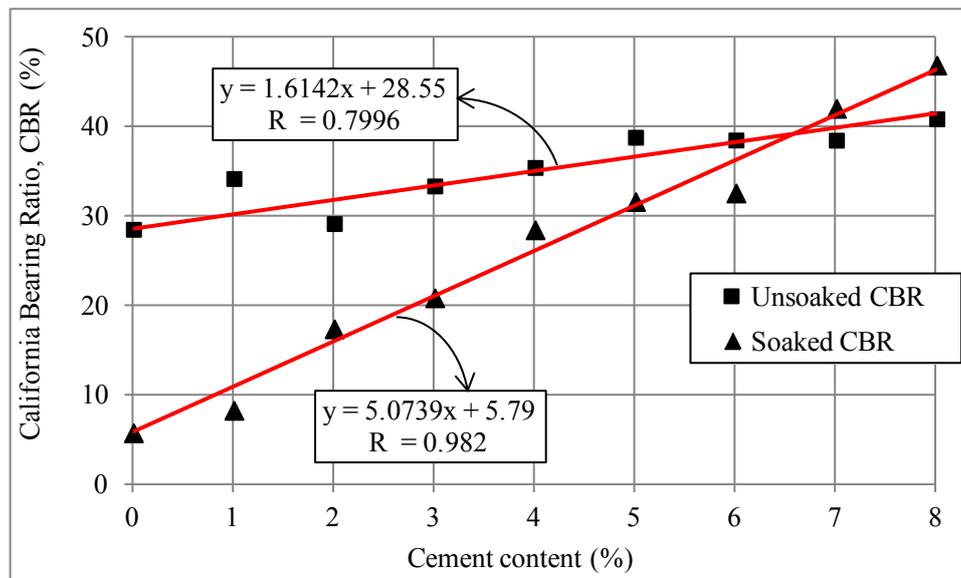
It can be noted that the swelling pressure of clay and the corresponding free swelling decrease in an appreciable way with cement content. This mitigation is due to the soil stabilization by effect of cementing, which seems to indicate that the clay becomes insensitive with swelling from 3% of cement content roughly.

### California Bearing Ratio (CBR)

Figure 5 presents the load-penetration curves of samples tested before and after their soaking for various cement contents. Figure 6 presents the corresponding unsoaked and soaked CBR values according to the cement content.



**Figure 5.** Pressure versus penetration curves for various cement contents



**Figure 6.** Californian bearing ratio values versus cement content

It can be noted that the unsoaked and soaked CBR values increase linearly with cement content. The treatment of this clay with cement is translated, in both cases, by a clear improvement of its bearing capacity and a very sensitive lowering of its deformability resulting from an excessive humidification after her compaction under the optimum Proctor conditions.

## Summary and conclusions

This paper has the aim of characterizing the laboratory behavior of expansive natural clay treated with cement for its use in the road works as roadway foundation (fills, base and sub-base courses). Choice of Sidi-Aissa urban site (wilaya of M'sila, Algeria) was justified because of its extension towards zones at risk, where significant disorders frequently appear in road infrastructures and in small buildings.

The soils tested were identified as low plastic muddy clay. Various classifications based on the geotechnical properties show that this clay is characterized by a medium-to-high swelling and shrinkage potentials; swelling and shrinkage being to some extent due to the mineralogical structure of soils (presence of montmorillonite) and to the variations of their water content (cycles of desiccation-humidification of soils).

Treatment of this clay was carried out by using an artificial Portland cement locally manufactured in Lafarge Company of Hammam Dalaa (wilaya of M'sila, Algeria). Tests results obtained make it possible to show a sensitive improvement of the mechanical properties of expansive clay compacted under the optimum Proctor conditions. Moreover, it can be noted that the treatment allows:

- to decrease the swelling pressure of clay and the corresponding free swelling, clay becomes no expansive and better compactable;
- to increase the unsoaked and soaked CBR, allowing of this fact of increasing the bearing capacity of clay and reduction of its expansibility.

Performances acquired by this expansive clay treated with cement get stability, durability and better resistance.

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## CERAMIZABLE SILICONE RUBBER COMPOSITES – A SAFE SOLUTION FOR CABLE WIRE COVERINGS

Zbigniew Pędzich\*, Dariusz M. Bieliński\*\*, Rafał Anyszka\*\*, Jan Dul\*\*\*, Grzegorz Parys\*\*\*

\* - AGH - University of Science & Technology,

Department of Ceramics and Refractories, Krakow, Poland

\*\* - Lodz University of Technology,

Institute of Polymer & Dye Technology, Poland

\*\*\* - Institute of Polymers and Dyes Engineering,

Division of Elastomers & Rubber Technology, Piastow, Poland

pedzich@agh.edu.pl; dbielin@p.lodz.pl

**Abstract:** After the concise information on ceramization phenomena the brief state-of-the-art in the field of ceramizable silicone rubber-based composites is presented. Usually the composites are made of silicone rubber - silica compounds filled with Ca- or Al-based mineral fillers combined with fluxing systems. Phenomenon of ceramization is based on preventing volatiles of thermal decomposition of silicone rubber from evacuation by creation of ceramic layer on composite surface. Usually, the layer is composed of mineral filler particles, connected by fluxing agent. The ceramic barrier created is aimed to protect copper wire inside the cable from melting, being additionally strong enough to maintain integrity of electrical circuit. The paper presents experimental data on mechanical properties of silicone rubber composites, morphology and strength of their ceramized layer and associated thermal characteristics and flammability of materials. The results are discussed from the point of view of material composition, kind, size and surface modification of mineral fillers.

**Key words:** silicone composites, ceramization, mechanical strength, thermal properties.

### Introduction

Flame resistant coverings of electrical cables play very important role from the point of view of electrical installation performance under fire. Apart obligatory conditions concerning: self-extinguishness, low heat of combustion, limited flame expansion and emission of toxic gases, the material for cable coverings should secure the integrity of electrical circuits at high temperature. It gives time indispensable for evacuation from buildings or any mean of public transportation on fire, supporting working of power supply and steering of fire protection systems. In Europe there are two existing standards: EN 50200 and IEC 60331-31:2004, according to which electrical cables are classified from the point of view of their fire durability. Time of correct performance of electrical cable, subjected to the action of fire at temperature 830 – 870°C, reflects its class of flame resistance, e.g. PH90 - 90 min.

Materials applied for coverings of PH class electrical cables are silicone rubbers filled with silica, mica (muscovite) and other components, able to form relatively quickly compact and stiff protecting coating, strong enough to maintain integrity of electrical circuit, even up to melting temperature of metal core [1]. Such materials became commercially available from the beginning of running century (Corning Dow and Wacker Chemie). Since that time we are witness of permanent progress in the field.

The paper discusses their influence on ability of silicone rubber – silica composites, additionally containing wollastonite, muscovite, calcium and aluminium hydroxides or montmorillonite, to ceramization. The fillers differ according to their content, aspect ratio, dimensions and size distribution of particles. Performance of the composites during fire testing has been explained based on the results of their thermal analysis (TGA /DSC and microcalorimetry), as well as morphological studies (microporosimetry and SEM) and breaking strength analysis of ceramized phase produced during fire or heat treatment.

### Materials and Method

Four commercial silicone rubber composites of various origin, designated as: F, S, W and N, used for insulation of electrical cables, were the subject of our studies. Detailed information on their composition remains confidential. Nevertheless, from our previous work<sup>2</sup> it follows, that the materials have similar base made of silicone rubber filled with pyrogenic silica in the amount of ca. 50 phr. Another 50 phr of fillers, being admixed to the base, are constituted mineral phase, which differs significantly according to composition and the kind of components – Table 1.

**Table 1:** Mineral phase components and composition of the silicone composites studied.

| Silicone composite | Mineral phase composition [wt %]   |                            |           |      |                     |                                 |                     |
|--------------------|------------------------------------|----------------------------|-----------|------|---------------------|---------------------------------|---------------------|
|                    | Wollastonite<br>CaSiO <sub>3</sub> | Quartz<br>SiO <sub>2</sub> | Kaolinite | ZnO  | Mica<br>(Muscovite) | Gibbsite<br>Al(OH) <sub>3</sub> | Portlandite<br>CaOH |
| F                  | -                                  | -                          | -         | 35.5 | 64.5                | -                               | -                   |
| S                  | -                                  | 96.5                       | 3.5       | -    | -                   | -                               | -                   |
| W                  | -                                  | -                          | -         | -    | -                   | 96.7                            | 3.3                 |
| N                  | 52.0                               | 40.2                       | 7.8       | -    | -                   | -                               | -                   |

Composites studied were ceramized under various conditions:

- by firing in an open flame (measured temperature exceeded 1000°C) with 2 min. soaking time, or
- by heating in a Linntherm (Germany) laboratory furnace, from room temperature up to 600, 800 and 1000°C with heating rate of 20°C/min., followed by 20 min. of soaking.

Methods:

Thermal analysis of the composites was performed by Differential Scanning Calorimetry/Thermogravimetry (DSC/TG) using a Netzsch STA449F3 Jupiter instrument (Germany), operated with a heating rate of 20 deg/min. Heat releasing rate of the composites was determined by Pyrolysis Combustion Flow Calorimetry (PCFC) with a Fire Testing Technology micro-calorimeter (USA), according to ASTM D7309-2007 standard.

Microstructure of the composites subjected to ceramization was analyzed by Scanning Electron Microscopy (SEM) with a FEI & Oxford Instruments Nova Nano SEM 200 apparatus (The Netherlands). Prior to observations sample crosssections were carbon coated to avoid charging.

Pore size distribution of ceramized composites was determined with a Quantachrome Poremaster 60 mercury porosimeter (USA).

Shrinkage of the composites due to heat treatment was calculated from changes to the dimensions of cylindrical specimens of radius  $r_0 = 16$  mm and of height  $h_0 = 14$  mm:

$$W_h = \frac{h_1}{h_0} \cdot 100\% \quad W_r = \frac{r_1}{r_0} \cdot 100\%$$

where:

$h_0, r_0$  – dimensions of virgin sample

$h_1, r_1$  – dimensions of heat treated samples.

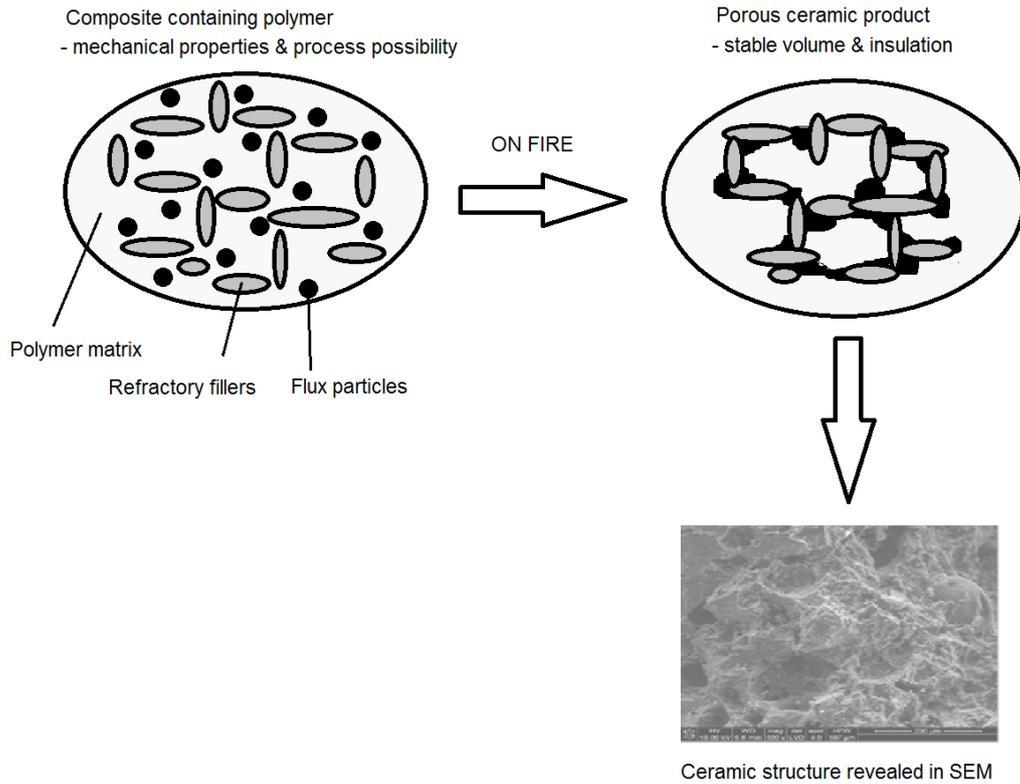
The same heat treated specimens were subjected to compression tests using a Zwick Roell Z2.5 instrument (Germany). Mechanical strength of the ceramized composites was each time calculated as an average value of 5 determinations.

## Results and Discussion

It has been proved that after pyrolysis at high temperature some mineral additives are able to form a ceramizable residue in silicone rubber composite [2]. This residue, due to the reaction between inorganic fillers and silica issued from the decomposed polymer matrix, forms an eutectic liquid phase at the edges of the fillers, able to penetrate into the matrix region [3]. The extent of eutectic formation was shown to be influenced by factors such as particle size and chemical composition of the fillers.

The residue of fired silicone rubber or silica filled elastomer exhibit a form of white powder. There is no evidence of solidification of silica particles, even after heating at 1100°C. However, the addition of mica (ca. 20 phr) results in eutectic reaction (starting already at 900°C) between mica particles and silica matrix, producing a liquid phase around their surface, what facilitates binding. At lower firing temperatures (600°C) the problem of binding between the product of pyrolysis (silica) and filler comes back, what results in formation of fragile surface shield.

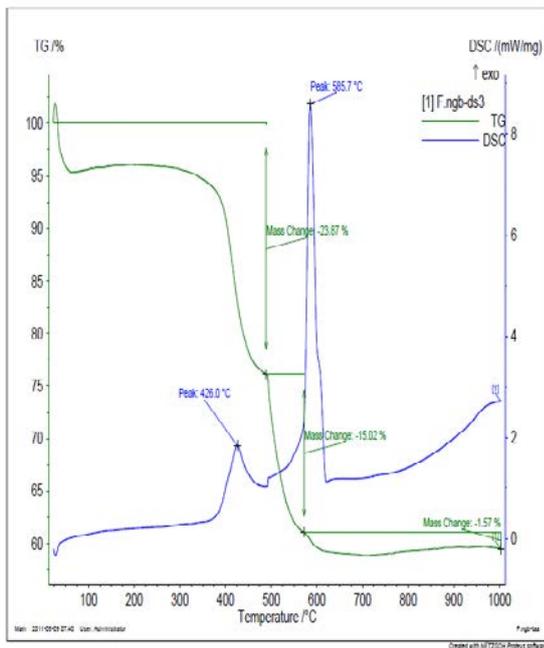
The problem can be overcome by the addition of certain inorganic materials to the silicone rubber - mica composite, e.g. glass frits, zinc oxide, ferric oxide and zinc borate, facilitating formation of a strong ceramic, required by electrical cable application, at lower temperature. Hamdani *et al.* [4, 5] reported on application of Ca-based (CaO, Ca(OH)<sub>2</sub>, calcite – CaCO<sub>3</sub>, wollastonite – CaSiO<sub>3</sub>) or Al-based (Al<sub>2</sub>O<sub>3</sub>, Al(OH)<sub>3</sub>, boehmite – AlOOH, mica, montmorillonite) refractory fillers for silicone rubber. In a combination with an adequate selection of flux agents, shifting the melting of ceramic phase to lower temperatures, it results in the ceramization process taking place simultaneously to degradation of a polymer matrix. Integral ceramic layer, being created on its surface, prevents volatile products of silicone rubber decomposition [6, 7] from evacuation, what makes it porous – Figure 1 [8].



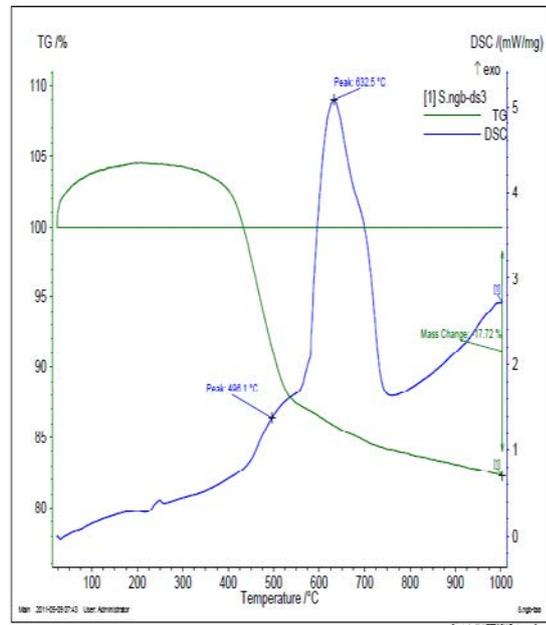
**Figure 1:** Scheme illustrating ceramization process of polymer composites.

Incorporation of mineral fillers to silicon rubber matrix changes thermal properties of the composites – Figure 2.

a) composite F

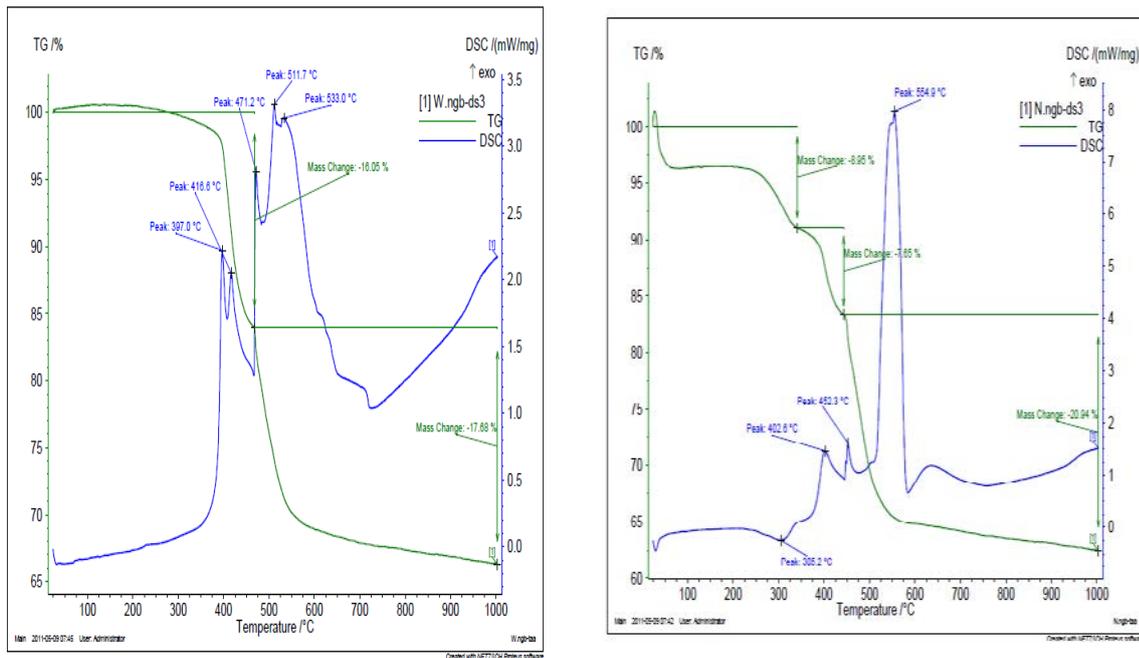


b) composite S



c) composite W

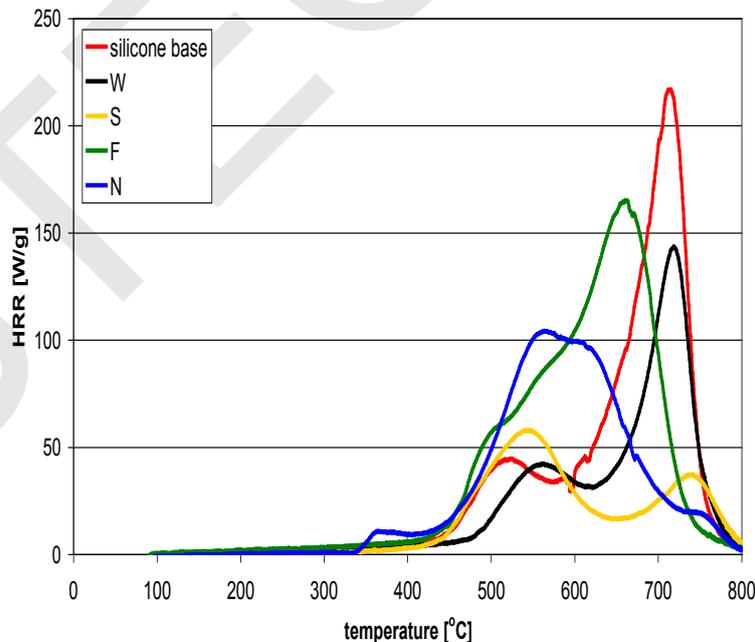
d) composite N



**Figure 2:** Results of DSC/TG analysis of the silicone composites studied.

From the results of TG analysis it follows, that the composites studied exhibit different temperature range of thermal decomposition of silicone rubber. It means that polymer phase disappears from the system with various efficiency, depending on the composition of its mineral phase. The process is practically already finished at ca. 600°C for the composite F, needs another 20-30 deg to be completed for the materials W and N, whereas the composite S requires temperature even exceeding 800°C. It decides the composition of flux required for each of the composites and determines temperature range in which their ceramization process can take place effectively.

Admixing of mineral fillers to the silicone base makes heat release rate (HRR) of the composites decreased – Figure 3.



**Figure 3:** Heat release rate (HRR) of the composites studied.

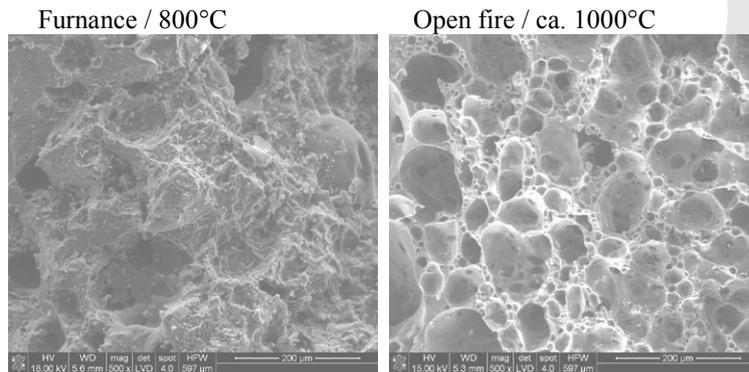
The highest effect is observed for the composite S, which represents the lowest heat release values. Despite the maximum of HRR curve for the material appears in the shortest time, another maximum in the longest time is present as well. The material N combusts at similar time, but more vigorously. The composite F seems to be the worst material,

according to flame resistivity. It releases the highest heat in a comparatively short time.

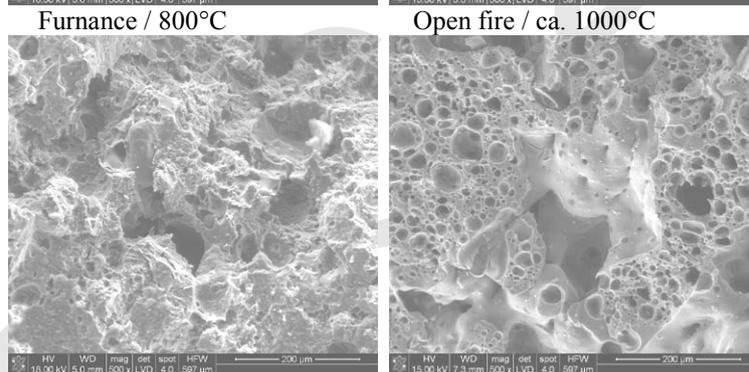
SEM analysis of the composites subjected to ceramization makes possible to reveal the influence of heat treatment conditions on structure of the materials – Figure 4.

Microscopic analysis of samples ceramized in a laboratory furnace at 800°C (see the left column pictures in Figure 4) demonstrates significant differences among the composites studied. The material N contains the highest amount of pores, contrary to other composites, for which pores are more difficult to be identified. Detailed information on pore size distribution of the composites studied is presented in Figure 5.

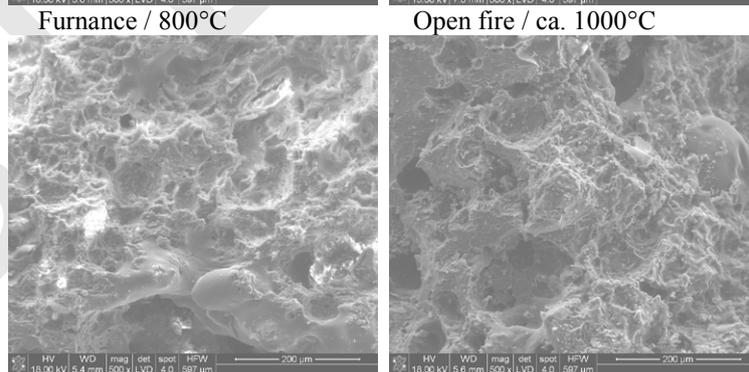
a) composite F



b) composite S

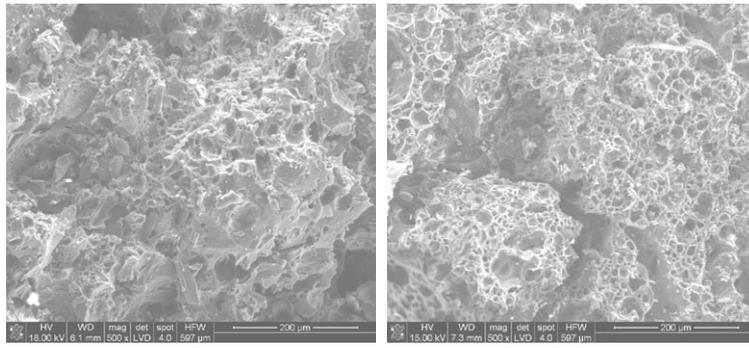


c) composite W

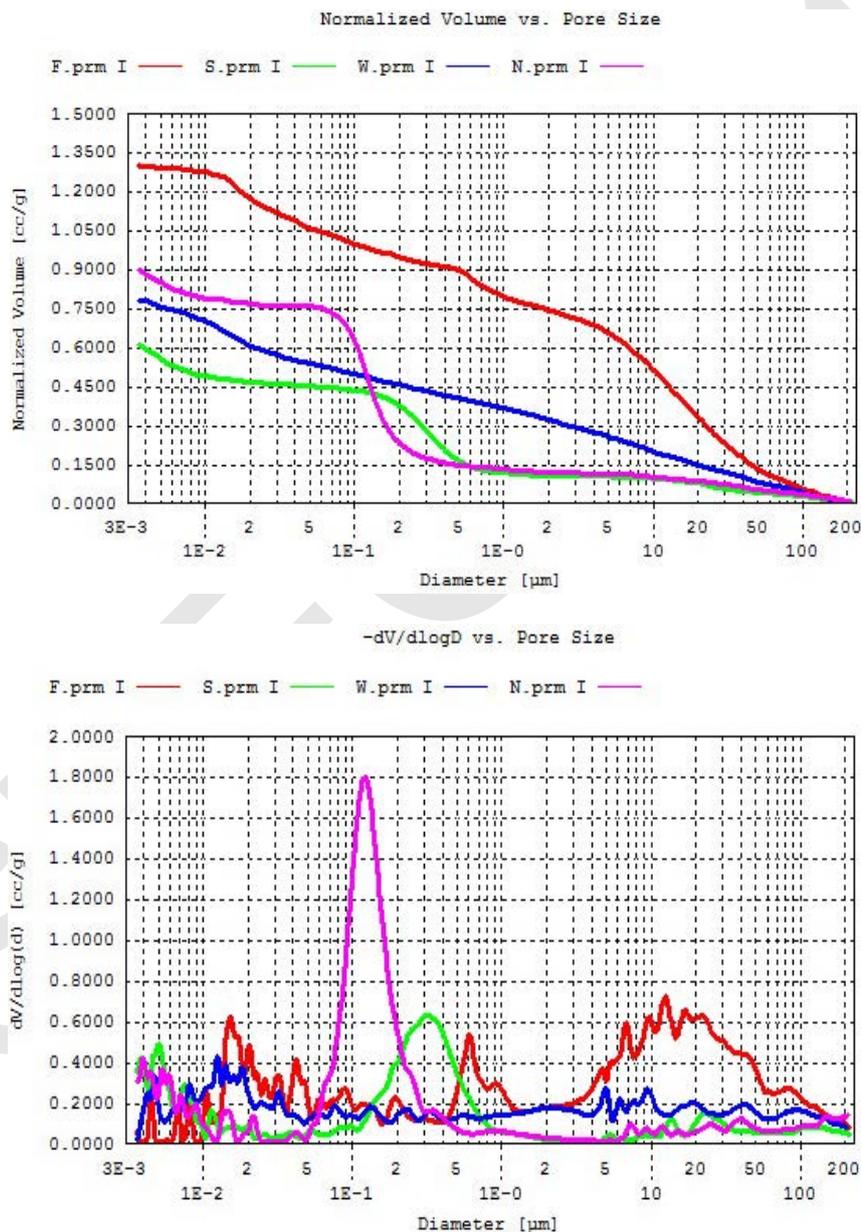


d) composite N





**Figure 4:** SEM images of the composites studied after ceramization: furnace heated at 800°C (left), fired in an open flame (right).



**Figure 5:** Pore size distribution for the composites studied after ceramization at 800°C.

The porosity of composites N and to small extent S, contrary to the other materials studied, is represented by two population of pores: sub-micro and micro ones.

Porosity of the composites depends on ceramization conditions (see the right column pictures in Figure 4). The smallest pores, of sub-micrometer dimensions, disappear when the materials have been fired directly in a flame. The

total degree of material porosity also decreases, what has been found to be dependent on the kind of mineral fillers applied [2, 9]. The smallest changes to porosity have been observed for the composites containing wollastonite (N), which additionally characterizes themselves by the smallest mass loss accompanied the increase of temperature and heating rate [10].

Created ceramic phase should exhibit limited thermal shrinkage, what allows to avoid problems concerning breaking or delamination of the surface layer from a polymer substrate [11]. Apart good heat insulation, prolonging the time to material ignition and the decrease of a heat release during fire, the micro-porous structure has to be strong enough to maintain the integrity of an electrical circuit. The comparison between the composites studied is given in Table 2.

**Table 2:** Mechanical strength and shrinkage parameters of the composites studied after ceramization

| Parameters | Furnance / 800°C   |                    |                    | Open fire / ca. 1000°C |                    |                    |
|------------|--------------------|--------------------|--------------------|------------------------|--------------------|--------------------|
|            | W <sub>h</sub> [%] | W <sub>r</sub> [%] | Breaking force [N] | W <sub>h</sub> [%]     | W <sub>r</sub> [%] | Breaking force [N] |
| Composite  |                    |                    |                    |                        |                    |                    |
| F          | 78.93              | 111.84             | 7.8                | 83.62                  | 104.23             | 32.3               |
| S          | 91.19              | 112.35             | 1480               | 96.94                  | 103.36             | 188.0              |
| W          | 86.55              | 107.51             | 16.3               | 97.73                  | 110.23             | 54.4               |
| N          | 97.21              | 108.30             | 86.0               | 79.64                  | 92.08              | 130.0              |

Thermal conditions of ceramization strongly influence shrinkage and mechanical strength of the composites studied. Generally, the higher shrinkage of material the lower strength of ceramized composite. The composite N is the only one which shrinks significantly when subjected to direct fire.

## Conclusions

Mechanical strength of ceramized composites depends on the kind of minerals and composition of mineral phase admixed to a silicone rubber-silica base. Performed investigations allowed us to evaluate the differences in structure of ceramic phase being formed. Composites containing muscovite and wollastonite have relatively big porosity, contrary to materials with quartz and calcined kaoline as well as aluminium hydroxide, exhibiting low porosity level.

The most important for ceramization process is degradation of polymer base, taking place usually in the temperature range from 600÷800°C, when mineral components do not interact strongly each other. In a composite for which decomposition of silicone rubber can be shifted to higher temperature, ceramized phase created exhibits the sub-micron porous structure of the highest durability.

Carried out experiments revealed also differences in ceramization effects associated with thermal conditions of the process. Ceramization performed in an open flame at ca. 1000°C led to ceramic structures distinctly different in porosity and pore size distribution in comparison to the materials gradually heated in a furnace up to 800°C. Generally, firing of the composites in an open flame produces materials of low porosity, without small pores. As a result of the process carried out at lower temperature in a furnace the highly porous ceramic phase of very wide pore size distribution range is created.

It was established that a composite with wollastonite (N) showed the most stable structure and properties. Its porosity was the least dependent on thermal conditions of ceramization, leaving considerable amount of sub-micron pores up to the highest temperatures. It should be profitable from the application point of view, because of potential increase of fracture resistance of ceramized composite and a decrease of its thermal conductivity.

Conclusions listed above could be helpful in design of optimal microstructure of silicone composites dedicated for fire resistant applications, e.g. in cable industry.

## Acknowledgements

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# CHARACTERIZATION AND ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL OF *NIGELLA SATIVA*

BESSEDIK Amina\*, Allem Rachida,  
Laboratory for Local Natural Bioresources  
Faculty of Science  
Hassiba Benbouali University of Chlef (Algeria)

**Abstract:** The aim of our work is to test the antimicrobial effects of essential oil extracted from *Nigella sativa* strains on gram+ and gram- (*Staphylococcus aureus*, *Echerechia coli*, *Klebsiella*). The study is based on extraction by steam distillation and analysis of organoleptic and physico-chemical properties of the essential oil of Nigel. The examination of the organoleptic properties of this essential oil shows that it is relatively comparable to those cited in the AFNOR. The antibacterial and antifungal properties of this oil reveal an important anti-microbial effect. Moreover, it shows an excellent activity against the Gram + strains studied compared to Gram-strains. The essential oil of black cumin possesses a very interesting antimicrobial effect against the pathogenic bacteria and fungi studied so far.

**Key words:** Antimicrobial effect, essential oils, *Staphylococcus aureus*, medicinal plants.

## Introduction

Commonly called in the past essences, essential oils are oily substances, very odorous and volatile. They have a high biological activity as antibacterial, antiviral, antifungal and antioxidant (Aligramus et al., 2001, Salehi et al., 2005; Abdelwahab et al., 2011). They are also used in anti-cancer treatment (Sylvestre et al., 2006).

Essential oils are complex mixtures of products which deriving from the terpenes (monoterpenes and sesquiterpenes) which are hydrocarbons of general formula  $(C_5H_8)_x$  (Mohamed et al., 2010). The oxygenated compounds which are derived from these hydrocarbons are alcohols, aldehydes, esters, ethers, phenols and oxides.

The aim of this work is to study the molecular composition of the essential oil of Nigel (GC / CM) and its inhibitory action against terrible pathogens for humans.

## Material and Methods

- **Extraction of essential oil:** The biomass used for the extraction of the essential oil are grains of *Nigella sativa* grown in Syria (2011 harvest). The extraction method is steam distillation, the solvent used is diethyl ether. The retrieved essential oils are stored in tinted glass bottles placed in a cool, dry place at 4 ° C and protected from light in a Clevenger type apparatus according to the technique described by Simard et al. (1988). An organoleptic character set of these oils has been achieved.
- **Chemical analysis of samples:** In order to identify their active ingredients, *Nigella sativa* seeds have been studied by photochemistry which revealed that these grains are much richer in secondary metabolites whose content varies according to the geographic and climatic conditions as well as the research methods (extraction and detection).

Our essential oil was analyzed on a Hewlett-Packard gas chromatograph of type Agilent 6890N controlled by ChemStation (NIST 98) and equipped with a capillary column HP5MS (30m x 0.25 mm x 0.25  $\mu$ m) coupled to a mass spectrometer (SM) type Agilent 5973. The analytical conditions are as follows:

- Injection of 0,5  $\mu$ l in split mode 1/50
- Injection Temperature 250°C
- Capillary column HP5MS (30m x 0,25mm x 0,25  $\mu$ m)
- Temperature programming: 50°C during 0 min, 4°C/min until 250°C during 30 min.

- Flow of carrier gas: Helium (1 ml/min), mass spectrum model Agilent 5973
- Temperatures: interface (280°C), strains (230°C), quadripole (150°C).
- **Identification of components:** The various constituents of the essential oil were identified by comparing their mass spectra with those of the compounds of the databases WILLET and NIRST 98, the mass spectrometer GC/MS and those of Adams spectral databases. The identification of the molecules was confirmed by comparison of their retention indices with those known in the literature (Adams 2001). Retention indices of the compounds were calculated using the retention time of a series of n-alkanes using a linear interpolation.
- **Study of the antimicrobial effect:** The method used is the holder-germs disks. It is based on the principle of impregnating disks with oil and seeding petri dishes by the pathogenic bacteria. This method is described by Carson et al. (1995). The bacteria used in this work are: *Escherechia coli ATCC 25922*, *Enterococcus faecalis 8V*, *Salmonella typhi*, *Proteus mirabilis*, *Pseudomonas aeruginosa ATCC 27583*, *Staphylococcus aureus ATTC 6538*, *Klebsiella pneumonia*. These bacteria are isolated from hospital samples. They have been identified in the microbiology laboratory of the Hassiba Benbouali University Chlef, Algeria.

## Results and discussions

*Nigella sativa* seeds reveal a moisture content of 7.21%. The yield of essential oils is 1.38%. Note that Imikraz (2006) obtained a yield of 1.5%, the highest yields of essential oils are collected during the flowering period (May-June) (Willem, 2004).

The physical and organoleptic properties provide a means of verification and quality control. The tests are determined according to a specific protocol and obeying standards set by AFNOR (1989). The appearance of the oil is liquid, oily, clear, and its smell is strong, specific and characteristic of the crushed seed. Its color is greenish yellow. Concerning its physical characteristics, it has a density of 0.76 g / l, its refractive index is 1.3770 and its optical rotation is 20 °.

The chemical analysis showed that our oil is rich in monounsaturated fatty acids such as oleic acid. There are also monoterpenes such as beta-phellandrene, beta-pinene, the limonene, and sesquiterpenes such as caryophyllene, polyphenols and aromatic aldehydes such as benzaldehyde. We note also the presence of saturated fatty acids such as stearic acid and palmitic acid and natural antioxidants such as E-vitamin and iron-phosphorus minerals. The results are presented in Table I below.

| Component             | Retention Time | (%)  |
|-----------------------|----------------|------|
| Beta-phellandrene     | 8.77           | 0.12 |
| Beta-pinene           | 9.00           | 0.12 |
| Limonene              | 10.60          | 0.16 |
| □ terpinene           | 11.60          | 0.60 |
| Linalole              | 13.10          | 0.50 |
| Terpinehol            | 15.90          | 0.31 |
| Geraniol              | 22.59          | 0.52 |
| Caryophyllen          | 24.04          | 0.17 |
| Tetradecanoic acid    | 34.11          | 0.11 |
| Tridecanoic acid      | 39.15          | 0.33 |
| Eicosane              | 40.00          | 0.17 |
| Heneicosane           | 42.34          | 0.14 |
| Phytol                | 42.50          | 0.19 |
| Heptacosane           | 42.70          | 0.38 |
| Hentricontane         | 42.80          | 0.12 |
| Octadecadienoic acid  | 43.00          | 0.47 |
| Oleic acid            | 43.20          | 0.51 |
| Octacosane            | 43.60          | 0.80 |
| Nonahaxacantonic acid | 43.75          | 0.11 |
| Tricosane             | 46.70          | 0.49 |
| Docosane              | 47.20          | 0.39 |
| Tetracosane           | 48.81          | 0.46 |
| Tetratriacantane      | 51.60          | 0.20 |
| Docosenamide          | 58.70          | 0.53 |

**Table I:** Molecular composition of the essential oil of *Nigella sativa*.

Concerning the antibacterial effect, the inhibition zones have diameters ranging from 8,33mm for *Klebsiella pneumonia* up to 18mm for *Proteus mirabilis*. See table II below.

| Bacteria                                 | Mean inhibition zones | Appearance of bacterial growth in the zone of inhibition after over 48 hours incubation |
|--|-----------------------|---|
| <i>Escherichia coli</i> ATCC 25922       | 15±0.05               | Positive  |
| <i>Enterococcus faecalis</i> 8V          | 8,5±0.15              | Positive  |
| <i>Salmonella typhi</i>                  | 14,8±0.2              | Negative  |
| <i>Proteus mirabilis</i>                 | 18±0.05               | Negative  |
| <i>Pseudomonas aeruginosa</i> ATCC 27583 | 11,7±0.11             | Positive  |
| <i>Staphylococcus aureus</i> ATCC 6538   | 12,6±0.03             | Positive  |
| <i>Klebsiella pneumonia</i>              | 8,33±0.5              | Positive  |

**Table II:** Results of the interaction of the essential oil of *Nigella sativa* with the bacterial strains

According to Roques et al. (2003), we say that a strain is sensitive if the diameter of the inhibition zone exceeds 13mm. It is resistant if the disc diameter is 6mm. In between, the strain is called intermediate. Therefore, the most sensitive strain is *Proteus mirabilis*. The most resistant is *Klebsiella pneumonia*.

On the basis of the work of Topozada (Topozada et al., 2010), salmonella and pseudomonas bacteria are very sensitive to the essential oil of *Nigella sativa*. Rouibi et al. (2009) reported that with the exception of *E-coli* ATCC 25922, other gram- strains are less sensitive than gram+ strains. This resistance is due to the chemical composition of the wall which is rich in lipopolysaccharides not allowing the penetration of hydrophilic molecules.

According to (Agrawal et al., 1979, Aljabre et al., 2005), the essential oil of *N. Sativa* presents a wide inhibition spectrum against many bacterial strains.

After a 48h incubation of bacteria at 37 °C, the essential oil of *Nigella sativa* exerted a bacteriostatic action against *Escherichia coli* ATCC 25922, *Enterococcus faecalis* 8V, *Pseudomonas aeruginosa* ATCC 27583, *Staphylococcus aureus* ATCC 6538 and *Klebsiella pneumonia*. By contrast, its action on *Enterococcus faecalis* and *Proteus mirabilis* 8V is bactericidal.

Finally, we may conclude that the essential oil of *Nigella sativa* possesses a wide inhibition activity spectrum on pathogenic bacteria for humans. A more careful analysis should be performed *in vivo* in order to determine its real effects.

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## CHARACTERIZATION OF CORK LIGHTWEIGHT MATERIAL USED IN BUILDING THERMAL INSULATION

N. Sotehi<sup>1</sup>, A. Chaker<sup>2</sup>

<sup>1</sup> *Département des sciences de la Matière, Université 20 Aout 1955 Skikda, BP 26 Route d'El-Hadaiek-Skikda (21000), ALGERIE.*

<sup>2</sup> *Laboratoire de Physique Energétique, Université Mentouri-Constantine, Route Ain El Bey, Constantine (25000)-ALGERIE.*

### **ABSTRACT**

An experimental study was carried out in order to determine the thermal properties of new materials used in building insulation. We are particularly interested in cork lightweight concrete. In this work, the thermal conductivity of the tested samples is determined in terms of moisture, density and fibers dosage. The thermal conductivity is measured in the similar conditions as those of utilisation. The thermal resistance is obtained by calculation. The obtained results allow us to specify the optimal use conditions of the tested materials.

### **KEY WORDS**

Thermal properties, thermal conductivity, thermal resistance, insulation material, cork, boxes method.

# CHARACTERIZATION OF WET FORESTS OF NORTH EASTERN ALGERIA

*Othmani Sendid Abla Rakia*  
*Laboratory of plant biology and environment.*  
*Biology department, Faculty of science*  
*Badji Mokhtar University BP12 ANNABA 23000 ALGERIA*

E-mail: [othmaniabla@yahoo.fr](mailto:othmaniabla@yahoo.fr)

**Summary:** Situated in sub humid to humid climate level. North Eastern Algeria (the region of El Kala) has wet forests composed mainly of alder (*Alnus glutinosa*) representing the largest natural stands of North Africa.

These wet forests are threatened by extinction due to the apparent reduction of their area, caused by a strong human pressure (pumping water, overgrazing, logging, etc.) and changing climatic conditions.

The preservation of these forests that have a significant floristic biodiversity becomes imperative and it is in this context that we are working in order to conserve them.

The particularity of their location: dune alder, lake alder and wadi alder; and their formation in contact with alluvial soils are the key points of our work for the conservation of these very vulnerable ecosystems.

**Keywords:** wet forests, alder, riverine forest, biodiversity

## Introduction

La Numidie orientale présente une concentration de zones humides renfermant chacune des caractéristiques différentes : lacs, étangs marais, aulnaies, saulaies, ...

Cette concentration a pour origine l'association d'une série de facteurs naturels favorables :

- Une pluviométrie abondante entre 800 mm et 1000 mm
- Un substrat formé d'argiles, de grès et de marnes.
- Une géomorphologie complexe : la présence du cordon dunaire et la subsidence des plaines qui rendent l'écoulement des eaux difficile.

Tous ces facteurs font de cette zone le siège d'une biodiversité faunistique et floristique remarquable. Cette biodiversité a pour origine la situation de la zone dans un carrefour climatique entre le Nord froid et humide et le Sud chaud et sec. Toutes les nuances entre ces deux climats existent dans la région. Les étages climatiques humides et subhumides, chauds et tempérés se conjuguent pour créer un véritable climat tropical ou au moins sub tropical. (Région du lac des Oiseaux)

Cette situation engendre une mosaïque d'hydro systèmes et d'écosystèmes : alternance de forêts, de dunes, de cuvettes, et de lacs.

Parmi ces écosystèmes les forêts humides qui se développent le long des oueds, dans les dépressions intra et inter dunaire et dans les zones marécageuses

Ces forêts sont caractérisées par des ripisylves qui sont des formations boisées associées à un cours d'eau, étirées le long de ses berges et qui revêtent des physionomies variées selon leur composition floristiques ; et des forêts marécageuses de surface généralement limitée et qui sont spécifiques aux zones où la permanence de l'engorgement en eau a façonné des peuplements adaptés à cette contrainte

La caractérisation de ces écosystèmes n'est pas une fin en soi mais elle devrait plutôt être le point de départ d'une action concrète pour la conservation et l'utilisation rationnelle des zones humides. Aussi tous les éléments sont à prendre en considération car le fonctionnement écologique de l'ensemble des zones humides est interdépendant ; il existe en effet une interaction amont-aval à l'échelon du bassin versant liée à la circulation de l'eau ; que l'on touche à un maillon de la chaîne et c'est tout l'ensemble qui est perturbé.

Pour des raisons écologiques et socio - économiques, chaque écosystème est à prendre en considération dans le cadre d'actions de conservation et de gestion.

## Matériels et méthodes

### Présentation de la zone d'études.

Située dans la partie la plus orientale de l'Algérie du Nord, la zone d'étude est limitée au Nord par un cordon dunaire qui borde la mer, à l'Ouest par l'oued Seybouse, au Sud et au Sud-Est par les monts de la Cheffia et les monts

de la Medjerda, à l'Est par la Kroumirie. Elle est comprise entre la latitude  $36^{\circ} 43'$  et  $36^{\circ} 57'$  et la longitude  $7^{\circ} 43'$  et  $8^{\circ} 37'$ .

Située entre Annaba et El Kala, elle couvre une surface de 560 km<sup>2</sup>. Elle s'étend en bandes parallèles à la côte:

Le cordon dunaire peu développé à l'Ouest (alt. 30 m) devient plus imposant à l'Est (alt. 118 m).

La chaîne numidique au Sud avec des altitudes croissantes de l'Ouest vers l'Est.

Entre les deux, une série de plaines qui se rétrécissent vers l'Est et qui sont drainées par l'oued El Kebir.

Elle se caractérise par un relief peu élevé et présentant une grande monotonie de forme

La constitution géologique du sous-sol de la région ne comporte que des terrains nummulitiques datant essentiellement du tertiaire et du quaternaire.

Le tertiaire est représenté par l'Eocène moyen (argile et grès de Numidie localisées sur les bordures, dans les fonds de vallées et sur les plaines)

Le Miocène : (sables conglomérats et bancs d'argile)

Le Quaternaire : est caractérisé par les dépôts fluviatiles, les dépôts marins éolisés, les dépôts actuels. (JOLEAUD 1936)

Ainsi les collines sont caractérisées par des grès et des argiles de Numidie : les dunes par des regosols et les dépressions par des alluvions et colluvions (Marre 1967)

Le relief de la région d'El-kala est formé par les ensembles géomorphologiques suivant:-

- Un cordon dunaire au Nord sur les côtes qui s'étend d'Ouest en Est sur une longueur de 40 km et se prolonge vers le Sud jusqu'au Djebel Segleb,
- De petites imminences gréseuses de relief de faible altitude (180 à 300 m) qui interrompent à certains endroits le cordon dunaire, ainsi qu'un ensemble de collines au Nord, à l'Est et à l'Ouest ne dépassant pas les 600 m d'altitude.
- une plaine alluviale et marécageuse, adossée aux collines intermédiaires des monts de Medjerda.
- Au Sud s'élève une partie de versant Nord de la chaîne de Medjerda où l'altitude moyenne est de 1100 m environ.

D'une manière générale ce relief se compose d'une juxtaposition de dépressions, dont le fond est occupé par des formations lacustres ou palustres et de hautes collines aux formes variées, dômes, escarpements, alignements de crêtes, couvertes par une végétation plus ou moins dense (De bélair. 1990)

Du point de vue climatique : Les données fragmentaires sur la climatologie de la zone ne permettent pas de dresser un tableau détaillé des conditions climatiques de ces écosystèmes particuliers qui bénéficient de conditions spéciales ou microclimat dont on ne cerne pas encore les contours. De manière générale, le climmagramme d'Emberger 1955, montre que la région se situe dans l'étage bioclimatique Sub-humide chaud à la limite de l'étage humide. Elle est caractérisée par un hiver froid et humide et un été chaud et sec. (BENYACOUB 1993).

Malgré des extrema très marqués pour certaines périodes ( $m=1.2^{\circ}$  et  $M=49.4^{\circ}$  pour El-Kala), la région d'étude reste sous l'influence d'un climat méditerranéen nuancé. Hiver doux et humide et Eté relativement sec, l'humidité des mois les plus chauds (juin, juillet et août) reste assez élevée, ce qui atténue le manque de précipitations. (OTHMANI, 2000)

La pluviosité annuelle moyenne est appréciable (910 mm pour la station d'El-Kala), mais elle est inégalement répartie suivant les saisons, 4% en été, 46% en hiver le reste étant réparti entre les printemps (21%) et l'automne (29%) (OTHMANI, 2000).

Du point de vue hydrologie la région est parcourue par un ensemble de chaaba à écoulement intermittent qui se concentre pour former des oueds(oued el hout oued Bouaroug) ou qui se jettent dans les dépressions intra et inter dunaire

### **Matériel utilisé**

La carte topographique au 1/25000.

Des sorties de terrain nous ont permis de faire un inventaire de la végétation

Des échantillons de sols pris dans les stations recensées

### **Méthode**

Localisation des sites sur les cartes topographiques

Reconnaissance de la végétation à partir de la flore Quezel et Santa.

Analyse des sols au laboratoire

## **Résultats et discussion**

### **Résultats**

L'analyse des sols au laboratoire a démontrés que les sols des différentes stations ont substrat sablonneux à tendance argileuse ou limoneuse pour les sites ripisylves. Pour les sites marécageux les sols sont sablonneux très riche en matière organique (tourbe).

La végétation est une végétation stratifiée où les quatre strates sont représentées.

La végétation représentative des aulnaies est :

*Alnus glutinosa, Fraxinus angustifolia, Ulmus campestris, Laurius nobilis, Salix pedicellata, Salix alba, Tamus cominus, Rubus ulmifolius, Smilax aspera, Pteridium aquilinum, Iris pseudo-acorus, Nerium Hedra helix, Osmonda regalis, Nerium olander.*

Pour la localisation des différents sites voir tableau 1.

Tab 1 : Localisation et caractéristiques des différents sites.

| Aulnaies                       | Coordonnées GPS   | Superficie ha | Alimentation hydrique                | Sol                   | Végétation                |
|--------------------------------|-------------------|---------------|--------------------------------------|-----------------------|---------------------------|
| aulnaie de dement errihane     | 36°52'N<br>8°23'E | 20            | Oued dement errihane                 | Sable-limon           | Aulnaie mixte             |
| aulnaie de bou mouhassen       | 36°50'N<br>8°03'E | 50            | Nappe dunaire                        | Sable-tourbe          | Aulnaie pure              |
| aulnaie de bou mellek          | 36°53'N<br>8°20'E | 3,5           | Nappe dunaire + source               | Sable-tourbe          | Aulnaie pure              |
| aulnaie d'Oum El-Agareb        | 36°49'N<br>8°12'E | 200           | Ain bouglez + nappe dunaire          | Sable-tourbe          | Aulnaie pure              |
| aulnaie du nord de lac tonga   | 36°52'N<br>8°31'E | 37            | Lac Tonga                            | Sable-alluvion-tourbe | Aulnaie pure              |
| aulnaie de sebaa               | 36°50'N<br>8°05'E | 1             | Ain sebaoun+ nappe dunaire           | Sable-tourbe          | Aulnaie pure              |
| aulnaie de berrihane           | 36°50'N<br>8°06'E | 3             | Nappe dunaire                        | Sable-tourbe          | Aulnaie pure              |
| aulnaie de righia              | 36°50'N<br>8°10'E | 400           | Nappe dunaire+oued bhaim+oued lahmar | Sable-tourbe          | Alnus glutinosa dominante |
| aulnaie de soug-regubet        | 36°54'N<br>8°17'E | 15            | Oued reguibet                        | Sable                 | Aulnaie pure              |
| aulnaie de boumerchen          | 36°52'N<br>8°25'E | 30            | Oued boumerchen                      | Sable-argile          | Aulnaie pure              |
| aulnaie de degrah Melleh       | 36°51'N<br>8°25'E | 0,5           | Oued degrah                          | Sable                 | Aulnaie mixte             |
| aulnaie d'oued bou aroug       | 36°52'N<br>8°20'E | 1             | Oued bou aroug                       | Sable-argile          | Aulnaie mixte             |
| aulnaie d'oued El Hout Oubeira | 36°52'N<br>8°32'E | 0,5           | Oued El Hout                         | Sable argile          | Aulnaie mixte             |
| aulnaie de bourdime            | 36°49'N<br>8°15'E | 85            | Oued bourdime+ lac bouredim          | Sable argile          | Alnus glutinosa dominante |
| aulnaie d'oued el mellah       | 36°52'N<br>8°20'E | 2             | Oued mellah                          | Sable argile          | Alnus glutinosa dominante |
| aulnaie d'ain el khiair        | 36°48'N<br>8°20'E | 170           | Garaet el ouez                       | Sable-tourbe          | Aulnaie pure              |

## Discussion

Pour répondre aux objectifs fixés : conservation et utilisation rationnelle des zones humides, nous nous sommes proposés de classer les différents sites suivant la nature de leur alimentation en eau : nappes dunaire, oueds lacs En fonction de l'espace étudié, nous distinguerons les hydro système suivants :

- L'hydro système fluvial, ou les différents cours d'eau (oueds) entretiennent des zones humides de quatre manières différentes :

- Zone humide constituée par le cours d'eau lui-même.
- Zone humide des rives du cours d'eau.
- Zone humide due aux inondations provoquées par les crues des oueds.

Ces zones humides sont caractérisées par leur temporalité. Ils sont aussi fonction des conditions orographiques (faibles pentes, obstacle,...).

- Hydro système lacustre est lui aussi associé à plusieurs types de zones humides :

- Le plan d'eau lui-même
- Les rives du plan d'eau

- Les oueds alimentant le plan d'eau
- Et éventuellement les zones inondées lors de la montée des eaux lors des fortes précipitations
- Hydro système dunaire, caractérisé par la présence d'une nappe aquifère de faible profondeur ou affleurant par endroit. Ces formations sont soit localisées dans les dépressions inter dunaire ou la nappe d'eau est affleurante, Soit situées à la limite du cordon dunaire, alimentées directement par l'écoulement de la nappe des dunes.

Ces zones sont tributaires de la nappe des dunes. Elles sont directement en relation avec le volume de pompage des puits exploitant cet aquifère. Une exploitation irrationnelle de ce dernier les fragilise

La zone d'étude ou le réseau hydrographique est en cours de formation (Marre, 1987) est caractérisé par sa complexité et les relations qu'il y a entre les différents systèmes.

Tab2 : Répartition des sites inventoriés par hydro système

|          | Site  |
|----------|---|
| Dunaire  | -aulnaie de righia<br>-aulnaie d'Oum El-Agareb<br>-aulnaie de berrhane<br>-aulnaie de sebaa   |
| Fluvial  | -aulnaie d'ain el khiar<br>-aulnaie de bou mouhassen<br>-aulnaie de bourdime  |
| Lacustre | <b>Tonga</b><br>-aulnaie du nord de lac tonga<br>-aulnaie d'oued El Hout<br><b>Oubeira</b><br>-aulnaie de dement errihane<br>-aulnaie de boumerchen<br>-aulnaie de degraph<br><b>Melah</b><br>-aulnaie de soug-reguibet et oued reguibet<br>-aulnaie d'oued el mellah<br>-aulnaie d'oued bou aroug<br>-aulnaie de bou malek |

## Conclusion

Malgré les conditions favorables à la mise en place et le maintien d'une importante biodiversité ces conditions peuvent facilement disparaître par l'action de facteurs contraires. Dans tous les cas, l'homme serait à l'origine de la dégradation progressive de ces forêts humides Par une exploitation irraisonnée de l'eau, un défrichement pour l'utilisation des terres au profit des cultures un surpâturage anarchique ; l'action anthropique peut amener à une disparition progressive de ces écosystèmes le risque est d'autant plus grand que l'action est irréversible.

Dans ce contexte menaçant pour la biodiversité il est impératif de prendre des mesures urgentes de conservation tout en prévoyant des solutions pour une exploitation de ses sites qui soit compatible avec les exigences de la conservation de la biodiversité.

Définir, enfin des enjeux précis et appliquer un programme de gestion rigoureux pour les zones humides

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# CHEMICAL ANALYSIS TO IDENTIFY ORGANIC COMPOUNDS IN PRE-COLUMBIAN MONUMENTAL EARTHEN ARCHITECTURE

Yuko Kita  
Annick Daneels  
Alfonso Romo de Vivar  
kitayuko@gmail.com

**Abstract:** In 2012 we started a program of chemical analysis on organic extracts of 14 samples of fills, adobes, floors and renders, dated AD 200–400, obtained during the excavations of monumental earthen buildings at the archaeological site of La Joya, Veracruz, Mexico, located on the humid tropical coastal plain of the Gulf of Mexico. The interest in identifying organic additives derives from the observation that the conservation conditions of buildings is better than expected, considering the mineral composition of construction materials in which smectite (montmorillonite), an expansive clay, dominates. This brought us to suspect the presence of certain compounds which served as consolidant and/or water-repellent. The organic compounds from the building samples are extracted in hexane and methanol, and analyzed by Thin Layer Chromatography [TLC], Fourier Transform Infrared Spectroscopy [FTIR], Nuclear Magnetic Resonance Spectroscopy [NMR] ( $^1\text{H}$  and  $^{13}\text{C}$ ) and Mass Spectrometry [MS] (Fast Atom Bombardment [FAB+]). The results of these analyses confirm the presence of the same organic compounds in all samples, especially more abundant in adobe samples. The compounds identified up to now are hydrocarbons, a triglyceride and a sugar. At the same time, the mucilage of plants used in the vernacular construction in humid tropical environments in Central America is analyzed using a similar process in order to compare it with the organic substances of the original materials. The importance of identifying additives in pre-Columbian earthen buildings resides not only in understanding what made a tradition of earth construction possible in humid tropical environments, which contributes to the history of technology, but also in the possible use of such an additive in the conservation of archaeological remains, as well as in modern construction.

**Key words:** organic additives, archaeology, Veracruz, México, Classic Period, adobe, Nuclear Magnetic Resonance Spectroscopy, Fourier Transform Infrared Spectroscopy

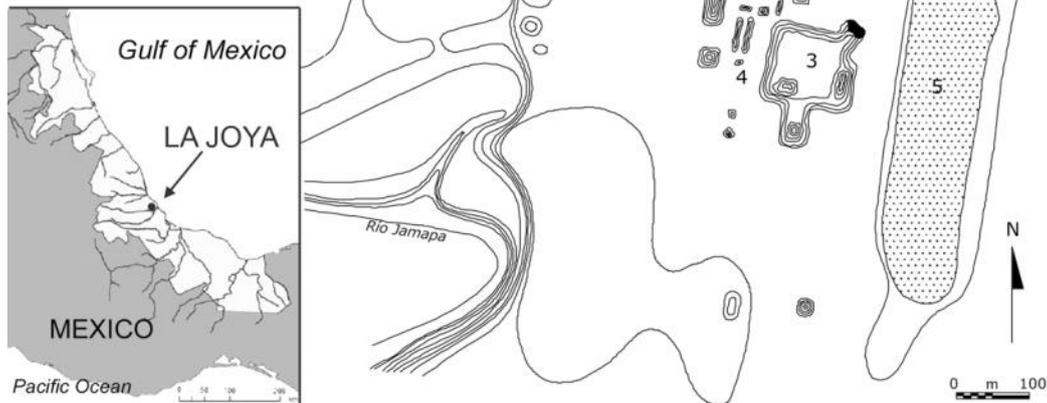
## Introduction

The archaeological site of La Joya is located on the coastal plain of the Gulf of Mexico, close to the modern city and major merchant port of Veracruz. Though the site is occupied since the Olmec period, the monumental earthen architecture dates between 200 BC and AD 1000, spanning what is locally called the Late Preclassic and Classic period. Excavations in the severely damaged site since 2004 have revealed evidence of a sophisticated building tradition that used only raw earth, all the more surprising because of the adverse tropical conditions of heavy rainfall in the summer (>1500 mm/year) and strong winds and hurricanes in the winter. Since 2009 a coordinated effort uniting archaeologists, architects, engineers, chemists, and biologists, is under way to understand the building technique. Initially we analyzed 20 structural samples of structure fills, adobes, floors and facings for composition (sediment analysis, petrography, X-ray Fluorescence, X-ray Diffraction, FTIR, botanical analysis of chopped grass component), and mechanical properties (density, porosity and resistance to compression), the results of which are reported elsewhere (Daneels & Guerrero-Baca, 2011 and Liberotti & Daneels, 2012).

## LA JOYA, VERACRUZ, MEXICO

Solid black areas: conserved sectors

1. Pyramid
2. North Platform
3. East Platform
4. Ball court
5. Artificial water reservoirs



**Figure 1:** Layout of the La Joya site in the State of Veracruz (in white), and its location on the Gulf Coast of Mexico

The results showed materials to be of a medium to poor quality. This is especially due to the fact that the mineral composition analysis by X-ray diffraction revealed that smectite dominates in the composition of earthen construction materials. This is highly expansive clay, very difficult to manage with the strong seasonal variation in humidity conditions. This led us to believe that the mineral mix was combined with a modifier that helped the earthen structure to resist the expansion-contraction cycles of smectite due to changes in environmental conditions such as precipitation, floods and hurricanes.

Organic additives such as fibers and polymers are often added to inorganic materials such as lime, earth, and sand to make mortar and adobe blocks. Today we can observe a large variety of natural organic additives used especially in vernacular architecture. These additives tend to be considered as “traditional materials” as well as “appropriate restoration materials” for archaeological and historical buildings, even though we do not know how long those materials have been used as additive. Interpretation of organic substances relies on the information based on local practice. Since the mucilage of a cactus called “nopal” (*Opuntia ficus-indica*) is used for vernacular construction in central Mexico (where semiarid conditions prevail) and is widely applied for restoration in Mexico, organic substances found in archaeological remains usually are supposed to be nopal mucilage. Although there are native and cultivated nopals in the region of La Joya, they are not as abundant as in the central highland of Mexico, due to the humid tropical climate. Also, the FTIR analysis of the initial sample series revealed the presence of an agglutinant that did not bear close resemblance to nopal mucilage (Daneels & Guerrero 2011). Therefore it was necessary to broaden the scope of the investigation. A promising lead comes from Central America, where traditional builders in humid tropical regions will use extracts of leaves and stems of the mallow shrub (*Sida rhombifolia*) or bark of the guacima tree (*Guazuma ulmifolia*) as additive for adobe, and apply it in archaeological restoration as additive for earth paste or as consolidant of earthen architecture surface (Ohi & Girón, 2000).

The formal research to identify the organic compounds in the pre-Columbian building materials started in 2011, testing a facing sample by Nuclear Magnetic Resonance Spectroscopy at The Institute of Chemistry of the National Autonomous University of Mexico. The  $^1\text{H}$  NMR spectra of the methanolic extract from 105g of the sample in deuterated methanol ( $\text{CD}_3\text{OD}$ ) recorded at 400 MHz showed signals of hydrocarbons, as well as signals between  $\delta$  3 and 3.8 which indicate the possible existence of a sugar, a signal indicative of a double bond at  $\delta$  5.34. This first result justified the design of a complete research protocol to identify the pre-Columbian substance that apparently made earthen architecture possible in humid tropical environments. In this paper, we present the preliminary results of this research.

## Sample and Method

Encouraged by the 2011 results, we started a set of analysis based on a new series of 14 pre-Columbian construction samples from the La Joya site, consisting of 8 floor layers, 2 facings, 2 adobe and 2 fills, dated to AD 200 – 400, from two buildings: The North Platform, a palace, and the altar annexed to the main Pyramid (Table 1). These

analyses, applied on extracts, are geared towards defining the possible modifiers added to the mineral mix, and were carried out by author Dr. Yuko Kita under the supervision of Dr. Alfonso Romo de Vivar at the Institute of Chemistry in the National Autonomous University of México.

**Table 1:** Sample list. Location: La Joya, Municipality of Medellín, Veracruz, Mexico (19°04'00''N96°09'00''W; UTM zone 14 799799E 2110514N).

| No. | Structure      | Description   | Date       |
|-----|----------------|---|------------|
| 1   | North Platform | Base layer and lower floor layer                      | AD 200-400 |
| 2   | North Platform | 3 layers of the surface floor                         | AD 200-400 |
| 3   | North Platform | 2 superposed floors (a sandy layer and a loamy layer) | AD 200-400 |
| 4   | North Platform | Adobe found loose in fill                             | AD 200-400 |
| 5   | North Platform | Superior line of adobe at east perimeter wall         | AD 200-400 |
| 6   | North Platform | 4 facings   | AD 200-400 |
| 7   | Pyramid SE     | Sandy fill under the level of plaza                   | AD 200     |
| 8   | Pyramid SE     | Mixed fill under the floor                            | AD 200     |
| 9   | Pyramid SE     | 2 layers of floor                                     | AD 200-400 |
| 10  | Pyramid SE     | 2 layers of floor                                     | AD 200-400 |
| 11  | Pyramid SE     | 2 layers of floor                                     | AD 200-400 |
| 12  | Pyramid SE     | 2 layers of floor                                     | AD 200-400 |
| 13  | Pyramid SE     | 3 layers of floor                                     | AD 200-400 |
| 14  | Pyramid SE     | Clayey facing (exfoliated)                            | AD 200-400 |

The analyses were carried out according to the following procedure: a 300g portion of each ground earthen sample was weighed out, soaked in methanol (MeOH), stirred with a glass rod and left to settle for 24 hours to dissolve organic components. Then, the sample in methanol was heated up at  $\pm 60^{\circ}\text{C}$  for 30 minutes, stirred and filtered. This process was repeated thrice. The residue was concentrated by rotary evaporator. Each extract was then analyzed by Fourier Transform Infrared Spectroscopy [FTIR] and/or  $^1\text{H}$  NMR.

Because the residues obtained from each sample are so scant, it was not possible to run  $^{13}\text{C}$  NMR spectra, much less with hetero nuclear experiments. But, as all extracts were very similar, they were put together, obtaining a 101.2 mg combined residue sample, which was mixed with celite and then concentrated. To be able to have a better idea of the structures of the diverse components, the extract was separated into each component by column chromatography with hexane, ethyl-acetate and methanol. These extracted substances were analyzed by FTIR,  $^1\text{H}$  NMR, with 2-dimensional homonuclear experiment: Correlation Spectroscopy [COSY],  $^{13}\text{C}$  NMR, with 2-dimensional heteronuclear experiment: Heteronuclear Multiple-Quantum Correlation Spectroscopy [HMQC], and 3-dimensional heteronuclear experiment: Heteronuclear Multiple-Bond Correlation Spectroscopy [HMBC]. Some samples were analyzed also by Mass Spectrometry [MS] (Fast Atom Bombardment [FAB+]).

## Results

The quantity of residue obtained through the extraction process varied from 0.7mg to 25.1mg; especially the adobe blocks, samples no. 4 and 5, contain large amount of organic component. The FTIR spectra reveal the presence of variable quantity of esters in a range between 1718 and  $1740\text{cm}^{-1}$ . The  $^1\text{H}$  NMR spectra recorded with deuterated chloroform ( $\text{CDCl}_3$ ) provide a pattern similar to a fatty acid ester, and with deuterated methanol ( $\text{CD}_3\text{OD}$ ) the spectra reveal the presence of a sugar whose characteristics correspond to methyl pentoses, such as rhamnose or fucose. Besides this we detected signals of aromatic compounds at  $\delta$  7.22 and 7.5 with coupling, and signals at  $\delta$  5.2 and 5.3 which seem to correspond respectively to a triglyceride and to a double bond.

The organic components show a complex but very similar composition. Because the quantities are very small to run  $^{13}\text{C}$  NMR spectra, we decided to combine all extracts in order to be able to separate components by column chromatography. The spectra of  $^1\text{H}$ NMR,  $^{13}\text{C}$ NMR, and their correlations such as COSY, HMQC and HMBC of the separated components by chromatography do not only support the interpretation of the spectra obtained for the individual samples, confirming the presence of hydrocarbons, a triglyceride and a sugar, but also indicate two methyl esters, one of them probably butyl phthalate whose signals appear at  $\delta$  3.6 and 3.8 (Figure 2 - 6). The hydrocarbons and the aromatic ester do not look like impurities, since they are abundant in all samples and the impurities of solvents are few.



from relatively shallow archaeological strata in an area close to where brick-kilns were in use in the 1990's. But, as the hydrocarbon signature shows up in all the samples, we are quite confident there is no modern contamination.

We do not have references on the pre-Columbian use of bitumen as a stabilizer of adobe blocks, but there is information on the use of bitumen to waterproof earthen structures and bind adobe blocks in ancient Mesopotamia (Barton, 1926; Taylor 1855), the Near East (Hollander, 2000), the Indus Valley and Egypt (Forbes, 1936). Besides, the use of water-in-bitumen emulsion is recommended as a good additive for adobe blocks for modern day construction in North America (O'Connor, 1973). The raw material was available and known by the ancient Gulf coast cultures since the Preclassic period (as early as 1600 B.C.), as there are natural seeps of bitumen along the coastal plains of Veracruz, and bitumen was traditionally used on ceramic and wooden objects, as well as building floors, as decoration and waterproofing (Belt, 1971; Daneels, 2006; Wendt & Cyphers, 2008). At the site of La Joya itself, there are instances of bitumen used as decorative paint on ceramic figurines and vessels dating to the same period as the architectural samples studied.

Regarding the sugar components found in the samples, these could stem from possible original organic additives. To identify them, we are using as an initial comparative base the organic compounds obtained from water extracts of leaves and stems of the mallow shrub (*Sida rhombifolia*) and bark of the guacima tree (*Guazuma ulmifolia*) which as we indicated above are used as additives for adobe blocks in humid tropical regions of Central America. We're currently applying the same analytical procedure to these extracts, and are also producing experimental adobe samples using local earth mixed with those organic extract to study their utility and polymerizing effects. Thus we will obtain results comparable to those obtained from the pre-Columbian samples.

## Conclusions

It's been possible to identify hydrocarbons, a triglyceride, methyl pentoses and an aromatic ester in the organic extracts of the construction material of the pre-Columbian earthen architecture of La Joya, a Classic period site located in a humid tropical environment on the coastal plain of the Gulf of Mexico. At this moment we cannot identify the specific source of the original organic additives, but hydrocarbons might come from locally available bitumen, as its use is attested in even the earliest Gulf Coast cultures, albeit for different purposes. The other components may be from shrubs and trees abundantly available in the region. In both cases, we still have to develop a comparative corpus of local resources in order to identify the specific sources, a study that is currently under way.

The major contribution of our research up to now is to have proven that there is a consistent organic compound mix present in the building material of the monumental earthen architecture, as part of a systematic pre-Columbian building technique. This sustains our initial hypothesis that earthen construction based on an expansive clay building material would not have been viable in the adverse tropical environment without the use of an effective additive. The discovery of a hydrocarbon as a binder, though common knowledge in the Old World and still recommended today for adobe constructions, had up to now not been reported for Ancient Mexico. This opens up a completely new set of perspectives for the research on Pre-Columbian architecture.

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## CHEMICAL PROFILE AND ANTIFUNGAL ACTIVITY OF ESSENTIAL OILS EXTRACTED FROM LEAVES OF *CITRUS AURANTIUM* AND *CITRUS SINENSIS* (L) OSBECK OF ALGERIA .

Hamdani fatima zohra\*<sup>a</sup> , Allem Rachida<sup>b</sup> , Meziane Malika<sup>a</sup> , Houari Abdelkader <sup>a</sup> , Setti Benali<sup>a</sup> , Ali Arous Samir<sup>c</sup> and Bourai meriem<sup>d</sup>

**Abstract.** The aim of this study was to determine the characteristics of essential oils obtained from leaves of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* L. The chemical composition and antifungal activity against five phytopathogenic fungi: *Alternaria solani*, *Fusarium oxysporum f. sp. albedinis*, *penicillium sp*, *Alternaria sp* and *Fusarium sp* have been studied. Essential oils have been chemically analyzed and identified by GC-MS while the agar dilution method was used to determine their antifungal activities. The effect of minimum concentration was also determined . The main constituents of essential oil of *Citrus sinensis* (L) Osbeck were  $\beta$  pinene ( 30 %) and D- limonene (9.37%) . In the essential oil of *Citrus aurantium* L the principal components were linalool (63.03%) and D-limonene ( 7.18 %) . The essential oil of *Citrus aurantium* L was much more effective than the essential oil of *Citrus sinensis* (L) Osbeck and had a much greater effect on *Alternaria solani*, *Fusarium oxysporum f. sp. albedinis*, *Alternaria sp* and *Fusarium sp* . These results indicate that essential oils can be used as natural fungicides against pathogenic fungi.

**Keywords.** Algeria , *Citrus sinensis* (L) Osbeck, *Citrus aurantium*, essential oil, CG/SM , antifungal activity.

### Introduction

Spoilage and food poisoning by pathogenic fungi are a major economic problems of crop and food production. Apart from their potential to cause yield losses and food decay, many of them represent very serious risk to consumers because of their production of dangerous secondary metabolites. The control methods used were based primarily on the application of chemical fungicides. In recent years, the controversy over the use of chemicals harmful to human health and the environment have increased the debate, they attribute their cancer risk and the residual toxicity (Aoudou, Leopold, Jazet-Dongmo, Xavier, & Moses, 2010).

The growing awareness of consumers about the relationship between diet and health is revolutionizing the food industry and to justify the search for new strategies and to explore other safer alternatives and biodegradable (Combrinck, Regnier, & Kamatou, 2010). New research has raised the possibility of using new compounds extracted from plants that can act as natural fungicides (Regnault-Roger, 2012). Recent years and for the elimination of pathogenic microorganisms, the researchers were interested in biologically active compounds isolated from plants or essential oils ( EOs) in the objective of providing solutions to many of the challenges facing the agricultural producers and distributors (Combrinck et al., 2010).

Studies have shown that EOs and their constituents have significant potential as antimicrobial agents. EOs are of great interest because of their wide acceptance by consumers, and their exploitation of potential multi-functional uses (Sawamura 2000). Very few publications have documented the antifungal activity of EOs extracted from *Citrus sinensis* (L) Osbeck and *Citrus aurantium* (Mishra & Dubey, 1994; Sherma & Tripathi, 2006b; Espina, Somolinos, Loran, Conchello, Garcia Pagan , 2011), but no study has been reported on the analyses of EOs and antifungal activity of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* occurring in Algeria . Therefore, the aims of the present study were (a) to examine the chemical composition of EOs of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* by GC-MS and (b) to determine the efficacy of EOs against *Fusarium oxysporum f.sp. albedinis* , *Alternaria solani*, *Alternaria sp* and *Fusarium sp*.

## 2. Materials and Methods

### 2.1 Samples

Fresh leaves of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* L used for the extraction of EOs was collected in the orchards of Chlef, Algeria in March - November 2011.

#### *Standard cultures*

The EOs were individually tested against *Fusarium oxysporum f.sp. albedinis* and *Penicillium sp.* These species were provided by the laboratory of Plant Pathology, Institute of Agronomy, University of Chlef. *Alternaria solani* was isolated from infected plants, potatoes, and identification was made on the basis of morphological and microscopic characters (Rieuf, 1985). The other two strains, *Alternaria sp.*, *Fusarium sp.*, from the Mycology Laboratory of INPV Chlef. All strains were purified and maintained on potato dextrose agar medium (PDA) at 22°C ±1 °C.

### 2.2 Methods

#### 2.2.1 Extraction of the essential oil

About 250 g of fresh leaves of *Citrus sinensis* (L) Osbeck and *Citrus aurantium*, were subjected to hydrodistillation for 3 h using a Clevenger type apparatus. The EO was dried over anhydrous Na<sub>2</sub>SO<sub>4</sub> and stored in a sealed vial at 4 °C until analysis.

#### 2.2.2 GC/MS analysis of essential oil

The analysis of the EO was carried out by HP GC 6890 A with flame ionization detector (FID), using a capillary column coated with 5% phenyl methyl siloxane (30 m x 0.25 mm x 0.25 μm the film thickness); the oven temperature was programmed from 60 °C for 2 min, then programmed at 5 °C / min to 260 °C. The injection temperature was 250 °C, detector temperature 280 °C, the injection mode, split; injected volume, 1 microliter of oil. The carrier gas was helium, 1 ml / min.

GC/MS was conducted using an Agilent 5973 GC/MS coupled to an Agilent 6890 gas chromatograph equipped with an HP-5MS capillary column (30 m x 0.25 mm, 0.25 μm film thickness), the oven temperature was programmed as follows: 60 °C for 2 min, then gradually increased to 260°C at the 5°C / min, For GC-MS detection, an electron ionization system with ionization energy of 70 eV was used. Helium was used as the carrier gas at a constant flow rate of 1 ml/ min. The identification of the components was performed on the basis of chromatographic retention indices and by comparison of the recorded spectra with computed data libraries (NIST 1998). Retention indices were calculated for all volatile constituents using a homologous series of n-alkanes C7-C29, hydrocarbons with as standard, under the same chromatographic conditions as those used for the analysis of EOs.

#### 2.2.3 Total phenol content

The total phenol content was determined using the FolineCiocalteu's reagent (Singleton, Ortofer, & Lamuela-Raventos, 1999).

#### 2.2.4 Antifungal activity

The fungitoxicity of the EOs was tested against *Alternaria solani*, *Fusarium oxysporum f.sp. albedinis*, *penicillium sp.*, *Alternaria sp* and *Fusarium sp* by the poisoned food technique (Perrucci, Mancianti, Coint, Flamini, Marelli & Maccnioni, 1994) using potato dextrose agar as medium. Required quantities of oil separately dissolved in 0.5 ml of 5% (v / v) Tween-80 were added aseptically to different Petri dishes sterilized (9 x 1.5 cm) containing 9.5 ml PDA media so as to provide the required concentration of 0.001 to 1 mg / ml. For control sets the requisite amount of sterilized distilled water in place of EO was added to the medium.

A fungal disc (5 mm diameter) of the pathogenic fungi, cut from the periphery of seven days old culture with the help of a cork borer, was inoculated aseptically to the center of the poured Petri plates of treatment and control sets. The plates were incubated at 25 ± 2 °C for seven days. Diameter of fungal colonies of treatment and control sets was measured. The percentage mycelial inhibition was calculated by the mean value of colony diameters by the following formula (Pandey, Chandra, & Tripathi, 1982).

Percentage Inhibition (PI %) = {1 - radial growth of treatment (mm) / radial growth of control (mm) } x 100

The minimum inhibitory concentration (MIC) of the EOs against fungal pathogens was determined at which the oil showed absolute fungitoxicity, experiments were carried out by the usual poisoned food technique (Pandey & Dubey, 1994). Different concentrations of the oil 0.001 to 1 mg ml<sup>-1</sup> were prepared by dissolving separately its requisite amount in 0.5 ml 5% (v/v) tween-80 and then admixing with 9.5 ml of PDA. The control sets were kept parallel to the treatment sets without EOs. The inoculated Petri plates were incubated for seven days at 25±2°C.

The lowest concentration without observable growth were defined as MIC. The lowest concentration without visible growth was defined as the MFC, indicating a mortality of 99.9% of the original inoculum. The nature of toxicity (fungistatic / fungicidal) of the EO was determined according to Thompson (1989). Inhibited fungal discs treated with EO was reinoculated onto fresh medium after washing with distilled water and the revival of growth was observed.

The spore colonies previously exposed to the EO of *Alternaria solani*, *Fusarium oxysporum f.sp. albedinis*, *Penicillium sp*, *Alternaria sp* and *Fusarium sp* were collected by adding 5 ml of sterile water containing 0.1 ml/100 ml Tween-80 in each Petri dish and rub the surface of the colony three times with spreader sterile L-shaped. The spore suspension was collected and then centrifuged. A haemocytometer slide was used to count the concentration of spores. The percentage inhibition of spore production (PIs %) was calculated relative to controls.

The homogeneous suspension containing spores of strain  $10^7$  spores / ml in each tube. From this, 1.5 $\mu$ l aliquots of the spore suspension were incubated in medium Agar fresh sterile depression slides. Slides containing the spores were assembled with the blade, then incubated in a moist chamber at  $25\pm 2^\circ\text{C}$  for 48 h in three replicates. For each treatment, 200 spores were examined and spore germination was assessed by looking for the emergence of germ tubes. The spore germ tube which reaches 50% of its size, is considered to be germinated. The percentage of inhibition of germination (PIg%) was calculated relative to controls.

### 2.2.5 Statistical analyses

The antifungal activity of EOs of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* has been tested. Each experiment was performed in triplicate and mean values were calculated. Statistical analysis was performed using ANOVA and differences between means were determined using the one Duncan test ( $P \leq 0.05$ ). A statistical analysis software (SPSS version 11.0) was used for data analysis.

## 3. Results and Discussion

### 3.1 Composition chemical of essential oils of *Citrus sinensis* (L) Osbeck and *Citrus aurantium*

The qualitative and quantitative analysis of volatile profiles of EOs is shown in Table 1.. These results showed that there are many qualitative similarities between the two EOs, although the quantities of some corresponding compounds are different. 18 compounds were recorded in common among the 44 identified, 33 compounds were identified in EO of *Citrus sinensis* (L) Osbeck, representing 95.17% against 29 compounds (92.90%) to *Citrus aurantium*. The  $\beta$  pinene (30%) and D limonene (9.37%) were the main compounds of EO of *Citrus sinensis* (L) Osbeck and linalool (63.03%), D limonene (7.18%), in *Citrus aurantium*. Fadel (1991). recorded high concentrations of  $\beta$  pinene (11.03 to 25%) in the EOs extracted from leaves of orange varieties. While Lota, Tomi, Serra, Jacquemond, & Casanova (2001). obtain linalool as major constituent of the EO of *Citrus aurantium*. High levels of monoterpene hydrocarbon were obtained from citrus oil (Farhat, Tixier, El Maataoui, Maingonnat, Romdhane, & Chemat, 2011; Settanni, Palazzolo, Guarrasi, Aleo, Mammina, Moschetti, & Germanà, 2012). Sesquiterpenes two isomers (Z) and (E)  $\beta$  - element are quantified, and the isomer (E)  $\beta$  - component is predominant at high proportions (8.97%). In the EO of *Citrus aurantium* other compounds were present at levels above 1% particularly linalyl Acetate (5.79%),  $\beta$  Pinene (5.25%), Caryophyllene (2.62%),  $\beta$  - Myrcene (1.40%),  $\beta$ -ocimene (1.13%). The oxygenated monoterpenes accounted for about 71.55% of the identified constituents of the essential oil of *Citrus aurantium* analyzed.

### 3.2 Total phenol content

The total phenolic contents of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* EOs were expressed as equivalents of Gallic acid (GAE  $\mu\text{g/ml}$  of essential oil). As shown in Figure 1. The EOs of *Citrus sinensis* (L) Osbeck is richer in total phenolic content (24.94 GAE  $\mu\text{g/ml}$  of EO) as opposed to the essential oil of *Citrus aurantium* (11.09 GAE  $\mu\text{g/ml}$  of EO). Phenolic compounds have various functions such as attracting or repelling insects, antimicrobial activity, antiviral activity, protection against harmful ultraviolet radiation and protection against herbivores (Harborne & Williams, 2000).

### 3.3 Antifungal activity

The results given in Table 2 show that in general the EOs exhibit an inhibitory effect.. In this regard, EO of *Citrus aurantium* revealed a strong inhibition with all fungal strains tested. Susceptibility to fungal EOs generates high percentages of inhibition and showed absolute toxicity (100% inhibition of mycelial growth). *Citrus sinensis* (L) Osbeck EO showed a wide spectrum of antifungal activity, being moderately active against *Penicillium sp* and highly active against *Alternaria solani*, *Alternaria sp*, *Fusarium oxysporum fsp albedinis* and *Fusarium sp*. Few studies have investigated the antifungal activity of EOs of citrus (Sharma & Tripathi, 2006 a,b ; Philips, Laird, & Allen, 2011).

Table 3 shows their minimum inhibitory concentration (MIC, mg / ml) and minimum fungicidal concentration (MFC; mg / ml) against five phytopathogenic fungi examined. The MIC values confirmed the greatest antifungal activity of EOs of *Citrus aurantium* (MIC 0.05 mg / ml), followed by *Citrus sinensis* (L) Osbeck, which shows a fungistatic important activity with MICs ranging from 0.4 to 1.0 mg / ml: *Fusarium sp* and *Alternaria sp* were more susceptible (MIC 0.4 mg / ml), *Alternaria solani*, was moderately susceptible (MIC 0.6 mg / ml) and *Fusarium oxysporum f.sp. albedinis* (MIC 1.0 mg / ml) was more resistant *Penicillium sp* with (MIC > 1.0 mg / ml). The assessment of CFM revealed that EOs of *Citrus aurantium* showed the highest fungicidal activity (0.05 mg / ml) against *Alternaria solani*, *Alternaria sp*, *Fusarium oxysporum f.sp. albedinis* and *Fusarium sp*.

Regarding *Citrus sinensis* (L) Osbeck was slightly less effective (CFM from 0.4 to > 1.0 mg / ml): *Fusarium sp* (CFM 0.4 mg / ml) was most sensitive followed by *Alternaria sp* (CFM 0.8 mg / ml), *Alternaria solani* (CFM 1.0 mg / ml). However *Fusarium oxysporum f.sp. albedinis* and *Penicillium sp* were more resistant showing a CFM > 1.0 mg / ml. The antifungal activity of EOs is reported by several studies and showed that the genus *Fusarium* and *Alternaria* are more sensitive to EOs of different origins including citrus (Aoudou et al, 2010; Sharma Tripathi and 2006, a). Lucini, Zunino, Lopez, and ZYGADLO (2006) reported that inhibition of mycelial growth is caused by monoterpenes present in EOs.

The strong inhibition recorded in the EOs of *Citrus aurantium* may be attributed to the presence of linalool (63.03%). Several authors have attributed the antifungal activity of citrus EOs in the presence of some major components such as linalool, D-limonene or citral and other (Sharma and Tripathi 2006 a, b; Viuda-Martos Ruiz-Navajas, Fernandez-Lopez, & Perez-Alvarez, 2008).

The impact of the EO on fungal sporulation revealed that spore production was inhibited by the EOs of *Citrus sinensis* (L) Osbeck, compared to untreated controls, with a decrease in spore production 95, 60% for *Fusarium oxysporum f.sp. albedinis*, 93.33% for *Alternaria sp*, 86, 29% for *Fusarium sp* and 60.44% for *Penicillium sp*. While the essential oil of *Citrus aurantium*, seems to have a less effective than the EO of *Citrus sinensis* (L) Osbeck, with 73.48% for *Fusarium oxysporum f.sp. albedinis*, 86, 62% for *Fusarium sp* and 73.44% for *Penicillium sp* (Figure. 2). The effect of EO of citrus on spore production was reported by several authors (Sharma & Tripathi, 2006 a,b; Chutia, Bhuyan, Pathak, Sarma, & Boruah, 2009; Philips, et al., 2011). Figure3. shows the impact of EO on spore germination. However, treatments with EOs of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* have been tested and found differences on spore viability of the five fungal species. Moreover, the greatest inhibition of spore germination was observed in *Citrus sinensis* (L) Osbeck to *Fusarium oxysporum f.sp. albedinis* (100%), *Alternaria sp* (77.66%) and *Fusarium sp* (73.33%). This could partly be correlated with the presence of high concentrations of monoterpenes.

The effects of EOs on sporulation may reflect the effects of volatile substances emitted by the oils on the surface of mycelial growth, the transition to the production of spores and / or perception / signal transduction mechanism involved in the transition from vegetative to reproductive development. The data presented here show the potential potent inhibitor of the EOs of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* vis-à-vis *Alternaria solani*, *Fusarium oxysporum f.sp. albedinis*, *Alternaria sp* and *Fusarium sp* and their possible integration into programs to protect against phytopathogenic fungi.

**Table 1:** Chemical composition of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* EOs from Algeria and their relative percentages of total chromatogram area, and Kovats Index.

| Number | Component             | Kovates indexes |                 | <i>Citrus aurantium</i><br>(% area) | <i>Citrus sinensis</i><br>(% area) |
|--------|-----------------------|-----------------|-----------------|-------------------------------------|------------------------------------|
|        |                       | RI <sup>a</sup> | RI <sup>b</sup> |                                     |                                    |
| 1      | 3 hexen- 1-ol         | 866             | 866             | 0.91                                | -                                  |
| 2      | $\alpha$ -Thujene     | 931             | 925             | 0.02                                | 1.49                               |
| 3      | $\alpha$ -Pinène      | 939             | 934             | 0.38                                | 2.04                               |
| 4      | camphene              | 953             | 955             | 0.03                                | -                                  |
| 5      | $\beta$ - Pinène      | 979             | 983             | 5.25                                | 30.0                               |
| 6      | $\beta$ - Myrcène     | 991             | 997             | 1.40                                | 4.52                               |
| 7      | $\alpha$ Phellandrene | 1008            | 1007            | -                                   | 0.68                               |
| 8      | 3 Carene              | 1012            | 1012            | 0.16                                | 6.41                               |
| 9      | (+)-4-Carene          | 1035            | 1035            | -                                   | 2.77                               |
| 10     | D-Limonene            | 1036            | 1038            | 7.18                                | 9.37                               |
| 11     | (Z) $\beta$ Ocimène   | 1045            | 1040            | -                                   | 0.74                               |
| 12     | (E) $\beta$ Ocimène   | 1050            | 1048            | 1.13                                | 8.59                               |
| 13     | $\gamma$ Terpinene    | 1062            | 1062            | -                                   | 4.42                               |
| 14     | Cis sabinène hydrate  | 1068            | 1068            | -                                   | 0.21                               |
| 15     | Cis Linalool oxide    | 1174            | 1074            | 0.69                                | -                                  |
| 16     | $\alpha$ -Terpinolene | 1096            | 1077            | -                                   | 2.53                               |
| 17     | Linalool              | 1107            | 1098            | 63.03                               | 1.24                               |
| 18     | Citronellal           | 1159            | 1159            | -                                   | 0.90                               |
| 19     | Terpinen-4-ol         | 1177            | 1176            | 0.43                                | 2.14                               |
| 20     | $\alpha$ Terpeneol    | 1189            | 29189           | 1.00                                | 0.07                               |

|                            |                       |      |      |       |       |
|----------------------------|-----------------------|------|------|-------|-------|
| 21                         | Citronellol           | 1226 | 1208 | -     | 1.05  |
| 22                         | Nerol                 | 1228 | 1233 | 0.46  | -     |
| 23                         | Citral                | 1254 | 1254 | 0.15  | 0.22  |
| 24                         | Linalyl acetate       | 1257 | 1256 | 5.79  | -     |
| 25                         | Geraniol              | 1276 | 1276 | 0.99  | 0.22  |
| 26                         | $\delta$ - Elemène    | 1340 | 1341 | 0.05  | -     |
| 27                         | Acetate de geranyle   | 1381 | 1383 | -     | 0.45  |
| 28                         | (Z) $\beta$ Elemene   | 1393 | 1390 | -     | 0.44  |
| 29                         | (E) $\beta$ - Elemene | 1398 | 1398 | 0.08  | 8.97  |
| 30                         | Caryophylène          | 1417 | 1419 | 2.62  | 3.48  |
| 31                         | Aromadendrene         | 1439 | 1440 | 0.05  | -     |
| 32                         | $\beta$ Famesene      | 1458 | 1445 | 0.12  | 0.65  |
| 33                         | $\alpha$ -humulene    | 1474 | 1473 | 0.39  | 1.33  |
| 34                         | $\beta$ -Selinene     | 1485 | 1484 | -     | 0.47  |
| 35                         | $\alpha$ - Selinene   | 1493 | 1490 | -     | 0.56  |
| 36                         | $\alpha$ -Farnesene   | 1509 | 1509 | -     | 0.61  |
| 37                         | $\delta$ -Cadinene    | 1514 | 1513 | 0.01  | -     |
| 38                         | $\gamma$ Cadinene     | 1523 | 1524 | 0.08  | 0.22  |
| 39                         | Cis Nerolidol         | 1534 | 1539 | 0.37  | -     |
| 40                         | Caryophylene oxide    | 1606 | 1599 | 0.04  | 0.23  |
| 41                         | $\alpha$ Cadinol      | 1654 | 1653 | 0.04  | -     |
| 42                         | $\beta$ Sinensal      | 1706 | 1706 | -     | 0.72  |
| 43                         | $\alpha$ Sinensal     | 1750 | 1749 | -     | 0.30  |
| 44                         | Phytol                | 2128 | 2129 | 0.05  | -     |
| Monoterpene hydrocarbons   |                       |      |      | 15.55 | 71.03 |
| Oxygenated monoterpenes    |                       |      |      | 71.55 | 08.53 |
| Sesquiterpene hydrocarbons |                       |      |      | 01.77 | 17.18 |
| Oxygenated sesquiterpene   |                       |      |      | 01.46 | 01.02 |
| Autres                     |                       |      |      | 00.96 | -     |
| Total identified           |                       |      |      | 92.90 | 95.17 |

The yields of the essential oil were *Citrus aurantium* 0.16 % : *Citrus sinensis* 0.93 %. RI<sup>a</sup>: Identification by NIST MS library RI<sup>b</sup>: Retention indices relative to C7–C29 on the HP-5MS capillary column, – : not detected

**Table 2:** Zones of growth inhibition in Percentage Inhibition (PI %) showing antifungal activity for EOs of *Citrus sinensis* (L) Osbeck and *Citrus aurantium*. Zones of growth inhibition values are presented as mean  $\pm$  standard deviation.

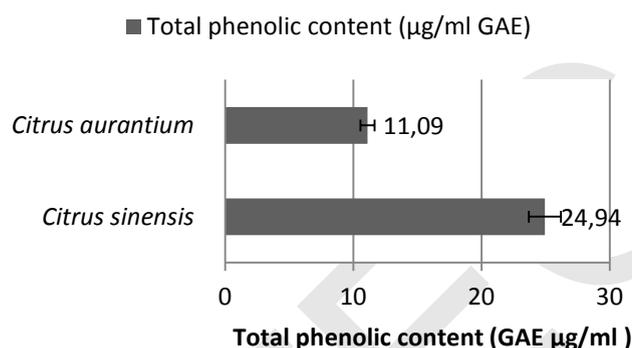
| Essential oils                   |       | Percentage Inhibition (PI %) <sup>a</sup> (mean $\pm$ SE, n=3) |   |                                |                              |                                |
|----------------------------------|-------|--|---|--------------------------------|------------------------------|--------------------------------|
|                                  |       | <i>Fusarium ssp</i>  | <i>Fusarium oxysporum fsp albedinis</i> | <i>Alternaria solani</i>       | <i>Alternaria sp</i>         | <i>Penicellium sp</i>          |
| Dose(mg/ml)                      |       |  |   |                                |                              |                                |
| <i>Citrus sinensis</i> (L)Osbeck | 1     | 100 $\pm$ 00.0 <sup>A</sup>                                    | 100 $\pm$ 00.0 <sup>A</sup>             | 100 $\pm$ 00.0 <sup>A</sup>    | 100 $\pm$ 00.0 <sup>A</sup>  | 63.92 $\pm$ 0.3 <sup>AB</sup>  |
|                                  | 0.8   | 100 $\pm$ 00.0 <sup>A</sup>                                    | 76.84 $\pm$ 7.8 <sup>A</sup>            | 100 $\pm$ 00.0 <sup>A</sup>    | 100 $\pm$ 00.0 <sup>A</sup>  | 60.62 $\pm$ 4 <sup>AB</sup>    |
|                                  | 0.6   | 100 $\pm$ 00.0 <sup>A</sup>                                    | 76.59 $\pm$ 3.5 <sup>A</sup>            | 100 $\pm$ 00.0 <sup>A</sup>    | 100 $\pm$ 00.0 <sup>A</sup>  | 56.91 $\pm$ 10.0 <sup>AB</sup> |
|                                  | 0.4   | 100 $\pm$ 00.0 <sup>A</sup>                                    | 65.90 $\pm$ 6.3 <sup>AB</sup>           | 60.34 $\pm$ 16.1 <sup>AB</sup> | 100 $\pm$ 00.0 <sup>A</sup>  | 13.02 $\pm$ 5.6 <sup>C</sup>   |
|                                  | 0.2   | 88.43 $\pm$ 0.7 <sup>A</sup>                                   | 50.33 $\pm$ 8.3 <sup>B</sup>            | 58.04 $\pm$ 5.8 <sup>AB</sup>  | 73.07 $\pm$ 4.3 <sup>A</sup> | N.A.                           |
|                                  | 0.1   | 12.35 $\pm$ 3.3 <sup>C</sup>                                   | 19.40 $\pm$ 5.5 <sup>C</sup>            | 46.66 $\pm$ 1.5 <sup>B</sup>   | 23.33 $\pm$ 2.6 <sup>C</sup> | N.A.                           |
|                                  | 0.05  | 3.92 $\pm$ 0.8 <sup>D</sup>                                    | 9.53 $\pm$ 0.7 <sup>C</sup>             | 44.5 $\pm$ 1.5 <sup>B</sup>    | 8.46 $\pm$ 8.6 <sup>C</sup>  | N.A.                           |
|                                  | 0.01  | N.A.   | 2.86 $\pm$ 0.5 <sup>C</sup>             | 32.83 $\pm$ 2.7 <sup>C</sup>   | 5.12 $\pm$ 1.7 <sup>C</sup>  | N.A.                           |
|                                  | 0.001 | N.A.   | N.A.                                    | N.A.                           | N.A.                         | N.A.                           |
| <i>Citrus</i>                    | 1     | 100 $\pm$ 00.0 <sup>A</sup>                                    | 100 $\pm$ 00.0 <sup>A</sup>             | 100 $\pm$ 00.0 <sup>A</sup>    | 100 $\pm$ 00.0 <sup>A</sup>  | 100 $\pm$ 00.0 <sup>A</sup>    |
|                                  | 0.8   | 100 $\pm$ 00.0 <sup>A</sup>                                    | 100 $\pm$ 00.0 <sup>A</sup>             | 100 $\pm$ 00.0 <sup>A</sup>    | 100 $\pm$ 00.0 <sup>A</sup>  | 100 $\pm$ 00.0 <sup>A</sup>    |
|                                  | 0.6   | 100 $\pm$ 00.0 <sup>A</sup>                                    | 100 $\pm$ 00.0 <sup>A</sup>             | 100 $\pm$ 00.0 <sup>A</sup>    | 100 $\pm$ 00.0 <sup>A</sup>  | 100 $\pm$ 00.0 <sup>A</sup>    |
|                                  | 0.4   | 100 $\pm$ 00.0 <sup>A</sup>                                    | 100 $\pm$ 00.0 <sup>A</sup>             | 100 $\pm$ 00.0 <sup>A</sup>    | 100 $\pm$ 00.0 <sup>A</sup>  | 100 $\pm$ 00.0 <sup>A</sup>    |
|                                  | 0.2   | 100 $\pm$ 00.0 <sup>A</sup>                                    | 100 $\pm$ 00.0 <sup>A</sup>             | 100 $\pm$ 00.0 <sup>A</sup>    | 100 $\pm$ 00.0 <sup>A</sup>  | 100 $\pm$ 00.0 <sup>A</sup>    |

|                  |       |                       |                       |                          |                          |                         |
|------------------|-------|-----------------------|-----------------------|--------------------------|--------------------------|-------------------------|
| <i>aurantium</i> | 0.1   | 100±00.0 <sup>A</sup> | 100±00.0 <sup>A</sup> | 100±00.0 <sup>A</sup>    | 100±00.0 <sup>A</sup>    | 100±00.0 <sup>A</sup>   |
|                  | 0.05  | 100±00.0 <sup>A</sup> | 100±00.0 <sup>A</sup> | 100±00.0 <sup>A</sup>    | 100±00.0 <sup>A</sup>    | 64,92±19.3 <sup>A</sup> |
|                  | 0.01  | N.A.                  | 34.11±3 <sup>AB</sup> | 24,93± 8.1 <sup>AB</sup> | 22,25± 2.5 <sup>AB</sup> | 1.80±5.6 <sup>B</sup>   |
|                  | 0.001 | N.A.                  | 21.50±1. <sup>B</sup> | 21.16 ± 4 <sup>B</sup>   | 13.16± 3.5 <sup>B</sup>  | N.A.                    |
|                  |       |                       |                       |                          |                          |                         |

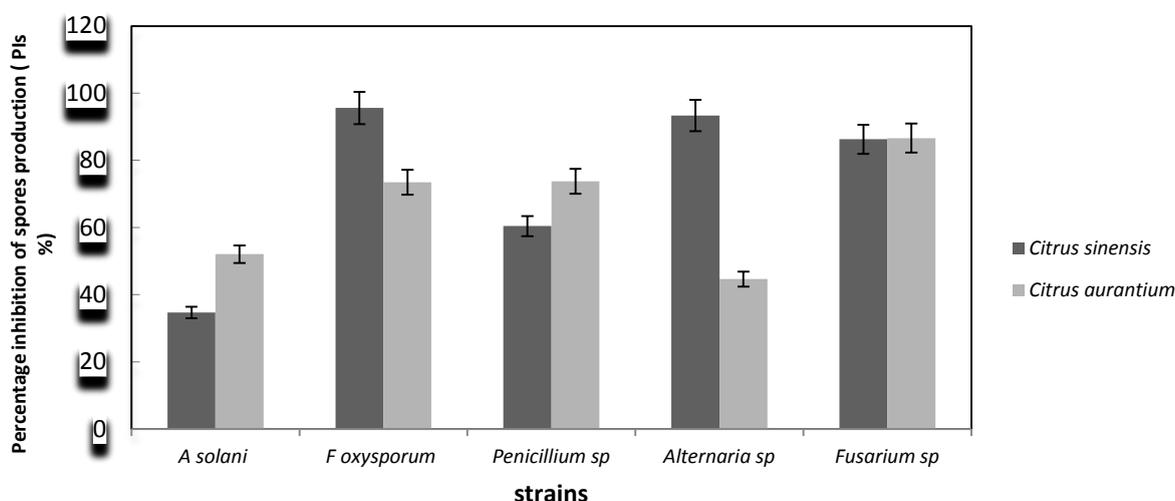
<sup>a</sup> Values followed by same alphabetic letters are not significantly different according to ANOVA and Duncan's Multiple Range Test ( $p \leq 0.05$ ). N.A., non-active.

**Table 3 :** Minimal inhibitory concentration (MIC) and Minimal fungicidal concentration (MFC) (mg/ml) values of EOs of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* from Algeria

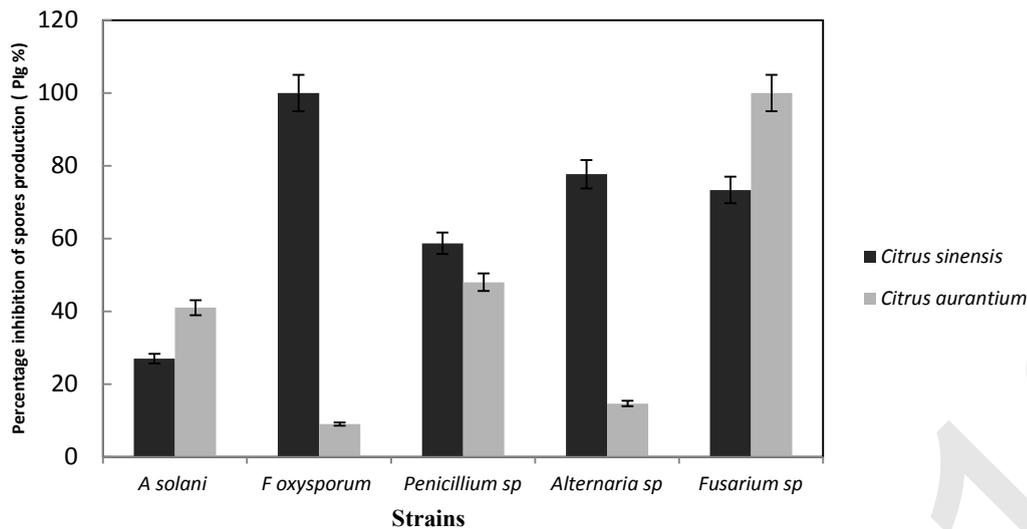
| Fungal species                          | <i>Citrus sinensis</i> (L) Osbeck |             | <i>Citrus aurantium</i> |             |
|---|-----------------------------------|-------------|-------------------------|-------------|
|   | MIC (mg/ml)                       | MFC (mg/ml) | MIC (mg/ml)             | MFC (mg/ml) |
| <i>Alternaria solani</i>                | 0, 6                              | 1           | 0,05                    | 0,05        |
| <i>Alternaria sp</i>                    | 0, 4                              | 0.8         | 0,05                    | 0,05        |
| <i>Fusarium oxysporum fsp albedinis</i> | 1,0                               | >1,0        | 0,05                    | 0,05        |
| <i>Fusarium sp</i>                      | 0, 4                              | 0,4         | 0,05                    | 0,05        |
| <i>Penicillium sp</i>                   | >1,0                              | >1,0        | 0,1                     | 0,2         |



**Figure 1:** The amount of total phenolic content (µg/ml GAE) in essential oils of *Citrus sinensis* (L) Osbeck and *Citrus aurantium*. Data are means ± standard deviations (error bars).



**Figure 2:** Percentage inhibition (compared with controls) of spore produced of *Alternaria solani*, *Fusarium oxysporum f.sp. albedinis*, *Penicillium sp*, *Alternaria sp* and *Fusarium sp* in colonies previously exposed to essential oils of *Citrus sinensis* (L) Osbeck and *Citrus aurantium*. Data are means ± standard deviations (error bars).



**Figure 3:** Percentage inhibition (compared with controls) of spore germination of *Alternaria solani*, *Fusarium oxysporum f.sp. albedinis*, *penicillium sp*, *Alternaria sp* and *Fusarium sp* in colonies previously exposed to essential oils of *Citrus sinensis* (L) Osbeck and *Citrus aurantium*) Data are means  $\pm$  standard deviations (error bars).

## Conclusion

This study showed that essential oils of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* have significant antifungal activity and can be used as a promising future for treatment programs for managing plant diseases that eliminates the spread of fungi tested. Suppression of spore production by EOs could make a major contribution to limiting the spread of the pathogen. The underlying mechanism of action of EOs on the switch between vegetative and reproductive phases of development of the fungus remains to be understood. Our results showed that EOs of *Citrus sinensis* (L) Osbeck and *Citrus aurantium* antifungal are naturally very effective and could be used as a potential natural fungicide for control of fungal pathogens.

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# CHEMICAL STUDY OF TWO NATURAL SUBSTANCES EXTRACTED FROM *MEDICAGO SATIVA* GROWN ON DIFFERENT SOILS AND ANALYSIS OF THEIR EFFECTS ON THE GROWTH OF SOME PATHOGENIC BACTERIA

Meriem Bouzeraa-Bessila

Department of Biology, Laboratory of Plant Biology and Environment  
Faculty of Science, University Badji Mokhtar of Annaba 23000-Annaba, Algeria  
[m.bessilabouzera@yahoo.fr](mailto:m.bessilabouzera@yahoo.fr)

**Abstract:** To identify new phytotherapeutic molecules economically accessible and with an effective biological activity we are interested to *Medicago sativa* leaves extracts. Our first objective is to analysis the edaphic factor effect on the chemical characters of flavonoids and saponins. This could make easier a better control of the aspects of these extract with a view to a pharmaceutical preparation. The second objective is to determinate their antibacterial effect on some bacterial strains known for their pathogenicity in humans. The results show that the soil has an impact on the chemical composition of plant extracts. The microbial tests translate significant effects. Among the sensitivity degrees vary bacterial strains and plant extracts. These results have been encouraged to promote *Medicago sativa* on an appropriate soil and it is necessary to conduct additional tests to confirm the use of these substances to treat the bacterial infection. These preliminary tests allow us to justify the use of this species in traditional pharmacopoeia suggesting that their leaves possess an interesting antibacterial compounds.

**Keywords :** *Medicago sativa*, actives substances, flavonoïds, saponins, antibacterienne activity impact du facteur édaphique.

## Introduction

To cope with the appearance of the microorganisms, that show a resistance to antibiotics, due to an excessive and uncontrolled use of those molecules, the scientists are confronted to seek for new effective antibacterial substances and broad-spectrum. One strategy for this research is to explore the plants used in traditional medicine. Medicinal plants inexhaustible source of active compounds, are nowadays the main source and basis of numerous pharmaceutical specialties. However, large number of other plant species occurring in nature, in enormous quantities and with interesting therapeutic properties, remains untapped and the man has not yet been able to take advantage of them. In order to enhance and streamline their use and to identify more natural substances with effective and potential therapeutic properties, we are interested in *Medicago sativa* study, one fabaceae more known for his interest in animal feed for its use in public health care although its use in traditional medicine dates back hundreds of years it was used by herbalists to treat various infectious diseases (Bouvyer, 2007). The literature study revealed that exempt for studies on the chemistry of organs, this species has been no investigation on its biological activity. The goals this study is to:

- Achieve a chemical-screening of the plant for determining the principal compounds with a therapeutic interest.
- Determine the chemical profiles of flavonoids and saponins extracted from leaves of *Medicago sativa* from different native soils. The interest is to assess the impact of edaphic factor on their variability. This could facilitate a better control of the qualitative and quantitative aspects of these active substances in order of pharmaceutical preparations.
- Conduct an analysis of the antibacterial activity in order to identify molecules with potential antibacterial properties.

## Materials and Methods

### 1- Plant material

It consists of leaves of *Medicago sativa*. This plant family Fabaceae species is very rich in protein, vitamins and trace elements (Bouvyer, 2007). This plant is healthy and ecological, with specific bacteria living in symbiosis on its root system; it fixes atmospheric nitrogen necessary for its growth and requires no chemical fertilizer.

The leaves of this plant were harvested before the flowering stage in the Annaba region (North-eastern Algeria) in four culture stations with different soil characteristics. After drying in the dark at ambient temperature, the leaves are detached and powdered to be used to obtain different extract.

## 2- Microbial strains

The microbial support used is composed of:

- 3 Strains of Reference: *Escherichia coli* (ATCC); *Staphylococcus aureus* (ATCC); *Pseudomonas aeruginosa* (ATCC).

-9 Bacterial strains frequently isolated in hospital and often implicated in many diseases in humans.

## 3 - Screening Chemical

It consists in detecting the different families of compounds existing in the leaves by precipitation reactions or coloring using reagents specific to each class of compounds. The results are noted positive (+) or negative (-).

## 4- Solutions used

-The decoction is obtained from an aqueous decoction of powdered leaves (20g) mixed with distilled water (1 L) and brought to boiling for 15 minutes. The decoction of 2% obtained was filtered and concentrated on a rotary evaporator.

-Crude extracts flavonoids and saponins: After highlighting the different families of compounds in the leaves of *Medicago sativa*, we targeted these two families. Their preponderance in the leaves and their possible antimicrobial activities presumed encouraged us to submit them to our investigation. Their extraction was conducted using the method described by Lee & al., (1995) for flavonoids and method of Applebaum & al., (1969) for the saponins. For microbiological testing and chromatographic study, the crude extracts were recovered respectively with DMSO (Dimethylsulfoxide) and acetone.

## 5 - Determination of chemical profiles

The identification of chemical profiles of flavonoids and saponins was conducted on leaves coming from the four stations. The objective is to evaluate the impact of soil type on the variability of their chemical components. Separation and identification of substances was performed by TLC (thin layer chromatography) on silica gel G60 plates (Merck). Spots 2 $\mu$ l of each sample is deposited at point's pins on the edge of the plate and immersed in an appropriate eluent. After development of the chromatogram, the plate is dried at ambient temperature and then examined in the UV ( $\lambda=254\text{nm}$  and  $365\text{nm}$ ). The results contain information on the number of chemical constituents their RF (retention factors of chemical constituents) and their behavior under UV light.

## 5-Microbiological tests

The antibacterial activity of the tested solutions was performed on filter paper discs by diffusion method on solid medium (Bauer & al., 1966). Muller Hinton agar is the medium used for tests of bacterial strains (Nostro & al., 2000). The media are inoculated with a few ml of the inoculums (10 CFU / ml) for bacterial species (Cavallo, 2006) in order to cover the whole agar surface. Filter paper discs loaded with test solution are deposited on the surface dry of medium. After 24 h of incubation at 37 ° C, the antibacterial activity is manifested by the appearance of a halo of inhibition of bacterial growth around the discs (Bauer, 1966; Duvar 1980; Carbonelle & al., 1987): is considered respectively as resistant strain sensitive, highly sensitive or extremely sensitive that having a diameter  $D < 8\text{mm}$ ;  $9\text{mm} \geq D \leq 14\text{mm}$ ;  $15\text{mm} \geq D \leq 19\text{mm}$ ;  $D > 20\text{mm}$ . (Duraffourd & al., 1990; Ponce & al., 2003).

## Results and discussion:

### Chemical Screening:

**Table 1:** Chemical screening of *Medicago* leaves

| Saponins | Flavonoids | Alkaloids | Essential oils | Anthocyanes | Stérols and thriterpenes |
|----------|------------|-----------|----------------|-------------|--------------------------|
| +        | +          | -         | -              | +           | +                        |

In this work it appears that the phytochemical screening based on specific tests allowed to characterize at the Medicago leaves some families of chemical compounds (Tab.1). These tests are in agreement with the results of the literature.

### Localization and characteristics of harvesting stations

**Table 2:** Geographical situation of the harvest stations

| Stations  | Latitude | Longitude | Altitude | Bioclimatic floor |
|-----------|----------|-----------|----------|-------------------|
| Fetzara   | 36°48N   | 7°45E     | 0-50m    | Subhumid          |
| Aeroporto | 36°50N   | 7°48E     | 0-50m    | Subhumid          |
| Besbes    | 36°46N   | 7°54E     | 0-50m    | Subhumid          |
| Ben mhidi | 36°41N   | 7°51E     | 0-50m    | Subhumid          |

**Table 3:** Physico-chemical characters of soils

| Stations  | pH   | pH   | Texture      | Organic matter % | Electrical conductivity | Total limestone % |
|-----------|------|------|--------------|------------------|-------------------------|-------------------|
|           | H2O  | KCl  |              |                  |                         |                   |
| Fetzara   | 7,66 | 6,90 | sandy- slimy | 3,70             | 2,07                    | 14                |
| Aeroporto | 7,52 | 6,80 | slimy-clay   | 2,11             | 0,14                    | 12,52             |
| Besbes    | 7,61 | 6,92 | slimy-clay   | 2,64             | 0,17                    | 22,37             |
| Ben mhidi | 7,12 | 7,04 | slimy-clay   | 2,26             | 0,12                    | 23,47             |

### Chemical profiles of Flavonoids and Saponins:

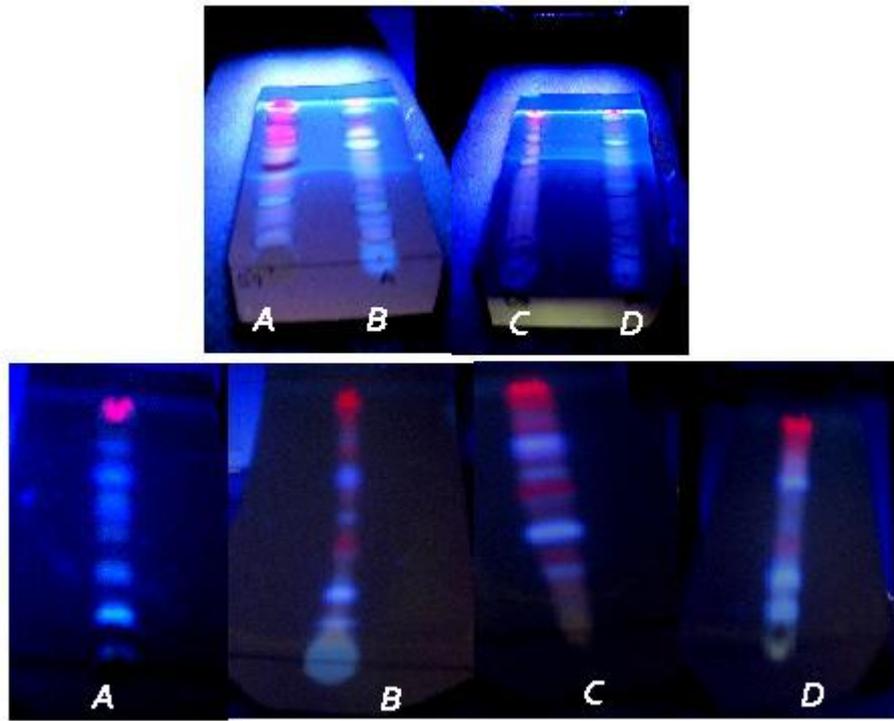


Figure1: Chromatograms observed under UV light at 366 nm (A:Benmhidi;B:Aeroport;C:Besbes;D:Fetzara)

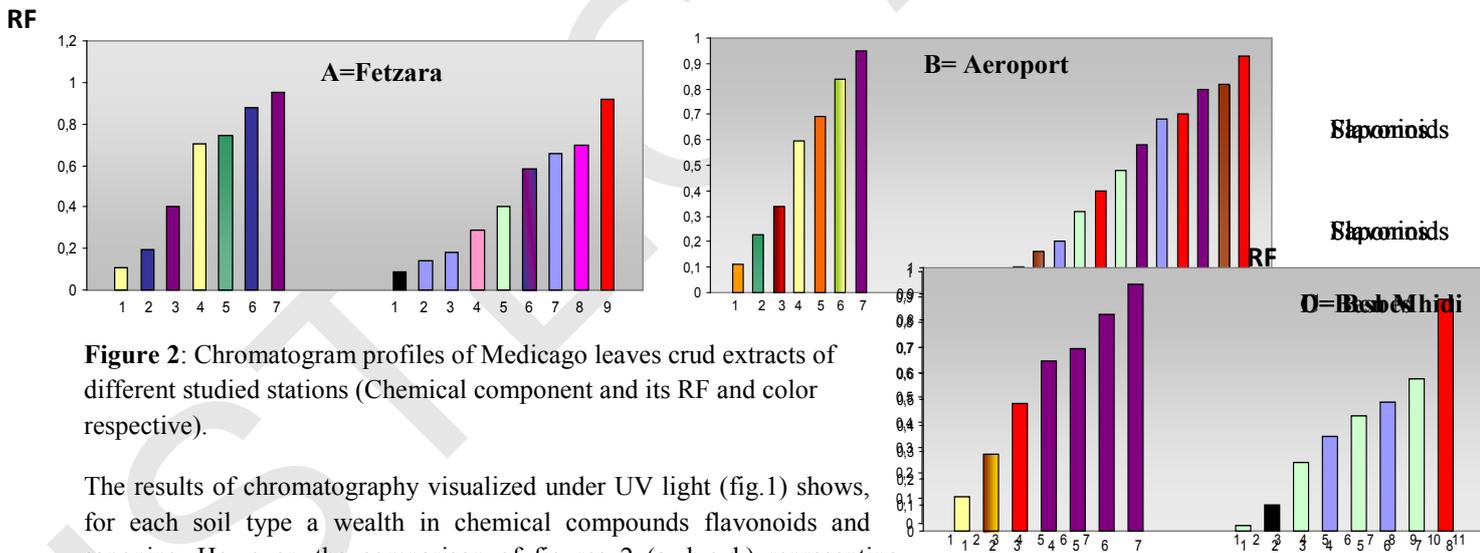
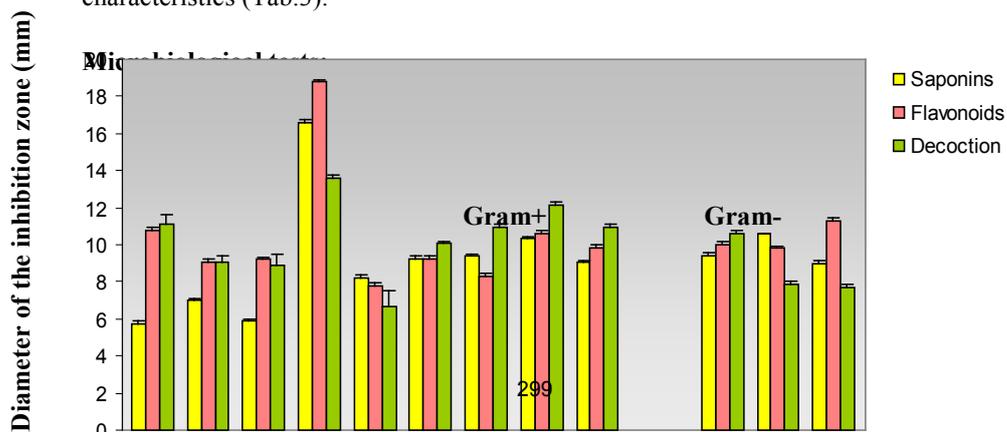


Figure 2: Chromatogram profiles of Medicago leaves crud extracts of different studied stations (Chemical component and its RF and color respective).

The results of chromatography visualized under UV light (fig.1) shows, for each soil type a wealth in chemical compounds flavonoids and saponins. However, the comparison of figures 2 (a, b,c,d.) representing their respective numbers, their colors and their RF indicate that these compounds vary qualitatively and quantitatively from soil to soil. These results indicate that although there is a geographic unit of the source of plant material (Tab. 2) the chemical composition of flavonoids and saponins is still dependent on soil physicochemical characteristics (Tab.3).



a   b   c   d   e   f   g   h   i                    j   k   l                    **Bacteria**

**Figure 3** :Compared activity of three extracts on Gram (-)and gram (+) bacterial growth. **a**: E. Coli; **b**: E. Coli(BLSE); **c**: E. Coli (ATCC) **d**: Klebsiella oxytoca; **e**: K.pneumoniae; **f**: Serratia,sp; **g**: Pseudomonas,sp; **h**: P,aeruginosa(ATCC) ; **i** : Acinetobacter; **j**: Staphylococcus aureus; **k**: S. epidermidis; **l**: S.aureus(ATCC)

Microbial tests reveal for each of three solutions studied an antibacterial activity well defined on most of the Gram+ and Gram- . The importance of this activity is variable depending on the strain (fig.3).

*Klebsiella oxytoca* was very sensitive towards the three solutions proved very active. Their diameters of zones of inhibition are of the order of 13,4mm, 18,7mm and 16,4mm respectively for the decoction, flavonoids and saponins. While *Klebsiella pneumonia* has proved resistant. Apart its effect on *Klebsiella oxytoca* whose sensibility towards the 3 solutions are quite similar the decoction is the average more active. With a concentration of 2% only its activity appears superior to that of flavonoids and saponins. This marked activity could be explained by the combined action of flavonoids and saponins in the decoction or by a synergy effect between the different constituents soluble in water because in the absence of complete chemical screening, we can not exclude the possibility of existence in the decoction of other molecules known for this type of activities such as: terpenoids (Ceccherell, & al., 1985; Grade & al., 1992;) and phenolic compounds (Slavienaka & al., 2005).

These sensitivity tests allowed us to determine the presence of an antibacterial activity in *Medicago sativa*. This plant is traditionally used to treat rum, digestive disorders, abscesses and other infectious diseases (Bouvyer, 2007). Therefore inhibiting the growth of bacteria tested partly responsible for these pathologies (Fauchère & April, 2002) would explain at least parts the plant using in traditional medicine.

## Conclusion

It appears from this study that the phytochemical screening based on specific tests allowed to characterize some families of chemicals in relation to literature results.

The study of chemical profiles of crude extracts of flavonoids and saponins isolated from the leaves of *Medicago sativa* native soils of different shows for each substance rich in chemical compounds, however, varies qualitatively and quantitatively from one soil to another. This shows that although there is a geographic unit of the source of plant material, homogenization chemical characteristics is all the same dependent edaphic factor.

The results of microbiological tests showed that the leaves of *Medicago sativa* possess chemical molecules with antibacterial power defined on the majority of strains tested. On *Klebsiella oxytoca* the effect is very potential.

Those results have been encouraged to promote *Medicago sativa* on an appropriate soil. It is necessary to conduct additional tests to confirm the specific use of the studied solutions to treat the bacterial infections caused by bacteria found to be sensitive to our extracts because the preliminary tests of bacterial activity allow us to justify the use of *Medicago sativa* in traditional pharmacopoeia suggesting that their leaves possess an interesting antibacterial compounds.

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# CONSTRAINT MAP DEVELOPMENT FOR HIGH VOLTAGE OVERHEAD TRANSMISSION LINES CONGESTION MANAGEMENT IN DEREGULATED ELECTRICITY

Ahmad M AL-Kandari<sup>a</sup> Ayman Ahmed Sami<sup>b</sup> Ahmed Sami<sup>c</sup> Bader Alkandari<sup>a</sup>

**a: College of Technological Studies, PAAET, Kuwait**

**b: Senior GIS Analyst Engineer**

**c: Consultant at Egyptian Electric Utility Regulatory Agency ERA Egypt**

**Abstract** Congestion management is considered one of the essential functions of the transmission system operator (TSO) in the deregulated electricity. Transmission congestion occurs when actual or scheduled flows of electricity across a line or piece of equipment are restricted below desired levels either by the physical or electrical capacity of the line or by operational restrictions created and enforced to protect the security and reliability of the grid.

At first the critical and conditional congestion areas are identified then designation of one or more National Corridors to facilitate relief of transmission congestion in these areas will be executed.

The specific preliminary corridor alignment details are input into a GIS database. This allowed the GIS constraint mapping and analysis to begin. Multiple layers of constraints are researched and overlaid onto the routing maps. These layers are overlaid together through the GIS mapping software, but required quality control with regard to completeness. Due to the multiple sources of information pertaining to each constraint, multiple databases are researched, agency contacts are made, and quality review of the data is completed. Much data is eliminated due to level of completeness or receipt from non-qualified resources..

**Key words:** congestion management, TSO, constraint map, overhead transmission line routing

## INTRODUCTION

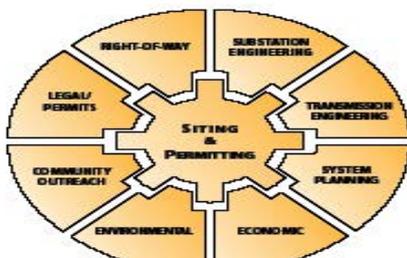
The electricity industry is characterized by high volatility of demand, non storability of electricity and strong unavoidable network externalities in case of congestion. Due to these characteristics transmission plays a crucial role in both supporting market trading and offering a reliable service. The establishment of (TSO) as a key institution in the emerging competitive electricity markets is intended to ensure the necessary level of coordination in grid operations. However the extent of centralized control and market management by the TSO is a debated point from both a theoretical and practical perspective. A transmission link is congested when net demand exceeds its safe transfer capacity. Possible actions to deal with congestion are either a reduction of demand in the congested direction or an increase of counter flows in the opposite direction.

Much of the congestion seen today results from the practice of adhering to reliability limits imposed so as to be prepared to withstand contingencies. Without questioning the need for such adherence, there are nonetheless legitimate questions about whether we have adequate tools to represent and analyze the complex relationship between contingencies and congestion. This relationship needs to be more fully understood. Similarly, some congestion and flow restrictions are due to scheduling practices and transmission rights rather than reliability and operational capabilities.

“Choosing the route for an electric power transmission line requires consideration of a number of factors. The values of these factors will usually vary across space. While the exact set of factors to be considered may change in different parts of the country, most transmission line routing will require some attention to environmental factors, such as wetlands and flood plains, community factors, such as existing neighborhoods and historic sites, and engineering factors, such as slope and access.

## Transmission Line Sitting Process

Sitting a transmission line requires consideration of input from a variety of sources. The sitting wheel illustrates the various sources of input considered during this process .Sitting a transmission line is a three-phase process that involves mapping resources, identifying opportunities and constraints, and completing an alternative evaluation.



### Phase 1

Available data, information sources, and aerial photography are analyzed to identify opportunities and constraints for sitting the transmission line.

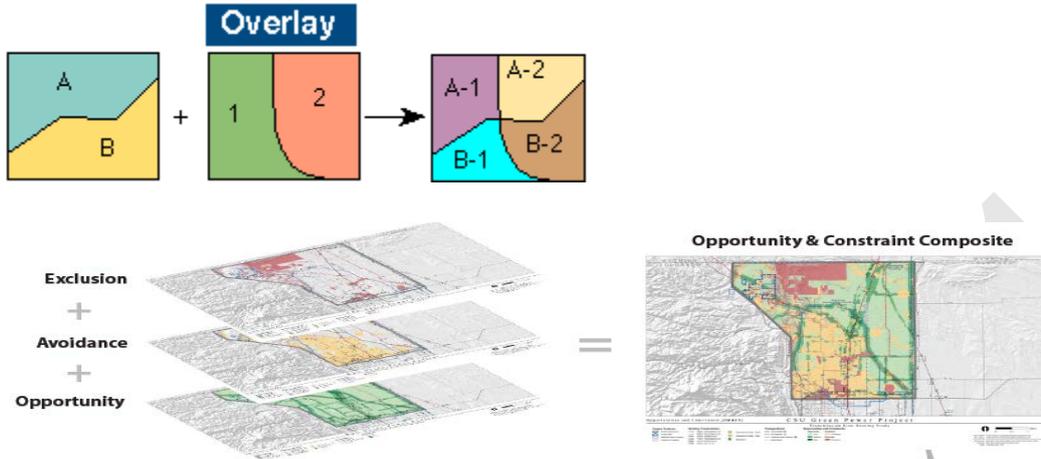
Opportunity Areas: Existing utility line easements, transportation corridors, rangelands, and along section lines or the edge of agricultural fields.

Avoidance Areas: Residential areas and structures, open water, visually sensitive areas, irrigated agriculture, wilderness, conservation areas or other designated lands, and critical plant or wildlife habitat.

## Phase 2

Phase 2 of the siting process involves creating an opportunity and constraint composite map to identify regions in the project study area that are suitable for routing a transmission line based on the criteria developed for the project.

Preliminary alternative corridors have been identified by conducting an opportunity and constraint analysis based on the siting criteria.



## Phase 3

Phase 3, or Route Refinement, consists of a comparative analysis that focuses on the number and type of resources that may influence the transmission line alignment within each corridor which typically include the following:

- Length of transmission line
- Right-of-way requirements and availability
- Land use considerations such as visual impacts, proximity to residences, and impact on agricultural activities as well as existing and future land use
- Environmental resource considerations such as impacts on cultural or biological resources such as wildlife, plants and wetlands
- Topography
- Jurisdiction and regulatory considerations
- Conflicts with airport height restrictions
- County requirements
- Cost

The process involves identification, quantification, and assessment of the environmental consequences, engineering needs, and costs that would be expected as a result of implementation of each of the transmission line alternatives. With the completion of this phase and considering public and agency input, a preferred route and alternatives are identified. Congestion areas of concern are areas where a large-scale congestion problem exists or may be emerging, but more information and analysis is needed to determine the magnitude of the problem and the likely relevance of transmission and other solutions. The congestion in these areas may be significant, but it does not appear to be of critical importance at this time. These areas are shown in Figure 1 by light blue arrows. The arrows also indicate where some possible transmission solutions have been suggested and the direction of the additional electricity flows that would result.

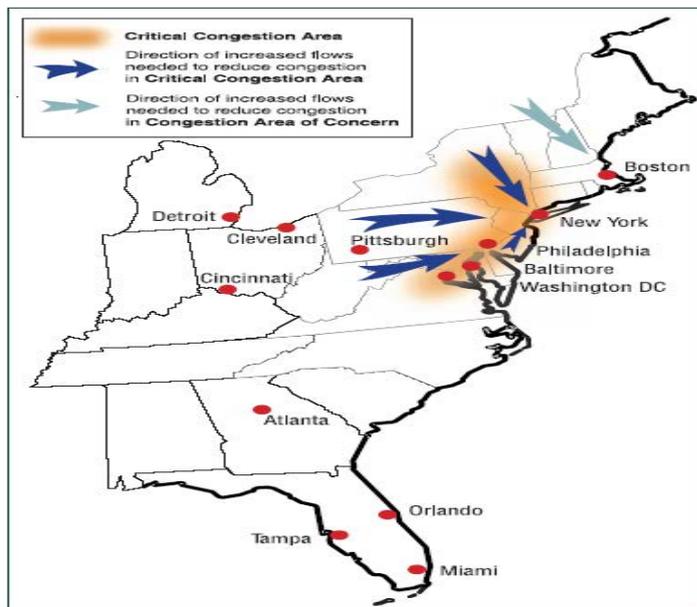


Figure 1 Critical Congestion Area and Congestion Area of Concern

### Conclusion and recommendations

The constraint map development is very significant step in congestion management for high voltage overhead transmission lines, accordingly and based on the long term forecast of energy source and demand requirements TSO can execute in due time the reinforcement action for the transmission network using the created constraint map. The role of GIS is used essential to analyze routes for infrastructure expansion and development of constraint map. GIS serves as a vehicle for change and resolution in addressing former inadequacies inherent in the manual siting process for linear facilities. This technology allows for comprehensive quantifiable assessment of social, engineering, and ecological impacts with the implementation of a consistent and defensible siting methodology. Consequently, organizations are armed with a tool which enables them to adhere to regulatory policies and secure appropriate permissions in an efficient manner, thereby reducing associated time and costs.

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## Converters Control of Wind Turbine Chain Based on Doubly Fed Induction Generator

A. Dekhane, A. Abderrezak  
 Badji Mokhtar-Annaba University  
 P.O. Box 12, 23000  
 Annaba, Algeria  
 Panzer.23@hotmail.com

**Abstract :** In this paper, we evaluate a topology of a three phase space vector pulse width modulation based rectifier, feeding a three-phase two levels inverter, associate to a double-fed induction generator (DFIG) in a horizontal axis wind turbine conversion chain, to improve power quality and ensure maximum participation of the chain on the service system. We take on consideration the mathematical model of the DFIG. The results of different simulations of the whole conversion chain, realized under the MATLAB / Simulink, were used to show the performance of the proposed control.

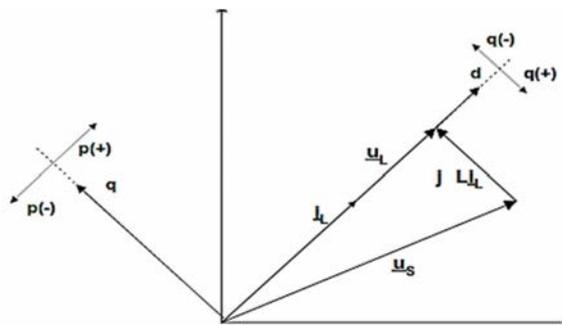
**Key words:** Control, wind turbine, converter, PMW, DFIG.

### Introduction

Wind energy is clean energy that has been a rapid development during the last two decades. Wind energy seems to be an interesting alternative that allows controlling the energy injected into the network and thus diversifying the energy markets. To be used in numerous applications and respond to economic constraints, the chain of conversion of this energy must be robust and reliable. It must also submit a better efficiency and be achieved at low cost. In this aim, it is necessary to extract the maximum wind power. The operating power of the wind depends on the intensity and wind speed in particular the speed of the turbine (Tafticht 2003).

The technology used for the production of wind energy saw their first efforts will concentrate on the constant speed operation for small machines that are directly connected to the mains through a soft start to reduce switching transients. Given the advantages of variable speed wind turbines, the use of large machines is made possible because of their effectiveness (Janaka 2003). Among these machines, we consider in this work a doubly fed induction generator supplied with a device of power electronics made up mainly of a rectifier installed in cascade with an inverter. The converter is dimensioned with the third of the rated power of the rotor (Mishra 2009).

Since the chain of conversion thus requires bidirectional converters, the rectifiers containing IGBT, GTO or MOSFET, controlled in SVPMW, has very good advantages comparing with topology to diodes. These converters take part in the deterioration of the 'power quality' and the voltage of the distribution networks seen their consumption of the Non-sinusoidal currents (Blasco-Giménez 2000).



**Figure 1.** Power flow in bi-directional AC/DC converter.

In addition to non-reversibility (see “Fig. 1”), topology in diode poses many disadvantages like the rate of the very high harmonics and the power-factor very low compared to the rectifiers with PWM, one which guarantees a power-factor very high and function in the four (4) quadrants (KWON 1999).

In this document proposing a control of the converter side rotor which enables us to complete the direct control of the active and reactivates powers separately, this converter must be supplied with a stable continuous voltage, this voltage will be to regulate by the controlled rectifier, and the results of simulation of this double objective will be presented and interpreted.

## System Description

The wind system, whose diagram of the principle is shown in “Fig. 2”, has been the subject of our study. It includes DFIG, a turbine, which through a multiplier, drives the DFIG, which is directly connected to the grid by the stator where it is also connected through static three phase converters to rings / brushes system of the machine rotor.

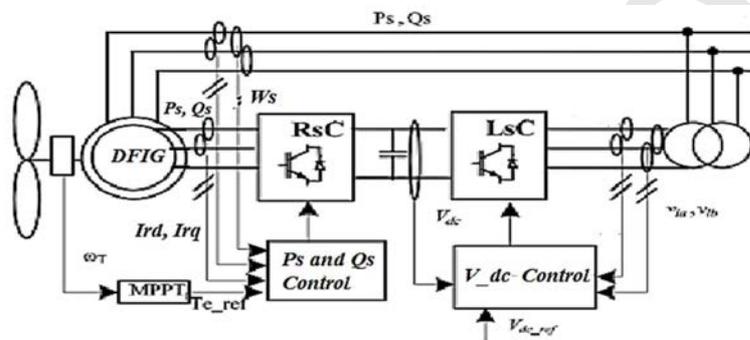


Figure 2. Variable speed wind turbine studied.

## Mathematical description of the Voltage-Source Pwm Rectifier

The topology of the rectifier based SVPWM is presented in “Fig. 3”, it includes three legs in each one six fully controlled switches containing GTO or of IGBT connected to the voltage of network egA, egB, egC.

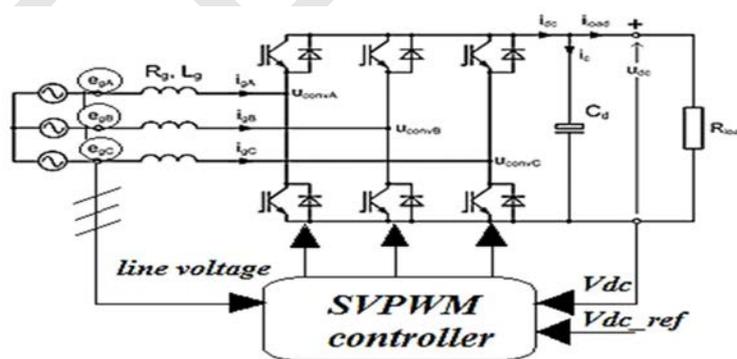


Figure 3. Three-phase voltage-source PWM rectifier

The instantaneous states of the power switches and can be described in a form of equations (1).

$$u_{convA} = \frac{K_a \cdot u_{dc}}{2}, \quad u_{convB} = \frac{K_b \cdot u_{dc}}{2}, \quad u_{convC} = \frac{K_c \cdot u_{dc}}{2} \quad (1)$$

Where the  $K_i$ , are the control switching signal.

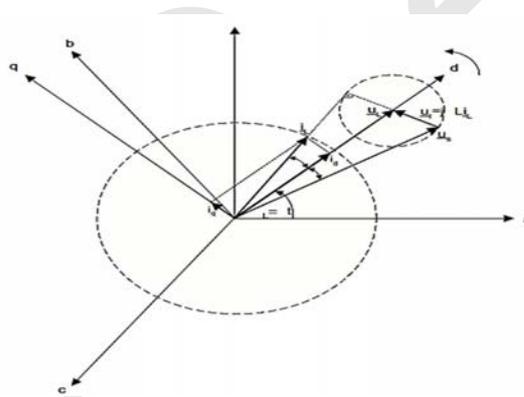
The mathematical model of the voltage-source PWM rectifier in the d-q coordinates can be formulated:

$$\begin{aligned} \frac{d}{dt} u_{dc} &= -\frac{u_{dc}}{R_{load} C_d} + \frac{3}{2C_d} K_d i_{gd} \\ \frac{d}{dt} i_{gd} &= -\frac{R_g}{L_g} i_{gd} + \omega i_{gq} - \frac{1}{2L_g} K_d u_{dc} + \frac{1}{L_g} e_{gd} \\ \frac{d}{dt} i_{gq} &= -\frac{R_g}{L_g} i_{gq} - \omega i_{gd} - \frac{1}{2L_g} K_q u_{dc} \end{aligned} \quad (2)$$

Assuming that the power conversion is lossless the power balance of the PWM rectifier can be described by the nonlinear differential equation (3) (Blasco-Giménez 2000) :

$$\frac{3}{2} e_{gd} i_{gd} = u_{dc} C_d \frac{d}{dt} u_{dc} + \frac{u_{dc}^2}{R_{load}} \quad (3)$$

The basic relationship between vectors of the PWM rectifier is presented in “Fig. 4”.



**Figure 4.** Power flow in bi-directional AC/DC converter

## Modeling of the DFIG

The model is drawn in the same manner as that of the cage induction motor except that the rotor voltages are nonzero (Gaillard, 2010). In a landmark two-phase, the equations of tension and flux, the generator can be written as follows (Benelghali 2010).

$$\begin{cases} V_{sd} = R_s I_{sd} + \frac{d\phi_{sd}}{dt} - \dot{\theta}_s \phi_{sq} \\ V_{sq} = R_s I_{sq} + \frac{d\phi_{sq}}{dt} - \dot{\theta}_s \phi_{sd} \\ V_{rd} = R_r I_{rd} + \frac{d\phi_{rd}}{dt} - \dot{\theta}_r \phi_{rq} \\ V_{rq} = R_r I_{rq} + \frac{d\phi_{rq}}{dt} - \dot{\theta}_r \phi_{rd} \end{cases} \quad (4)$$

$$\begin{cases} \phi_{sd} = L_s I_{sd} + M I_{rq} \\ \phi_{sq} = L_s I_{sq} + M I_{rd} \\ \phi_{rd} = L_r I_{rd} + M I_{sd} \\ \phi_{rq} = L_r I_{rq} + M I_{sq} \end{cases} \quad (5)$$

Where,

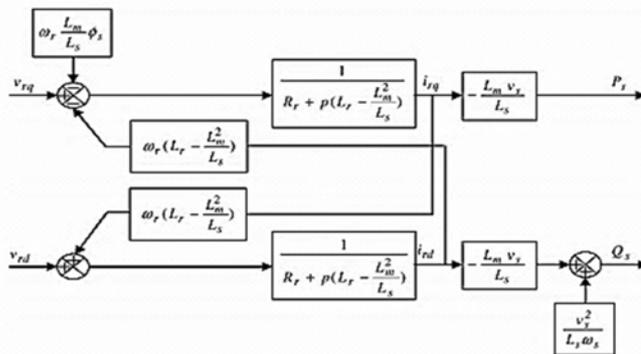
$$L_s = L_s - M_s; L_r = L_r - M_r; M = \frac{3}{2} M_{sr} \quad (6)$$

And the mechanical equation and the torque of the machine are given respectively by the following terms:

$$J \frac{d\Omega}{dt} = T_{em} - C_r - k_f \cdot \Omega \quad (7)$$

$$T_{em} = p \frac{M}{L_s} (I_{rq} \phi_{sd} - I_{rd} \phi_{sq}) \quad (8)$$

And, we consequently represent the block diagram (see "Fig. 5").



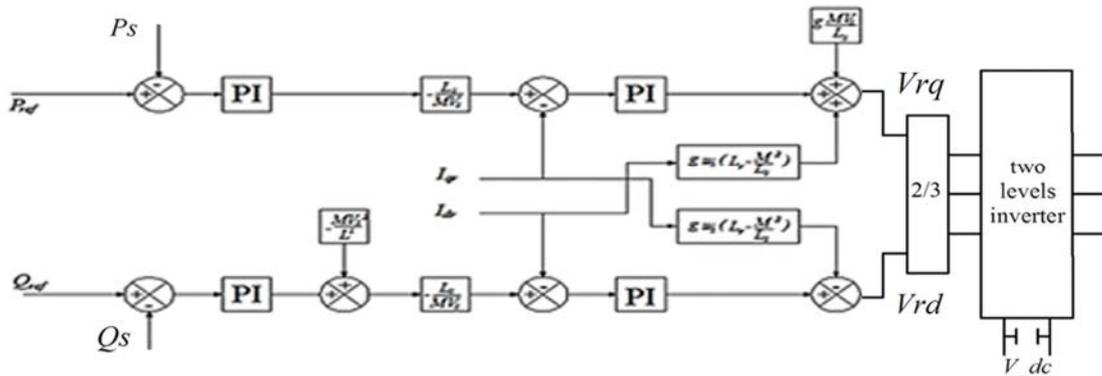
**Figure 5.** Block diagram of the DFIM model

## Inverter control

To facilitate the electrical production control of the wind turbine, we carry out an independent control of the DFIG active and reactive powers. For this purpose, there are two solutions (Akagi 2001): The first method consists in neglecting the coupling terms and installing an independent regulator on each axis to control the active and reactive powers independently. This method will be called direct method because the powers regulators control directly the machine rotor voltages. The second method consists in taking into account these coupling terms and compensating them by carrying out a system includes two loops, making the possibility of rotor powers and currents control. This method is called indirect method. This last method will be taken on consideration.

The indirect method consists in reproducing, in opposite direction, the block diagram of the system to be controlled (Ekanayake 2003) (Lie Xu 2006). We build a block diagram allowing thus, expressing the voltages according to the powers. We end up then to a model which corresponds to that same of the machine but in opposite direction. The

indirect control will contain therefore, all the elements showed in the DFIG block diagram.



**Figure 6.** Bloc diagram of indirect control with the power loop.

So as to improve the indirect control, we will incorporate an additional regulation loop at the powers in the goal to eliminate the static error while maintaining the system dynamics (Dekhane 2012).

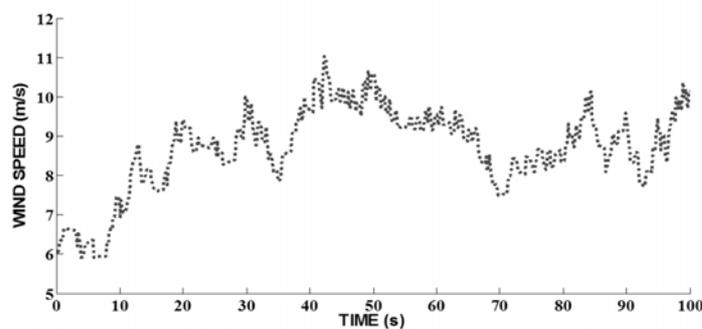
We end to the block diagram presented in “Fig. 6”, where we distinguish well the two regulation loop functions for each axis, one controlling the current and the other power.

## Simulations and Discussions

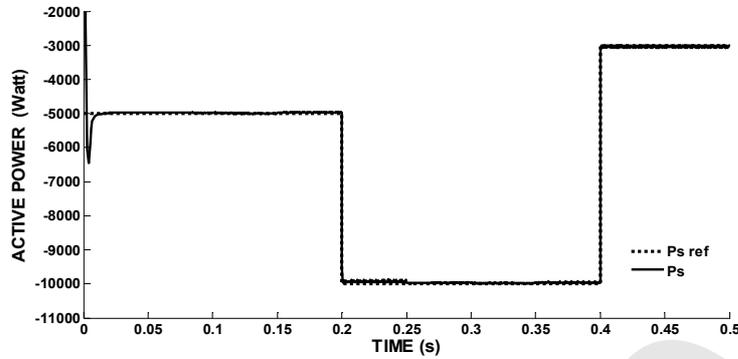
For simulation, we considered a variable wind according to the figure simulated below in a time of 100s “Fig. 7”, then we imposed variations in the reference values the active and reactive powers so validating the mathematical model of the DFIG and testing the control of the inverter in aim to decoupling between the powers and to see at the same time the behavior of rectifier regarding the inverter as a load. The figures below represent the results of simulation.

“Fig. 8” and “Fig. 9”, present respectively the active and reactive power, it is noticed that, those figures represent a good pursuit of its reference and a very good decoupling. The changing of one’s powers doesn’t cause ones of other. Therefore, their control is independent. We observe a dynamics which reacts quickly and without exceeding. The references are correctly followed and there is no more error on the powers. However the response time of the reactive power is slightly long than the active power because of the short time of simulation that is require powerful calculation hardware.

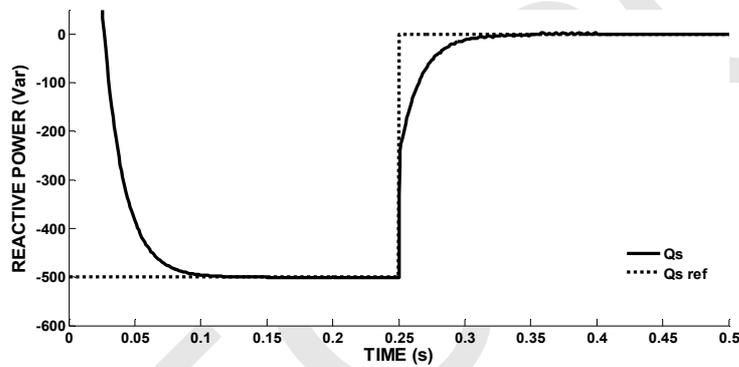
“Fig. 10” shows the DC-voltage delivered by the controlled rectifier, the voltage is constant and it has kept its value and we see a small variation in time 0.2s and 0.4 due to the power references values changing. The rectifier presents a very good dynamics in term of stability.



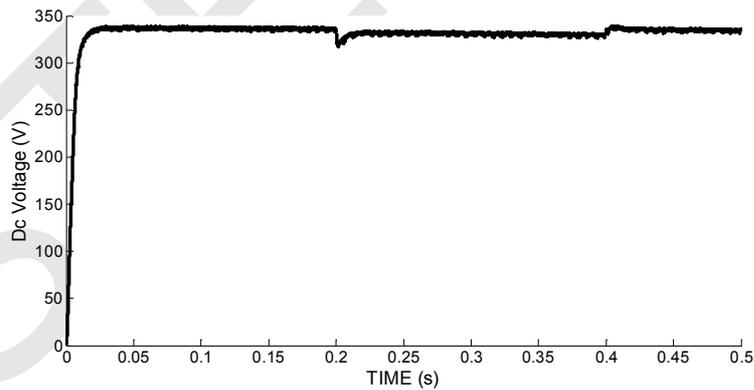
**Figure 7.** Wind speed variation/100s.



**Figure 8.** Active power.



**Figure 9.** Reactive power.



**Figure 10.** Dc voltage in dc-bus

## Conclusion

Following this work we had in first place approved by simulation, the mathematical model of a doubly fed

induction generator. Which we applied the separate control powers. The results of various performed simulations have been commented. The indirect method for the inverter, indeed more complex for implement, offers an advantage for the practical realization because it integrates the rotor current regulation loop, thus making it possible to protect the machine by interposing the current limitations. In addition, since it has a control loop rotor currents, it is easy to limit the maximum current machine during transients and abrupt changes of the load.

The SVPWM control method for the rectifier it is also easy to realized where the voltage output is ensured by a reference value, which ensure the functionality objective of the controlled inverter and the power flow in the both direction whatever the operating mode of the DFIG (sub or super-synchronous).

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# CRT MONİTÖR GERİ DÖNÜŞÜM MAKİNASI VE OTOMASYONU

Fatih Ertam  
Fırat Üniversitesi  
Enformatik Bölümü  
Türkiye  
fatih.ertam@firat.edu.tr

Fehmi Fatih Gedik  
Yıldız Teknik Üniversitesi  
Çevre Mühendisliği Bölümü  
Türkiye  
ffgedik@hotmail.com

Haluk Dilmen  
Fırat Üniversitesi  
Enformatik Bölümü  
Türkiye  
hdilmen@firat.edu.tr

**Özet:** Her yıl milyonlarca televizyon ve monitör doğaya atılmakta ve kurşun, fosfor, kadmiyum, stronsiyum, baryum, arsenik gibi çok tehlikeli ve toksik maddeler ile yenilenebilir olmayan kaynakları içeren materyaller toprağa, suya ve atmosfere karışmaktadır, bu durum çevre ve sağlık sorunlarını beraberinde getirmektedir. Özellikle CRT (Cathode Ray Tube; Katot Işınlı Tüp) monitörler günümüzde yerlerini LCD monitörlere bırakmıştır. Dünyada evlerde ve iş yerlerinde kullanılmayan belki de milyonlarca monitör atıl durumda beklemektedir. CRT monitörlerin ekran camının iç yüzünde renkleri oluşturan fosfor tabakası bulunmaktadır. Kırılan tüplerden oluşan tozların teneffüsü sağlık açısından çok risklidir. Monitörler içerisinde bulunan fosfor açığa çıktığında insan sağlığına zararlı bir madde olmaktadır. Bu sebeple bu monitörlerin rastgele bir yerde parçalanması sağlıklı önemli şekilde etkileyecektir. Bu cihazlar sağlığa zarar vermeden bertaraf edilmelidir. Geliştirilen donanım ile CRT monitörler -Aynı zamanda Televizyonlar- kesilecek ve içerisindeki fosfor çevreye yayılmadan toplanacaktır. Ayrıca kurşun içerikli ekran camlarının, diğer camlardan ayrılması sağlanacaktır.

**Anahtar kelimeler:** Geri dönüşüm, endüstriyel otomasyon, zararlı atıklar, fosfor, kurşun, e-atık

## CRT Monitor Recycling Machine and Automation

**Abstract:** Every year millions of TV and monitor are being thrown to the nature and lead, phosphor, strontium, barium, with arsenic like very dangerous and toxic materials with non-recyclable sources contaminates soil, water and atmosphere. This situation brings about health and environmental issues. Especially CRT (Cathode Ray Tube) monitors nowadays left their places to the LDC monitors. There are millions of unused idle waiting monitors stays in business places and homes. There is phosphor layer inner side of display glass which make up colors. Recessing the dust from broken pipes is very risky for health. Phosphorus contained in monitors is a harmful substance to human health when released. For this reason, random fragmentation place of these monitors will significantly affect the health. These devices must be disposed of without harm to health. With developed hardware CRT monitors -at the same time TVs- will be cut and phosphor will be accumulated without spreading to environment. In addition, the lead content display glasses will be separated from other glasses.

**Keywords:** Recycling, industrial automation, hazardous waste, phosphor, lead, e-waste

## Giriş

Her yıl milyonlarca televizyon ve monitor doğaya atılmakta ve kurşun, fosfor, kadmiyum, stronsiyum, baryum, arsenik gibi çok tehlikeli ve toksik maddeler ile yenilenebilir olmayan kaynakları içeren materyaller toprağa, suya ve atmosfere karışmaktadır. Uygun bir şekilde atıl bilgisayarlar ve monitörler bertaraf edilmezse diğer atık elektronik cihazlar gibi değerli maddelerle birlikte potansiyel olarak tehlikeli maddeleri de içermektedir bu durum çevre ve insan sağlığı için çok ciddi sorunları beraberinde getirmektedir. (Nnorom , 2011)

Elektrikli ve elektronik cihazlar günlük hayatımızın vazgeçilmez bir parçası haline gelmiştir. Gelişen teknoloji ile beraber gün geçtikçe daha çok yeni model piyasaya sürülmekte ve tüketim artmaktadır. Kullanım ömrü dolan elektrikli ve elektronik cihazların ne olduğu hakkında ise pek çok kişinin bir fikri bulunmamaktadır. Sonuçta insanlık bugün elektronik atık adı verilen yeni bir çöp türü ile karşı karşıyadır. E-atıklar, yer kaplamaları ve zehirli maddeler içermelerinden dolayı dünyada gittikçe büyüyen bir sorundur. Son zamanlarda elektronik atık bertarafı konusunda kaygılar oldukça artmıştır. Özellikle CRT depolama yasakları gibi ulusal ve bölgesel politikalar oluşturulmuş, katot ışınlı tüp (CRT) monitörlerden gelen zararlı atıkların doğaya karışarak zehirlenmeler oluşturması bir çok soruşturma açılmasına neden olmuştur. ([CDTSC, 2004], [Dagan ve ark., 2007], [Halluite ve ark., 2005], [Musson ve ark., 2000], [Musson ve ark., 2006] and [Townsend ve ark., 2004]) Günümüzde elektronik atıkların bertarafı (e-atık) -özellikle katot ışın tüplerin- (CRT) küresel bir çevre sorunu haline gelmiştir (Poon, 2008).

Özellikle CRT (Cathode Ray Tube; Katot Işınlı Tüp) monitörler günümüzde yerlerini LCD monitörlere bırakmıştır. Türkiye' de Evlerde ve iş yerlerinde kullanılmayan belkide milyonlarca monitör atıl durumda beklemektedir. CRT monitörlerin ekran camının iç yüzünde renkleri oluşturan fosfor tabakası bulunmaktadır. Kırılan tüplerden oluşan tozların teneffüsü çok risklidir. Monitörler içerisinde bulunan fosfor açığa çıktığında insan sağlığına zararlı bir madde

olmaktadır. Bu sebeple bu monitörlerin rastgele bir yerde parçalanması sağlığı önemli şekilde etkileyecektir, bu camların kırılması ve depolanması özel prosedürler gerektirmektedir (Weitzman, 2003). CRT tüplerin % 85 ini cam oluşur, bu değer TV veya monitörün toplam ağırlığının yaklaşık % 65'ine denk gelir ([Andreola ve ark., 2005a] ve [Andreola ve ark., 2007b]). CRT ile ilgili yapılan önceki çalışmalar, CRT boyun ve huni camları içerisindeki toksit maddelerin tehlikeli atık olduğunu göstermiştir ([Jang and Townsend, 2003], [Musson ve ark., 2000] and [Musson ve ark., 2006])

E-atık dünyanın en hızlı büyüyen sorunlarından biridir ve bu atıkların yaklaşık % 50-80 Asya (Takashima, 1999) ve Afrika ülkeleri gibi gelişmekte olan ülkelere ihraç edilmektedir. Gelişmekte olan ülkelerde yanlış yönetim teknikleri (Widmer ve ark., 2005) nedeniyle elektronik atık (Nnorom ve Osibanjo, 2008) yönetiminde büyük zorluklarla karşı karşıya kalmaktadır. 2011 ÇED Raporuna göre (EIA, 2011) Üçüncü dünya ülkelerine (Basel Eylem Ağı, 2012) e-atık ihracatı yasak olduğu için sadece yasadışı taşımacılık ile giriş olabilecektir.

Geliştirilen donanım ile CRT monitörler -Aynı zamanda Televizyonlar- kesilecek ve içerisindeki fosfor çevreye yayılmadan toplanacaktır. Ayrıca kurşun içerikli ekran camlarının, diğer camlardan ayrılması sağlanacaktır.

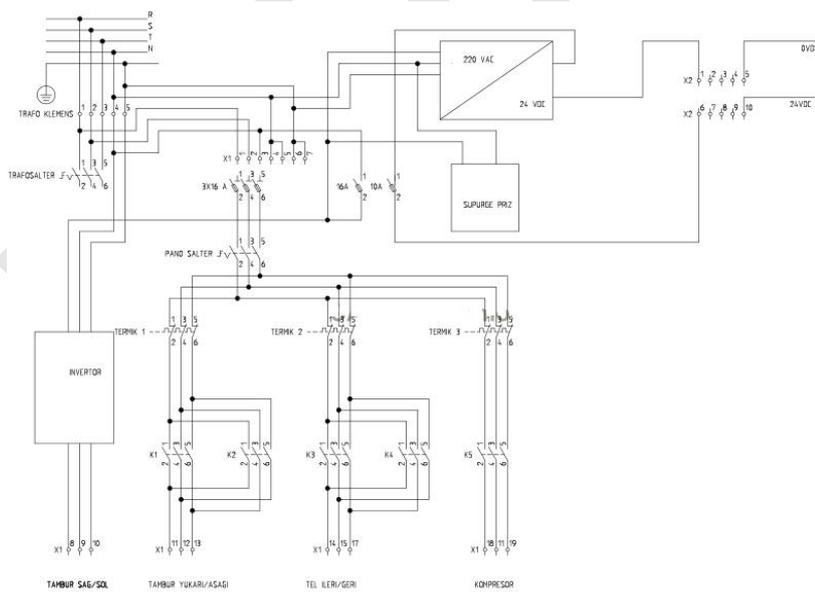
## Materyal ve Metodlar

CRT geri dönüşümü monitör kesme ayırma ünitesi ve fosfor temizleme ünitesi olmak üzere iki ana bölümden oluşmaktadır.

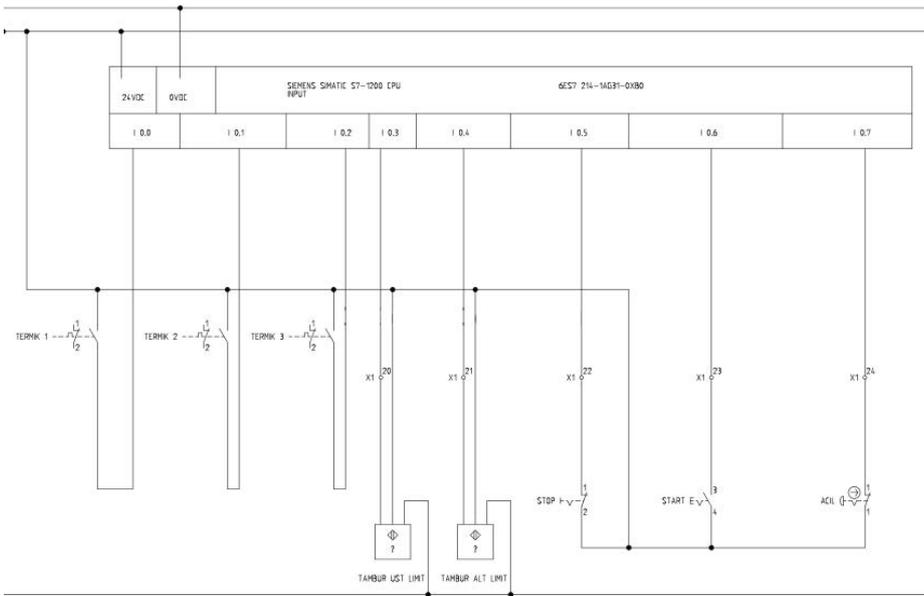
**Table 1:** Projenin tamamlanabilmesi için gerekli olan malzeme listesi.

| Donanım                                     | Miktarı      |
|---|--------------|
| PLC Kontrol Ünitesi                         | 1            |
| Elektrik Şalt Malzemeleri                   | Yeteri Kadar |
| Asenkron Sürekli Miknatıslı Motor           | 3            |
| İnverter                                    | 1            |
| PLC Kontrollü Ayarlanabilir Voltajlı Trafo  | 1            |
| Lazer Işığı Kullanan Optik Mesafe Sensörü   | 1            |
| Pnömatik Pistonlar                          | Yeteri Kadar |
| Valfler                                     | Yeteri Kadar |
| Hava Şartlandırıcısı                        | 1            |
| Vakum Sistemi                               | 1            |
| Kompresör                                   | 1            |
| Uygun Omajda Tel, Rezistans Sarf Malzemeler | Yeteri Kadar |

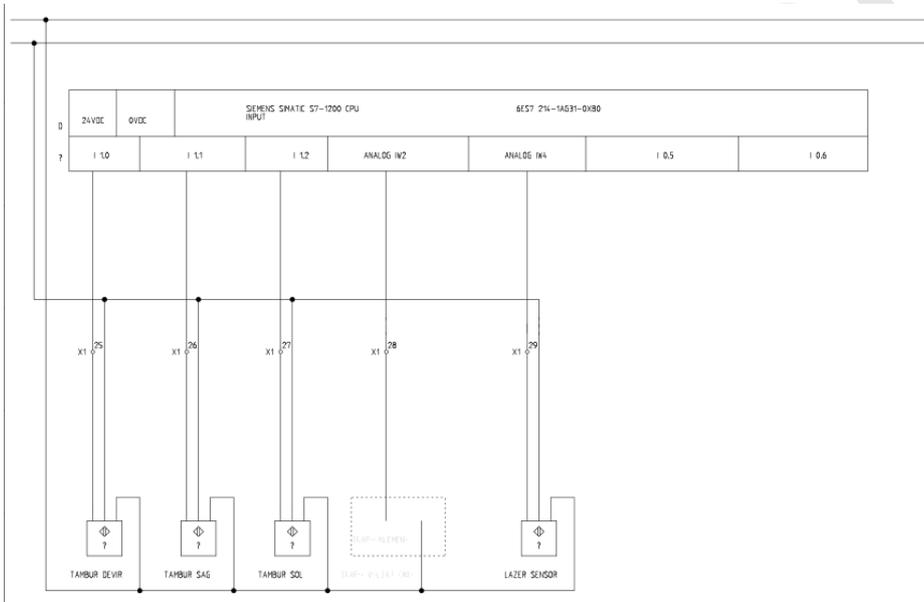
Projenin gerçekleştirilebilmesi amacıyla öncelikle devre şeması hazırlanmıştır. Devre şeması teorik olarak test edildikten sonra uygulama aşamasına geçilmiştir.



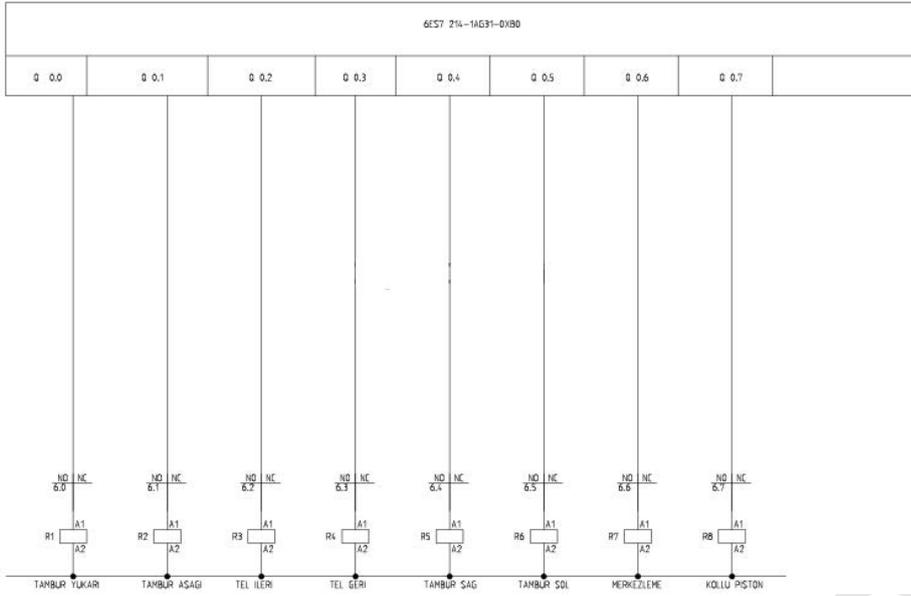
**Şekil 1:** Devre şeması birinci bölüm



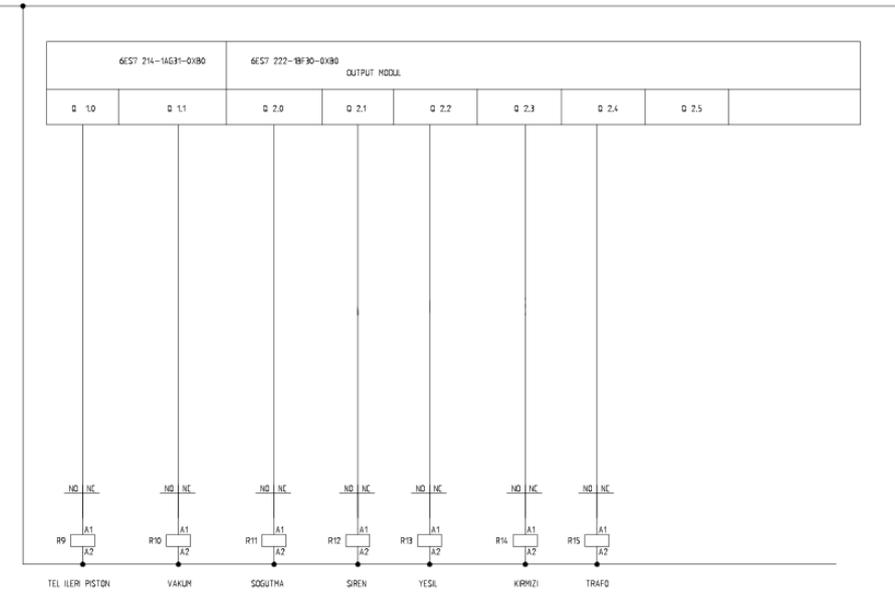
Şekil 2: Devre şeması ikinci bölüm



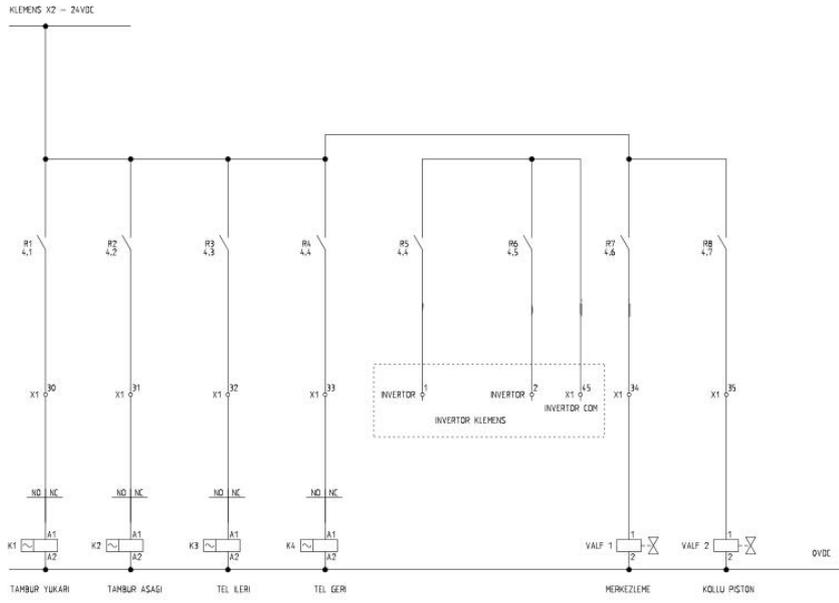
Şekil 3: Devre şeması üçüncü bölüm



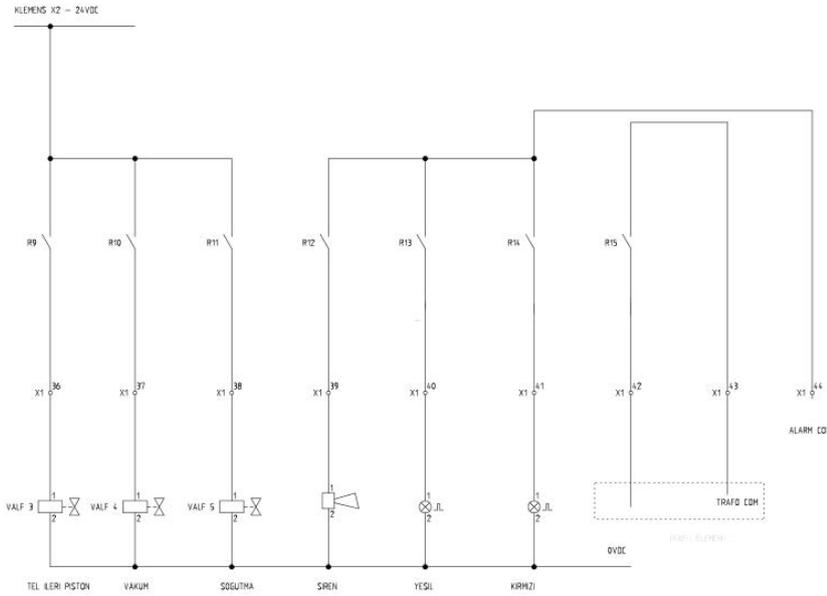
Şekil 4: Devre şeması dördüncü bölüm



Şekil 5: Devre şeması beşinci bölüm



Şekil 6: Devre şeması altıncı bölüm



Şekil 7: Devre şeması yedinci bölüm

## Sonuçlar

Devre tasarımı gerçekleştirildikten sonra donanım kısmı tamamlanmış ve kullanıcı için bir yazılım, otomasyon gerçekleştirilmiştir. Kullanıcı bu otomasyon ile CRT ürünlerin kesme işlemini kontrol edebilmektedir.



Şekil 8: Otomasyon menüsü



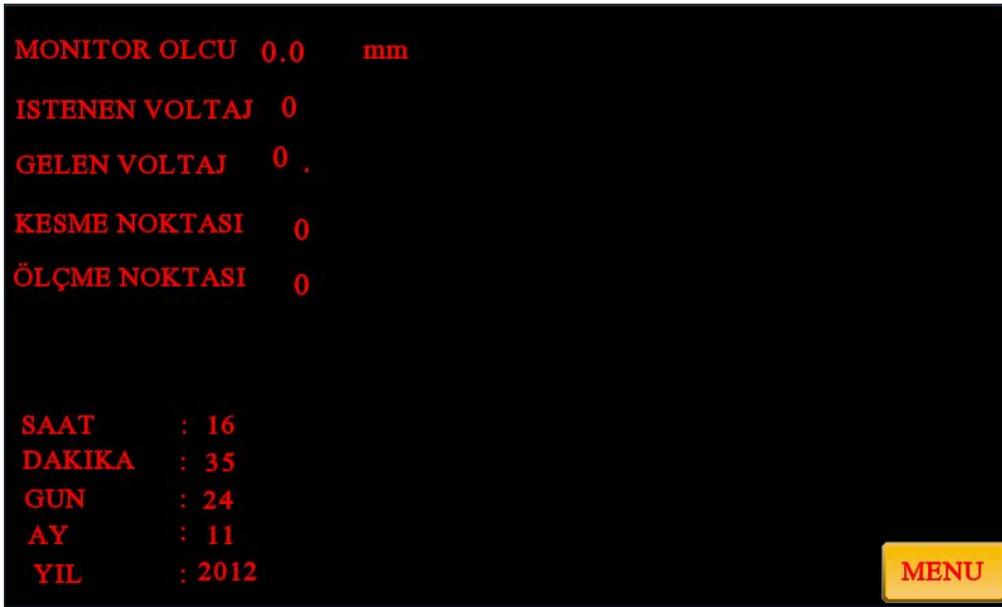
Şekil 9: Otomatik alt menüsü



Şekil 10: Manuel alt menüsü



Şekil 11: Sayıcılar alt menüsü



Şekil 12: Ayarlar alt menüsü



Şekil 13: Giriş/Çıkış alt menüsü

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# ÇOKKÜLTÜRLÜ EĞİTİM SÜRECİNİN SOSYOLOJİK TEMELLERİ<sup>1</sup>

Nesrin AKINCI ÇÖTOK

Eğitim olgusunun kuramsal çerçevesi ve buna uygun pratik yaşama aktarım süreci, içinde bulunduğu toplum yapısı ve makro ölçekteki sosyolojik söylemlere bağlı olarak belirlenmektedir. Modern zamanın sanayi toplumu tipi ile nitelendirilmesi sürecinde ifade edilmiş ve günümüzde de devam ettirilen kitlesel eğitim, sosyolojik olguları da içine alan temel paradigmalara bağlı olarak sürekli bir dönüşüme maruz bırakılmaktadır. Bu durumun en temelde savunusu bir toplumsal kurum olan eğitimin toplumsal değişimlere bağlı olarak yenilenme zorunluluğudur. Eğitim olgusu, öncelikle pozitivist paradigma içinde toplumsal ihtiyaca cevap verirken daha sonra toplumsal yapının değişim seyri içinde post-pozitivist paradigmanın temel argümanlarına göre şekillenmiştir. Bu gelişim, açıklama temelli bir eğitim- öğrenme modelinden anlama temelli bir eğitim- öğrenme modeline giden süreç olarak ifade edilebilir. Paradigmatik değişimler ışığında şekillenen eğitim olgusu, daha özelde sanayi toplumu eğitimi, bilgi toplumu eğitimi, küreselleşme ile ortaya çıkan evrensel değerleri ön plana alan küresel eğitim gibi ifadelerde tanımlanmaktadır. Uluslar arası dolaşım ağlarının artması ile meydana gelen göç olgusunun sonuçlarından biri olan çokkültürlülük, çokkültürlü eğitimi yükselen bir eğilim olarak sunmaktadır. Çalışmada tarihsel süreçte toplumsal yapının değişimine göre tanımlanan her sosyolojik olgunun eğitim anlayışını nasıl şekillendirdiği, temelde paradigmatik dönüşümler noktasından –eğitimde davranışçılık ekolünden yapılandırıcılığa- üzerinde durulacak, eğitimin toplum tiplerine göre tanımlanan özelliklerinden çokkültürlülük olgusunun eleştirisi ve çokkültürlü eğitime kadar giden sürecin serüveni ortaya konacaktır.

Anahtar Kelimeler: Kitlesel eğitim, Bilgi toplumu, Çokkültürlülük, Pozitivizm

## SOCIOLOGICAL FOUNDATIONS OF MULTICULTURAL EDUCATION

The theoretical frame of education fact and the transfer period of it to the practical life is determined by depending upon the structure of the society and the macro scale sociological discourses. The mass education, that is stated in the period of qualification of industrial society in modern times and still is going on nowadays, is exposed to a continuous change depending on the basic paradigms which also cover the sociological facts. The basic defence of this situation is the necessity of educational renewal that depends on the sociological changes. The fact of education has been firstly responded to sociological requirement in positivist paradigm, then shaped according to basic arguments of post-positivist paradigm in the period of change of social structure. This development can be stated as a period going from explanation based education-learning model to comprehension based education-learning model. The education fact that has been shaped in the light of paradigmatic changes is defined by the expressions like education of industry society, education of information society and global education that bring universal values arised with globalization to forefront. Multiculturalism that is a result of immigration fact which takes place by the increase of international circulation web, presents multicultural education as an increasing trend. In this study, one can find how sociological facts shaped the education perception in the period of time. Also, a discussion on multiculturalism fact from properties depending upon the society types will be presented and adventure of education to multicultural education will be emphasized.

Key Words: Mass Education, Information Society, Multiculturalism, Positivism

<sup>1</sup>Yrd.Doç.Dr. Nesrin AKINCI ÇÖTOK, Sakarya Üniversitesi, Eğitim Fakültesi, nakinci@sakarya.edu.tr

# DE-INKING PAPER SLUDGE REQUIREMENT OF LIMING HIGH ACIDIC POTATO SOIL

Lotfi Khiari, Marie-Jude Merisier and Antoine Karam  
Department of Soils and Agrifood Engineering  
Laval University  
Quebec/Canada  
lotfi.khiari@fsaa.ulaval.ca

**Abstract:** Biosolids from de-inking processes are increasingly being used in Quebec (Canada) to improve acid soil. The objective of this study is to determine the optimum rates of de-inking paper sludge (DPS) for attaining target soil pH values of 5.2 and 5.5 for potato grown on podzolic soil. Incubation experiment was conducted during 18 weeks with a coarse textured soil (pH 4.8) and increasing rates of CaCO<sub>3</sub> or DPS. Results indicate that the amounts of DPS required varied from 4.0 to 8.2 dry Mg DPS ha<sup>-1</sup> for attaining pH 5.2 and from 7.6 to 15.2 dry Mg DPS ha<sup>-1</sup> for attaining pH 5.5. The required amount of DPS is proportional to its total CaCO<sub>3</sub> equivalent.

**Key words:** Liming materials, Soil amendment, Soil acidity, Lime requirement.

## Introduction

The most common problem associated with acid coarse-textured soils in the province of Quebec (Canada) is aluminum (Al) toxicity particularly in soils devoted to potato (*Solanum tuberosum* L.) cultivation with pH below 5.5. Potato producers often attack this problem with soil amendments or liming materials. However, liming acid soils devoted to potato cultivation above 5.2 constitute a potential risk of scab disease especially for sensitive cultivars and soils infested with *S. scabies*. Although planting scab-tolerant potato is a reasonable option for dealing with acid soils and scab disease, liming is traditionally used to enhance pH to 5.5 in order to reduce Al availability and to improve soil productivity. Soils infested with *S. scabies* may be managed by adjusting the soil pH to a point unfavorable to the scab organism (Waterer, 2010).

In Quebec, about 74 000 Mg of primary de-inking paper sludge (DPS) were used in 2010 as soil amendment in crop plants (MDDEP 2010). This DPS contains cellulose fibers, removed inks, clay fillers (Barriga et al., 2010), coatings of used paper by a de-inking process (Charest and Beauchamp, 2002) and chemical additives added during the manufacture of paper, printing, and recycling (Beauchamp et al., 2002). Due to its high content of calcium carbonate, DPS may help reduce the use of commercial lime to treat acidic coarse-textured soils. DPS has been used to reduce soil acidity and availability of toxic Al (Baziramakenga et al., 2001; Battaglia et al., 2007), to enhance biological functioning (Chantigny et al., 1999), and to improve soil fertility (Fierro et al., 1997) and physical properties of soils (Trépanier et al., 1996; Chantigny et al., 1999).

Although the optimum pH range commonly reported for potatoes is 5.5 to 7.5 (Smith 1940), a soil pH of 5.2 to 6.2 is typical for commercial potato production in Quebec (CRAAQ, 2010). Potato is an important crop in Quebec's agricultural economy. The aim of the present experiment was to determine the optimum rates of DPS for attaining target sandy loam soil pH values of 5.2 and 5.5.

## Materials and Method

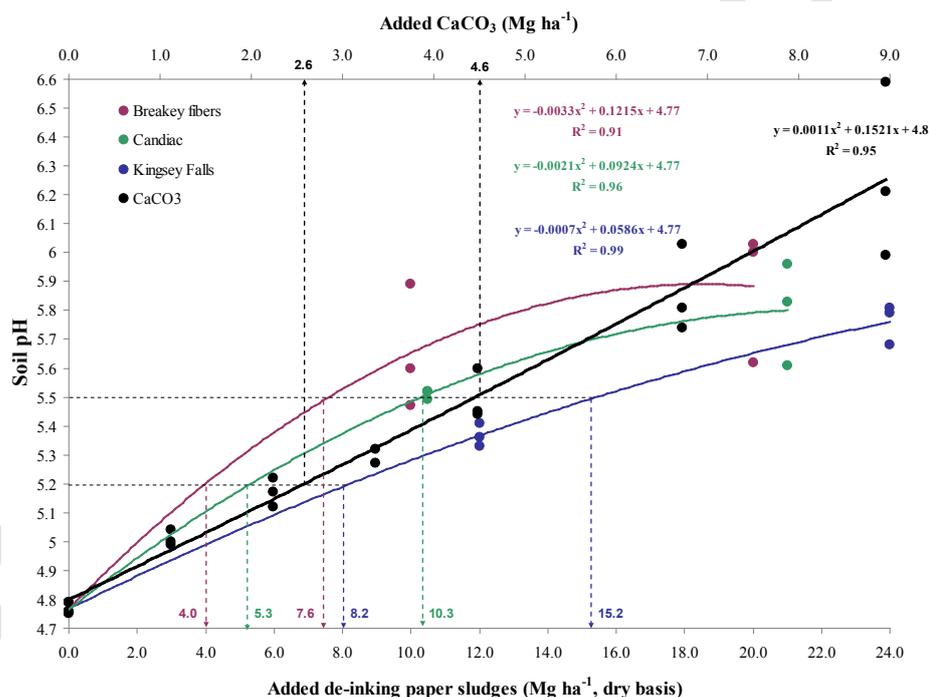
Three types of primary de-inking paper sludge (DPS) were collected from three Cascade factories in Canada, namely Breakey fibers (DPS1), Candiac (DPS2) and Kingsey Falls (DPS3). DPS were air-dried, mixed, homogenized and ground to pass a 2 mm sieve prior to analysis for total C, total N and total Ca. Briefly, DPS1 contained 45% organic matter (OM), 0.2% total N and 16.1% total Ca; DPS2 contained 44.0% OM, 0.14% total N and 14.1% total Ca; DPS3 contained 52.0% OM, 0.12% total N and 12.7% total Ca. The pH was 8.0, 7.8 and 8.2 for DPS1, DPS2 and DPS3, respectively. The total calcium carbonate equivalent (TCCE) (BNQ, 2005) was 45.0, 42.0 and 37.5 for DPS1, DPS2 and DPS3, respectively. All analyses were done in triplicate. The pH of DPS was measured in deionised water using 1:10 DPS to water ratio. The Morin sandy loam soil (humo-ferric podzol) used for soil-liming material mixtures was taken from Patates Dolbec inc. farm in St-Ubalde (Quebec, Canada). Selected properties of the soil were as follows: sand 72%; clay 4%, pH<sub>water</sub> (1:1 soil:distilled water ratio) 4.8; buffered pH or pH<sub>SMP</sub> 5.6; organic matter 4%, Mehlich-3-extractable Al 1888 mg kg<sup>-1</sup>.

## Incubation test

The incubation experiment was planned using randomized block design containing three replicates for each test (chemically pure  $\text{CaCO}_3$  ground to pass a 400 mesh sieve, DPS) and control treatment (without  $\text{CaCO}_3$  or DPS). The treatments consisted of six  $\text{CaCO}_3$  rates (1.1, 2.2, 3.4, 4.5, 6.7, and 9.0  $\text{Mg CaCO}_3 \text{ ha}^{-1}$ ) and three rates of DPS: Breakey fibers (0.0, 10.0, and 20.0  $\text{Mg ha}^{-1}$ , dry basis), Candiac (10.5 and 21.0  $\text{Mg ha}^{-1}$ , dry basis) and Kingsey Falls (12.0, and 24.0  $\text{Mg ha}^{-1}$ , dry basis). One kg of air-dried soil samples were placed into 1.5 L polypropylene recipients with drainage holes. A filter paper was deposited in the bottom of each recipient to prevent nutrient leaching. The soil was thoroughly mixed with reagent-grade  $\text{CaCO}_3$  or DPS. Soil samples were moistened until water flows through the drainage holes. The moisture was adjusted every week by adding de-ionized water. All treatments were incubated in triplicate at  $23 \pm 2^\circ\text{C}$  for 18 weeks.

## Results

Increasing  $\text{CaCO}_3$  or DPS rates significantly raised the soil pH after 18 weeks of incubation (Fig. 1). The pH of soil amended with  $\text{CaCO}_3$  or DPS varied from 4.8 to 6.6. Soil samples amended with liming materials ( $\text{CaCO}_3$  or DPS) exhibited the same pH response pattern. The four curves shown in Figure 1 are the best-fit asymptotic regression curves describing the relationship between  $\text{CaCO}_3$  or DPS rates and pH of incubated soil samples. These relationships were significantly described ( $P < 0.05$ ) by means of quadratic model:  $\text{pH} = aX^2 + bX + c$  ( $R^2: 0.91-0.99$ ), where X is the rate of  $\text{CaCO}_3$  or DPS rate and a, b and c are constants. Soil pH increased with the rate of DPS in the following order: Breakey fibers > Candiac > Kingsey falls. The first target pH of 5.2 is attained by adding 4.0, 5.3 and 8.2  $\text{Mg ha}^{-1}$  of Breakey fibers, Candiac and Kingsey falls, respectively. The second target pH of 5.5 is attained by adding 7.6, 10.3 and 15.2  $\text{Mg ha}^{-1}$  of Breakey fibers, Candiac and Kingsey falls, respectively. For calcitic limestone, soil pH values of 5.2 and 5.5 were attained by adding 2.6 and 4.6  $\text{Mg CaCO}_3 \text{ ha}^{-1}$ , respectively. The effectiveness of DPS in neutralizing soil acidity is negatively proportional to their TCCE value (Fig. 2).



**Figure 1:** Graphic method for determining the amount of  $\text{CaCO}_3$  and de-inking paper sludge (Breakey fibers, Candiac and Kingsey Falls) needed to reach soil pH values of 5.2 and 5.5.

## Discussion

Strongly acidic soils and soils with a high buffering capacity often require a large quantity of lime. The amount of lime required to raise soil pH to 5.5, noted  $\text{LR}_{5.5}$ , is usually estimated in Quebec (Canada) by the recommendation system using  $\text{pH}_{\text{SMP}}$  as the diagnostic index of lime requirement (Table 1). According to this system, the amount of liming material that must be applied to the coarse-textured soil with a  $\text{pH}_{\text{SMP}}$  of 5.6 in order to reach soil  $\text{pH}_{\text{water}}$  of 5.5 was 7.1 meq per 100g (Tran and van Lierop, 1982) or 7.8  $\text{Mg CaCO}_3 \text{ ha}^{-1}$  (CRAAQ, 2010), substantially larger than the value of 4.6  $\text{Mg CaCO}_3 \text{ ha}^{-1}$  derived from soil- $\text{CaCO}_3$ -moist incubation LR method (Fig. 1). This amount is somewhat

close to 3.8 and 5.3 Mg ha<sup>-1</sup> predicted respectively from Webber et al. (1977) and Soon and Bates (1986) equations (Table 1).

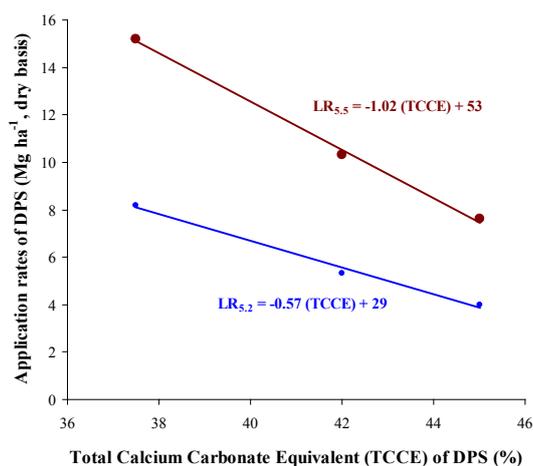
**Table 1:** Lime recommendation equations for Canadian mineral soils based on SMP soil-buffer pH.

| References                 | Number of samples | Provenance     | Soil type             | Equilibrium period | Equations of lime requirement  | r <sup>2</sup> |
|----------------------------|-------------------|----------------|-----------------------|--------------------|--|----------------|
| Tran and van Lierop (1982) | 37                | Quebec soils   | Coarse-textured soils | 3 months           | LR(5.5)* = 4.0 (pH <sub>SMP</sub> ) <sup>2</sup> - 54.7 (pH <sub>SMP</sub> ) + 188     | 0.894          |
| Soon and Bates (1986)      | 24                | Ontarian soils | Loamy sand to clay    | 72 hours           | LR(5.5)* = 3.66 (pH <sub>SMP</sub> ) <sup>2</sup> - 48.98 (pH <sub>SMP</sub> ) + 164.3 | 0.828          |
| Webber et al. (1977)       | 39                | Candaian soils | Loamy sand to clay    | 30 days            | LR(5.5) <sup>#</sup> = 3.4 (pH <sub>SMP</sub> ) + 23.3                                 | 0.740          |

\* LR(5.5) in meq CaCO<sub>3</sub> per 100 g soil

# LR(5.5) in t CaCO<sub>3</sub> per acre

This result indicates that the current recommendation system (Table 1) overestimates the lime requirement of the sandy loam soil by 3.2 (7.8-4.6) Mg CaCO<sub>3</sub> ha<sup>-1</sup>. Excess amount of lime can be expected to increase soil pH to 6.0 rather than target pH value of 5.5 (Fig. 1) which would constitute a potential risk of scab disease especially for sensitive cultivars.



**Figure 2:** Application rates of DPS relative to their total calcium carbonate (TCCE) and target soil pH for potato crop.

As would be expected, Breakey fibers with the highest TCCE (45.0%) had greater effectiveness to attain the optimum pH range for potato plant than Candiac with TCCE of 42.0% and Kingsey Falls with TCCE of 37.5%. A one percent change in the TCCE of DPS could vary LR<sub>5.5</sub> and LR<sub>5.2</sub> by one and one half Mg DPS ha<sup>-1</sup> (Fig. 2). TCCE values are probably related to the origin of recycled paper. Therefore, the amount of DPS required varies, depending on liming value of DPS and target pH value for potato crop.

## Conclusions

The results indicated that the current Quebec recommendation system overestimate the lime requirement of coarse-textured soil.

The amounts (Mg ha<sup>-1</sup>, dry basis) of DPS that must be applied to the coarse-textured soil with a pH<sub>water</sub> of 4.8 in order to reach soil pH<sub>water</sub> of 5.2 and 5.5 were respectively in the following range: 4.0-8.2 and 7.6-15.2. The amounts of DPS were negatively proportional to their TCCE value. Results also revealed that DPS were as efficient as CaCO<sub>3</sub> to neutralize soil acidity.

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## DERS KİTAPLARININ DİKKAT ÇEKME ARAÇLARI AÇISINDAN DEĞERLENDİRİLMESİ\*

Mehmet ŞAHİN\*\*

**Özet** Bu araştırma, Sosyal Bilgiler ders kitaplarının dikkat çekme araçları açısından değerlendirilmesi amacıyla yapılmıştır. Araştırma metin incelemesine dayalı nitel bir çalışmadır. Çalışma evrenini Milli Eğitim Bakanlığı'nca onaylanan ilköğretim altıncı sınıf Sosyal Bilgiler ders kitapları oluşturmaktadır. Veriler, ders kitaplarının en büyük ünitesi olan "İpek Yolunda Türkler" ünitesi değerlendirilerek elde edilmiştir. Araştırmanın verilerini toplamak amacıyla soru listesi ve rubrik geliştirilmiştir. Veriler, rubriklerde yer alan ölçütlere göre analiz edilmiş ve kitap içerisinden seçilen somut örneklerle desteklenmiştir. Dikkat çekme araçları; büyük harf kullanma, renkli yazma, metni koyulaştırma, italik yazma, altını çizme, tırnak içine alma ve tablo/çizgi/kutu içine alma yönünden ele alınmıştır. Araştırmanın bulgularına göre dikkat çekme araçları çok az yerde tutarlı kullanıldığı ve önemli bilgileri vurgulamada yetersiz kaldığı ortaya çıkmıştır.

**Anahtar Kelimeler:** Sosyal Bilgiler, Ders Kitabı, Mesaj Tasarımı, Metin İnceleme, Değerlendirme.

### The Evaluation Of Textbooks In Terms Of Message Design Principles (Highlighted Words)

**Abstract** This research was conducted to evaluate textbooks in terms of message design principles. The research is a descriptive study based on examination of the textbooks. The books that were approved by the Ministry of National Education, as to be used in sixth-grade Social studies courses, comprised the research universe. Experiments covered "Turks on the Silk Road" unit which has the largest volume in the textbooks. In order to collect data for the study, a question set and a rubric scale were developed by the researcher. Data were analyzed in accordance with the rubrics and selected perceptible text-examples were used to demonstrate the inferred results. In this research writing in capital letters, colored writing, darker texting, writing in italics, underlining, quoting, getting into table/line/box is discussed as drawing attention materials. According to the symptom of the research, it has come out that drawing attention materials are used consistently in few places and are incapable of addressing important information.

**Key Words:** Social Studies Course, Message Design in Textbooks, Text Analyzation, Rubric in Textbooks.

\* Bu makale, Gazi Üniversitesi Eğitim Bilimler Enstitüsü'nde hazırlanan doktora tezinden üretilmiştir.

\*\* Yrd. Doç. Dr. Mehmet ŞAHİN, Çankırı Karatekin Üniversitesi Edebiyat Fakültesi Öğretim Üyesi  
[mehmetsahin\\_38@hotmail.com](mailto:mehmetsahin_38@hotmail.com)

## Ders Kitaplarının Dikkat Çekme Araçları Açısından Değerlendirilmesi

### I. Giriş

Ders kitapları, öğrencilerin gelişim özellikleri ve öğretim programlarının ilkelerine göre hazırlanan öğrenme ve öğretme materyalidir. Öğretim sürecinin ayrılmaz bir parçası ve öğretim programlarında yer alan kazanımların gerçekleştirilmesini sağlayan, öğretmen ve öğrencilerin en sık kullandığı önemli bir araçtır. Bilgileri plânlı ve düzenli bir biçimde açıklayan ve dersin hedefleri doğrultusunda öğrenciyi yönlendiren temel bilgi kaynağıdır. Eğitsel yönden kitap, yazılı ve basılı bir öğretim-öğrenme ortamıdır. Ayrıca kitap, öğrenme yaşantılarına kaynaklık eden çalışma aracıdır (Keser, 2004).

Ders kitapları öğretim etkinlikleriyle birlikte kullanıldığında, öğrencilerin okuma ve düşünme becerilerini geliştirir, konu ile ilgili temel kavramları, tamamlanmış tümce yapılarını öğretir ve sözcük dağarcıklarını artırır. Ayrıca birçok öğrenciye karmaşık bir metinden ana fikri bulma, okuduğunu sentezleme, önceden bildikleri ile okuduğu bilgiyi bütünleştirerek yeni bilgileri yapılandırma yardımcı olur (Eşgi, 2005). Kitaplar, öğretimde öğretmenin gücünü daha iyi kullanmasına ve daha sistematik sunmasına imkân verir. Özellikle öğrenme güçlüğü olan öğrenciler için ders kitabı, sözel öğretimin yarattığı boşluğu doldurmasını sağlar (Ünsal ve Güneş, 2002)

İçeriği iyi örgütlenmiş bir metin baştan sona okur açısından sürükleyici olabilmektedir. Eğitim araştırmaları başlıklar, içindekiler listesi, bölüm başlıkları, özet, sözlük, kaynakça gibi metin örgütleyicilerin öğrenciler tarafından beğeni ile karşılandığını göstermektedir. Ayrıca, metin örgütleyicileri kullanmak öğrencinin ileride karşılaşacağı değişik metinlere uyum sağlamasını da kolaylaştırmaktadır. İçindekiler listesinin işlevsel ve çekici biçimde düzenlenmesi, başlıkların, sözlük ve kaynakçanın etkili varlığı gibi örgütleyiciler, ders kitabı tasarımında görsel bütünlüğün yanında kullanılabilirlik ve hedefe göreliği de beraberinde getirmektedirler (Alpan, 2008). Örgütleyiciler metni anlaşılabilirliğini ve tutarlılığını sağlamada, öğrenciyi düşündürmede ve ilgili bilgiye yönlendirmede önemli bir etkiye sahiptir. Metin içerisinde birçok yardımcı unsur içeriğin örgütlenmesine katkı sağlar (Yalın, 1996b).

Etkili bir ders kitabı öğrenciye verilmek istenen mesajı en kısa yoldan, açık ve anlaşılır biçimde iletmesi gerekir. Mesaj tasarım ilkelerine uygun olarak hazırlanan bir ders kitabı öğrenme ve öğretme sürecinde daha işlevsel olur. Ders kitaplarında dikkate alınması gereken birçok mesaj tasarım ilkesi bulunmaktadır. Bu araştırmada ders kitapları metin örgütleyicileri, metindeki üst düzey yapılar, metin içerisindeki sorular, görsel öğeler ve sayfa tasarımı açısından değerlendirilmiştir. Ancak bu makalede mesaj tasarımı ilkeleri dikkat çekme araçları ile sınırlandırılmıştır.

Dikkat çekme araçları öğrenciye bir başlığı, soruyu, kavramı, tanımı, tarihi, olayı, olguya, formülü vb. önemli ya da farklı bir bilgiyi vurgulamak için kullanılır. Dikkat çekme araçları etkili ve tutarlı kullanılırsa ilgili bilgiyi vurgular ve öğrencinin düşünmesini sağlar (Mayer, 1993). Ancak aynı amaca yönelik tutarlı bir şekilde kullanılmazsa önemini kaybetmekle kalmayıp öğrencilerde zihinsel karmaşaya yol açar. Dikkat çekmek amacıyla bir kavram ilk kullanıldığında tırnak içerisinde alınır. Metin içerisinde ilk defa kullanılan önemli kavramların hepsinde aynı dikkat çekme aracının tutarlı bir şekilde kullanılması gerekir (Yalın, 1996a).

Dikkat çekme araçları, metnin genel yapılandırmasını belirlemede olduğu kadar metindeki farklı noktaların vurgulanmasında da kullanılmaktadır. Örneğin, büyük harfler, kalın, italik, altçizgi ve renk okuyucunun dikkatinin

belirli bir noktaya veya sözcüğe çekilmesinde kullanılabilir. Yazım alanı kısıtlaması bu işaretlerin kullanılmasına genellikle engel olmaktadır. Ayrıca çocukların ve büyüklerin dikkat ettiği bu işaretleri her zaman anlamadıkları, bunların anlamlarının izah edilmesine ihtiyaç duydukları ve çoklu işaretlemenin karışıklık yarattığı görüşü yaygın bir şekilde kabul edilmektedir (Hartley 1990).

Ders kitaplarında koyu, italik, renkli, yazı çeşitlerinin, bütünlüğü bozmayacak biçimde çarpıcı tasarlanmış olması gerekmektedir. Dikkati odaklamak için metin içinde yeni ve önemli kelime ya da cümleler vurgulanır. Yazı boyutunu değiştirme, yazıyı renklendirme, italik yapma, kalın yazma ve kutu içine alma vurgulama araçlarından bazılarıdır. Alt çizme sadece olumsuzluk bildiren sözcüklerde tercih edilmelidir. Ders kitaplarında ana başlıklarda büyük harf, metinde ise küçük harf kullanılmalıdır. Metin içerisinde büyük harf kullanılması okuma hızını yavaşlatmakta ve dikkati dağıtmaktadır. Önemli kavramlara dikkat çekmek için yan başlıklar kullanılmalıdır. Vurgulama araçlarını kullanımında tutarlı olunmalı ve aşırıya kaçılmamalıdır (Keser, 2004).

Öğrenme sürecinde önemli bir etkisi olan ders kitaplarının nitelikli olması bir zorunluluktur. Çünkü ders kitapları, öğrencilere sınıf içi ve sınıf dışı etkinliklerde önemli ölçüde katkı sağlamaktadır. Ders kitapları öğretim programının amaçlarını gerçekleştirmek için öğrencilere gereken mesajı vermesi gerekir. Ancak öğrencilerin en çok yararlandığı temel kaynak olan ders kitaplarının niteliği ile ilgili yapılan birçok araştırmada değişik sorunların varlığı ortaya çıkmıştır. Ayrıca, ilgili araştırmalar incelendiğinde ders kitaplarının dikkat çekme araçları açısından değerlendirilmediği görülmektedir. Bu nedenle ders kitaplarının dikkat çekme araçları açısından değerlendirilmesine önemli ölçüde ihtiyaç duyulmaktadır.

**Araştırmanın amacı**, 6. sınıf sosyal bilgiler ders kitaplarını dikkat çekme araçları açısından değerlendirmektir. Bu makalede dikkat çekme araçları; büyük harf kullanma, renkli yazma, metni koyulaştırma, italik yazma, altını çizme, tırnak içine alma ve tablo/çizgi/kutu içine alma araçları ile sınırlandırılmıştır.

## II. Araştırmanın Yöntemi

Araştırmanın modeli, metin incelemesine dayalı nitel bir çalışmadır. Araştırmanın çalışma evreni Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı'na onaylanan ilköğretim 6. sınıf Sosyal Bilgiler ders kitaplarından oluşmaktadır. Altıncı sınıflara yönelik 4 farklı yayınevi tarafından sosyal bilgiler ders kitabı hazırlanmıştır (MEB, 2007). Altıncı sınıf sosyal bilgiler öğretim programında yer alan 7 ünite içerisinde “Kültür ve Miras” öğrenme alanı ve “İpek Yolu’nda Türkler” ünitesi kazanım sayısı ve ders saati süresi yönünden en fazla olduğu için “İpek Yolu’nda Türkler” ünitesi değerlendirilmiştir.

Verilerin toplanmasında metin inceleme yöntemi kullanılmıştır. Veri toplamak amacıyla alt amaçlara uygun olarak soru listesi ve bu sorulara uygun olarak rubrikler geliştirilmiştir. Soruların ve rubriklerin geçerliliğini sağlamak için farklı üniversitelerde görevli 6 alan uzmanından görüş alınmıştır. Soru listesi ve rubrikler hazırlandıktan sonra ders kitapları araştırmacı ile birlikte 3 alan uzmanı tarafından değerlendirilmiştir. Ayrıca, değerlendirme sürecinde ortak bir strateji belirlenerek yöntem konusunda görüş birliği sağlanmıştır. Bu aşamadan sonra uzmanlar ders kitaplarını rubriklere göre bağımsız olarak değerlendirmiş ve sonunda puanların aritmetik ortalamaları alınmıştır.

Veri toplama aracı olarak kullanılan rubrikler 5 seçenekli olarak hazırlanmıştır. Ders kitapları rubriklerde belirtilen ölçütlere göre, 1-5 arasında bir puanla değerlendirilmiştir. (1.0 - 1.8 hiç etkili değil, 1,9 - 2.6 çok az etkili, 2.7 - 3.4 orta düzeyde etkili, 3.5 - 4.2 oldukça etkili, 4.3 - 5.0 tamamen etkili olarak yorumlanmıştır.) Veriler, alt problemlere göre, her alt problem de kendi içerisinde sorulara ve rubriklere göre gruplandırılarak sunulmuştur. Bu verileri desteklemek amacıyla ders kitaplarından örnek metinlere yer verilmiş ve birlikte yorumlanmıştır. Araştırma raporu içerisinde ders kitaplarını hazırlayan yayınevlerinin adları, sürekli tekrar etmemek için alfabetik sıraya göre A, B, C, D biçiminde kodlanarak atıf yapılmıştır.

### III. Bulgular ve Yorum:

Ders kitaplarında, dikkat çekme araçları konu başlıklarında, metin içerisinde geçen kavram, tanım ve tarihlerde, sorularda, alıntı ve kaynak göstermelerde kullanılmıştır. Ders kitaplarında dikkat çekme araçlarının kullanım sayıları Tablo 1'de sunulmuştur.

**Tablo 1. Dikkat Çekme Araçlarının Kullanılma Sayısı**

| Dikkat Çekme Araçları  | Kullanım sıklığı (f) |    |    |    |
|------------------------|----------------------|----|----|----|
|                        | A                    | B  | C  | D  |
| Büyük harfle yazma     | 20                   | 43 | 19 | 11 |
| Renkli yazma           | 22                   | 30 | 44 | 19 |
| Koyu yazma             | 25                   | 39 | 18 | 35 |
| İtalik yazma           | 6                    | -  | -  | 1  |
| Altı çizili yazma      | -                    | 9  | -  | -  |
| Tırnak içine alma      | 21                   | 39 | 40 | 44 |
| Tablo/çizgi içine alma | 6                    | 51 | 15 | 4  |

Tablo 1'e göre, metin içinde büyük harf kullanma en çok A, en az D ders kitabında, renkli yazı en çok C, en az D ders kitabında, koyu yazı en çok B en az C ders kitabında kullanılmıştır. İtalik yazı en çok A ders kitabında kullanılmış, B ve C ders kitabında kullanılmamıştır. Altı çizili yazı sadece B ders kitabında kullanılmıştır. Tırnak içinde alma en çok D, en az A ders kitabında kullanılmıştır. Tablo/çizgi içine alma en çok B, en az A ders kitabında kullanılmıştır. Bu bulgulara bakıldığında ders kitaplarında dikkat çekme araçları tutarsız biçimde kullanılmıştır. Ders kitaplarında dikkat çekme araçlarının kullanılması ile ilgili bulgular Tablo 2'de sunulmuştur.

**Tablo 2. Dikkat Çekme Araçlarının Kullanılması**

| Ölçütler  | Ders kitapları | ORT. |
|---|----------------|------|
| 5 Dikkat çekme araçları metin içerisinde tutarlı kullanılmış, önemli bilgileri vurgulamış ve aşırıya kaçılmamıştır.         |                |      |
| 4 Dikkat çekme araçları metin içerisinde çoğunlukla tutarlı kullanılmış, önemli bilgileri vurgulamıştır.                    | A:2<br>B:2     |      |
| 3 Dikkat çekme araçları metin içerisinde kısmen tutarlı kullanılmış, ancak önemli bilgileri vurgulamada yetersiz kalmıştır. | C:2<br>D:2     | 2    |
| 2 Dikkat çekme araçları çok az yerde tutarlı kullanılmış, önemli bilgileri vurgulamada yetersiz kalmıştır.                  |                |      |
| 1 Dikkat çekme araçları metin içerisinde tamamen tutarsız kullanıldığı için hiç etkili olmamıştır.                          |                |      |

Tablo 2'e göre, ders kitaplarında (A,B,C,D) dikkat çekme araçları çok az yerde tutarlı kullanıldığı ve önemli bilgileri vurgulamada yetersiz kaldığı ortaya çıkmıştır.

**Büyük Harf Kullanma:** Ders kitaplarında büyük harf, metin başlıkları, tablo, şiir, alıntı, kısaltmalarda, bilgi notu, yönerge ve talimat gibi yerlerde kullanılmıştır.

A ders kitabında, ana başlıkların tamamında (8/8), alt başlıkların bazılarında (4/20), tablo başlıklarında, alıntı yapılan kişilerin soyadlarında ve kısaltmalarda büyük harf kullanılmıştır.

Örnek:

|   |
|---|
| Ana başlık: DESTAN YAZANLAR<br>Alt başlık: OĞUZ KAĞAN DESTANI, GÖÇ DESTANI<br><br>Ana başlık: TÜRK BÜYÜKLERİ KENDİLERİNİ ANLATIYOR<br>Alt başlık: Yusuf Has Hacıp, Kaşgarlı Mahmut, Gazneli Mahmut, Alparslan, Melikşah |
|---|

|   |
|---|
| Alıntı: "...Zamanla bayram haline dönüşerek gelen gelenek günümüze kadar devam etmiştir." M. Abdülhalük ÇAY<br><br>Kısaltma: "1992 senesinde Türk İşbirliği ve Kalkınma Ajansı (TİKA) kurulduktan sonra eğitim ve kültür alanında bir dizi çalışmalar yapıldı." |
|---|

Örnek Tablo:

| TARİH | ORTA ASYA                       | ARABİSTAN                               |
|-------|---------------------------------|---|
| 550   | 552 Yılında Kök devleti kuruldu | 570 yılında Hz. Muhammed Mekke'de doğdu |

B ders kitabında, ana başlıkların tamamında (8/8), alt başlıkların (7/22) ve tablo başlıklarının bazılarında, şiir başlıklarında, kısaltmalarda, her ana başlıktan sonra "KONUHA HAZIRLIK" alt başlığı ve konu sonlarında öğrenciyi etkinlik yapmaya yönlendiren "KERVAN adlı etkinliği yapınız" gibi talimatlarda büyük harf kullanılmıştır. Alıntı yapılan kişilerin soyadları küçük harfle yazılmıştır.

Örnek:

|  |
|--|
| Ana başlık: BELGELERİN DİLİ<br>Alt başlık: ORHUN YAZITLARI, ERGENEKON DESTANI, UYGURLARIN YAŞAMI, Kavimler Göçü<br><br>Şiir/Marş başlığı: TÜRK SİLAHLI KUVVETLERİ MARŞI<br>Kısaltma: "Divriği Ulu Camii'nin estetik taş süslemeleri, bu eserin UNESCO'un ilk kez .... listesine girmesini sağlamıştır."<br><br>Alıntı: "Büyük hayvan sürülerine sahip olan Türkler 'Çadır - köy' veya 'Çadır - şehir' halinde otları bol ve karı az olan dağların güneş gören bir yerini seçer ve oraya konarlardı...." Bahaeddin Ögel |
|--|

Örnek Tablo

| KÖK TÜRK - UYGUR | ÇİN              | BİZANS |
|------------------|------------------|--------|
| Canlı hayvan     | Pirinç, porselen | Ceviz  |

|  |  |
|--|--|
| <b>Hz. Ebubekir</b><br>Hz. Muhammed'in peygamberliğinden önce de arkadaşı olan Hz. Ebubekir ilk halifedir. | <b>Hz. Ömer</b><br>Hz. Ebubekir'in vefatı üzerine halife seçildi ve adaletli yönetimiyle kendisinden sonra gelen yöneticilere güzel bir örnek oldu |
|--|--|

C ders kitabında, ana başlıkların tamamı (8/8), alt başlıkların (2/20), şiir başlıklarının ve alıntı yapılan kişi soyadlarının bazılarını büyük harfle yazılmıştır. Tablo başlıkları ve konu sonlarındaki "Bilgi Notu" başlığı küçük harfle yazılmıştır.

Örnek:

Ana başlık: IŞIK DOĞUYOR  
Alt başlık: Türklerin İslamiyet'e Girişi, BU VATAN KİMİN ve TÜRK ORDUSU

Ana başlık. GELENEKSEL TÜRK SANATLARI  
Alt başlık: Halıcılık, Çinicilik ve Ebru

Şiir başlığı: BU VATAN KİMİN ve Kırım Şiiri  
Kısaltma. TİKA ve UNESCO  
Alıntı: Orhan Şaik Gökyay, Yılmaz ÖZTUNA, Mustafa kemal ATATÜRK, Gene Lorga

D ders kitabında, ana başlıkların tamamında, alt başlıkların bazılarında (1/15) büyük harf kullanılmıştır. Bunların dışında metin içerisinde büyük harf kullanılmamıştır.

Bu örneklerden de anlaşıldığı gibi, ders kitaplarında yer alan ana başlıklarda tutarlı bir şekilde büyük harf kullanıldığı, ancak alt başlıklarda hem kitaplar arasında hem de kitap içerisinde tutarlılık olmadığı görülmektedir.

**Renkli Yazı:** Ders kitaplarında renkli yazı; başlıklarda, sorularda ve bilgi notlarında, yönlendirici talimatlarda kullanılmıştır.

A ders kitabındaki ana başlıkların tamamı, alt başlıkların bazıları renkli yazılmıştır. Metin başlarında ve sonlarındaki sorular siyah, metin içerisinde soruların bazıları renkli, "bilgi notları" başlıkları renkli yazılmıştır.

Örnek:

Ana başlık: **YILLARDIR SÜREN TATLI GELENEK**  
Alt başlık. **Şemsiyesiz Mesir Şenliği**, Mesir Macununun Özellikleri  
Metin başı ve sonu: *"Ordumuzun, ülkemiz için önemi hakkında neler söyleyebilirsiniz?"*  
Metin içi: *"Türklerin tarih boyunca "ordu-millet" olarak adlandırılmasının sebepleri neler olabilir"*  
*"Ticaretin Kök Türk Devleti'nin ekonomisine nasıl bir etkisi olmuştur?"*

B ders kitabındaki ana başlıkların tamamı, alt başlıkların bazıları renkli yazılmıştır. Metindeki tüm sorular siyah, bilgi kutusu başlığı renkli, hazırlık, gözden geçirme ve etkinlik yapma gibi talimat ve yönergeler siyah yazılmıştır. Metin içerisindeki tüm sorular normal metin yazı rengiyle yazıldığı için dikkat çekme özelliği kalmamıştır.

Örnek:

Ana başlık: **İSLAMİYET VE TÜRKLER**  
Alt başlık: **Hz. Muhammed Döneminde Üç Savaş**, Abbasiler ve Türkler

C ders kitabındaki ana başlıkların tamamı, alt başlıkların bazıları, metindeki soruların tamamı renkli yazılmıştır.

Örnek:

Ana başlık: **IŞIK DOĞUYOR**  
Alt başlık: **Türklerin İslamiyet'e Girişi**, Türklerin Müslümanlığı Seçmelerinin Sebepleri, **BU VATAN KİMİN; TÜRK ORDUSU**  
Soru: *"Günümüzde Türklerin yoğun olarak yaşadıkları yerlerde hangi din yaygındır? Mustafa Kemal Atatürk'ün asker yönüyle ilgili ne biliyorsunuz?"*

D ders kitabında ana başlıkların tamamı tutarlı bir şekilde renkli, alt başlıklarda siyah olarak yazılmıştır. Başlıktan sonraki ilk soru renkli, metin içerisindeki diğer sorular siyah yazılmıştır. Siyah yazılan soruların bazıları koyulaştırılmıştır.

Örnek:

Ana başlık: **UYGURLIĞA ADINI VERENLER**

Alt başlık: Gazneli Devleti

Soru: *“Uygurluk ile Uygur kelimeleri arasındaki benzerliği nasıl açıklayabilirsiniz?”*

*“Sizce Işık dininin Uygurların sosyal hayatlarına yansımaları nasıl olmuştur?”*

*“Kağan ile hatunun adının tahta geçişte birlikte anılması neyin göstergesidir?”*

Örnekler incelendiğinde renkli yazının; başlıklarda, sorularda ve bilgi notlarında, yönlendirici talimatlarda kullanıldığı görülmektedir. Ana başlıkların yazı renginde ders kitapları arasında farklılık olmasına rağmen aynı kitap içerisinde renkler tutarlı kullanılmıştır. Alt başlıklarda, sorularda, yönerge ve talimat başlıklarında hem kitaplar arasında hem de aynı kitap içerisinde tutarlılık görülmemektedir.

**Koyu Yazı:** Metin içerisinde geçen önemli bir kavram, tarih, olay, formül vb. unsurlara dikkat çekmek için ilk kullanıldıklarında yazı değişikliği yapılarak koyulaştırılabilir. Ders kitaplarında koyu yazı kullanımını incelendiğinde farklı uygulamalar görülmektedir.

A ders kitabında bazı kavramlar (6) koyulaştırılarak vurgulanmıştır. Ancak, metin içerisinde ilk defa kullanılan önemli kavramlar dikkat çekmek amacıyla tutarlı bir şekilde koyulaştırılmamıştır. Metin içerisinde alıntı yapılan vecizelerin bazıları, alıntılardan sonra kaynak gösterilen kişi adlarının tümü koyu yazılmıştır.

Örnek:

*“Birincisine **Gün**, ikincisine **Ay**, üçüncüsüne **Yıldız** adını koydular. Uygurların yurdunda **Hulün** isimli bir dağ vardı. Bu dağdan Tuğla ve Selanga adında iki ırmak çıkardı.”*

Bu cümlede dağ ismi koyu yapılırken ırmak isimleri koyu yapılmamıştır.

*“**Ulus ve kahraman evlatlarından oluşan ordu öylesine birbiriyle birleşmiştir ki dünyada ve tarihte bunun örnekleri çok azdır. Bu ulusal gerçekle her zaman övünebiliriz.**” Mustafa Kemal Atatürk*

*“**Türk öldürülebilir, ama asla mağlup edilemez.**” Napolyon*

B ders kitabında başlıkların dışında metin içerisinde hiçbir kavram, sözcük ya da cümle koyulaştırılmamıştır.

C ders kitabında metin içerisinde sadece iki kavram koyulaştırılarak yazılmıştır. Alıntı yapılan bazı vecizeler koyu yazılırken bazılarında yazı değişikliği yapılmamıştır. Alıntı yapılan kişi adlarının tümü koyulaştırılmıştır. Aşağıdaki örnekte, Celali takvimi ve Kavimler Göçü koyu renkle vurgulanmış, ancak Hira mağarası aynı şekilde vurgulanmamıştır.

Örnek:

*“Bu takvime **Celali takvimi** denir. Yıllarca süren bu olaylara **Kavimler Göçü** denir. Tek bir yaratıcı olduğunu düşünen Hz. Muhammed zaman zaman Mekke yakınlarındaki Hira Mağarasına giderek burada düşünceleriyle baş başa kalmıştır.”*

*“Türk askerleri korku bilmez, Dünyada yenilgi adında bir kavram tanımaz. Türkler Asya'nın centilmenleridir.” İngiliz Mareşal Frenc*

*“**Ordumuz, Türk birliğinin, Türk kudret ve kabiliyetinin, Türk vatanseverliğinin çelikleşmiş bir ifadesidir...**” Mustafa Kemal ATATÜRK*

D ders kitabında metin içerisinde kavram, olay ve tarihlerden bazıları (8) koyu yazıyla vurgulanmıştır. Koyu yazılarak vurgulanan kavramların tamamı aynı sayfada yer almıştır. Metin içerisindeki alıntılarda referans gösterilen kaynak adları koyulaştırılmıştır.

Örnek:

*“Ölen kişilerin ardından **yuğ** denilen yas törenleri yapılırdı. Türkler, öldürülen düşmanın taştan kabaca*

*yontulmuş suretlerini temsil eden heykellere balbal diyorlardı.”*  
Yuğ kavramı koyulaştırılırken balbal kavramı koyulaştırılmamıştır.  
*Oğuz Kağan Destanı'ndan, Vatan, Millet ve Bayrak Sevgisi, s.64*

Yukarıda verilen örnekler incelendiğinde dikkat çekmek amacıyla koyu yazı hem kitaplar arasında hem de aynı kitap içerisinde yetersiz ve tutarsız biçimde kullanıldığı görülmektedir.

**İtalik Yazı:** Metin içerisinde bir kavrama, cümleye, alıntıya vb. dikkat çekmek amacıyla italik yazı kullanılabilir. Ancak, ders kitaplarında italik yazıya çok az yer verildiği görülmektedir.

A ders kitabında yer alan bazı kavram ve deyimlerde (6) italik yazı kullanılmıştır. Örnek: “*Ünlü eserim divan-ı Lügati't-Türk, benim ilk sözlük kitabımdır.*” B ve C ders kitaplarında italik yazı hiç kullanılmamıştır. D ders kitabında metin içerisinde italik yazı bir defa kullanılmıştır. Örnek: “*...Son Kervan adlı bir proje ile ilgili bilgiyi yandaki internet haberinde görüyorsunuz.*”

Bu bulgulardan da anlaşılacağı gibi metin içerisinde italik yazı biçimi ders kitaplarının hiç birinde etkili ve yeterli biçimde kullanılmamıştır.

**Altı Çizili Yazı:** Metin içerisinde altı çizili başlık, kavram ya da sözcük A, B ve D ders kitabında kullanılmamıştır. C ders kitabında ise 10 alt başlıkta kullanılmıştır. Ana başlıklardan sonra verilen KONU YA HAZIRLIK alt başlıklarının (9) altı çizilmiştir. Bunların dışında Kavimler Göçünün Sonuçları alt başlığının altı çizilmiştir. Genellikle olumsuzluk bildiren ifadelerin altının çizilmesi önerilebilir. Metin içerisinde kavram ya da cümlelerin altını çizmek yazı alanını daraltmaktadır. Bu nedenle kavramı ya da cümleyi vurgulamak amacıyla farklı bir dikkat çekme aracı kullanılabilir.

**Tırnak İçine Alma:** Tırnak işareti vurgulanmak istenen bazı kavram, deyim, atasözü, vecize, konuşma, başlık ve sorularda kullanılmıştır.

A ders kitabında dikkat çekmek için 10 kavram, 7 vecize ve 4 konuşma tırnak içerisine alınmıştır. Aynı sayfa, hatta aynı paragraf içerisinde tırnak işareti tutarsız kullanılmıştır. “Mehmetçik”, “Ordu-millet”, “Zafer haftası”, “İpek yolu”, “Göç! Göç!” gibi kavramlar tırnak içerisine alınmış, ancak Beş Balık, Kurtkapanı, Kervan gibi kavramlar tırnak içine alınmamıştır. Bazı kavramlar (ordu- millet, ipek yolu) ikinci ya da üçüncü kullanışında, bazı kavramlar (cahiliye) ise her kullanışında tırnak içerisine alınmıştır. Metin içerisindeki tüm konuşmalar ve vecizeler tırnak içerisine alınmıştır.

B ders kitabında, 11 kavram ve deyim, 12 vecize ve 16 başlık tırnak içerisine alınmıştır. Örnek: “Çadır-köy”, “Göçebe”, “Diyalog Yolu”, “Türk”, “Müslüman”, “Dört halife”, “ÇADIRDA YAŞAMAK”, “DEVLET ve MİLLET” gibi başlıklar tırnak içine alınmıştır. Konargöçer, medeniyet, marş gibi kavramlar tırnak içerisine alınmamıştır. Metin içerisindeki tüm konuşmalar ve vecizeler tırnak içerisine alınmıştır.

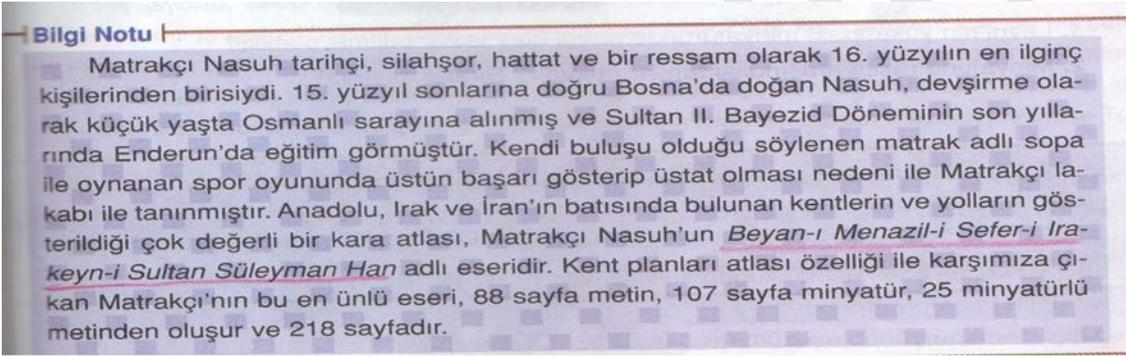
C ders kitabında, 24 kavram ve deyim, 16 vecize tırnak içerisine alınmıştır. Örnek: “kışlak”, “asker”, “İpek Yolu”, “Gök Tanrı” gibi kavramlar tırnak içerisine alınırken örs, turan gibi kavramlar tırnak içerisine alınmamıştır. Metin içerisinde bazı vecizeler koyu yazılmış, ama tırnak içine alınmamış, bazıları ise koyu yazılmadan tırnak içerisine alınmış, bazıları da hem koyu yazılmış hem de tırnak içerisine alınmıştır.

D ders kitabında, 23 kavram ve deyim, 17 vecize ve 4 bilgi tırnak işareti içine alınmıştır. Örnek: “İpek Yolu”, “Ordu Millet”, Türk Anıtları Projesi”, “at” “şarkı, dans” gibi kavramlar tırnak içerisine alınırken Ötüken, Toprak Ana, Kürk gibi kavramlar tırnak içerisine alınmamıştır. Ayrıca “Türk Anıtları Projesi” her yazıldığı yerde tırnak içerisinde gösterilmiştir. Bin Yılın Yolculuğu, 600–1600” ifadesinde tırnak açılmamış ama kapatılmıştır.

**Tablo / Çizgi / Kutu İçine Alma:** Ders kitaplarında belli metinlerin tablo, çizgi ya da kutu içerisine alma sıkça ve tutarsız bir biçimde kullanılmıştır.

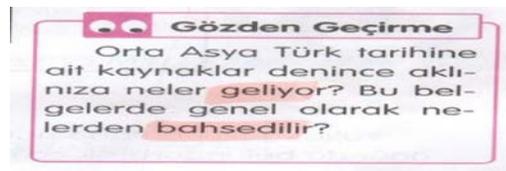
A ders kitabında, her ana konudan sonra metin başında ve sonunda verilen sorular ile metin içerisindeki özet amaçlı bilgi notları tablo içine alınmıştır. Tablo içindeki metinlerin arka planında renk ve şekil kullanılması, özellikle bilgi notlarının uzun olması dikkat çekme özelliğini azaltmıştır. Ayrıca tüm görsel öğeler tablo /çizgi içerisine alındığı için sayfa içerisinde çok sayıda tablo ya da çizgi kullanılmıştır. Aşağıdaki örnekte de görüldüğü gibi bu durum hem estetiklik açıdan olumsuz bir görüntü yaratmış hem de sıkıcılığı ve monotonluğu artırmıştır.

Örnek:



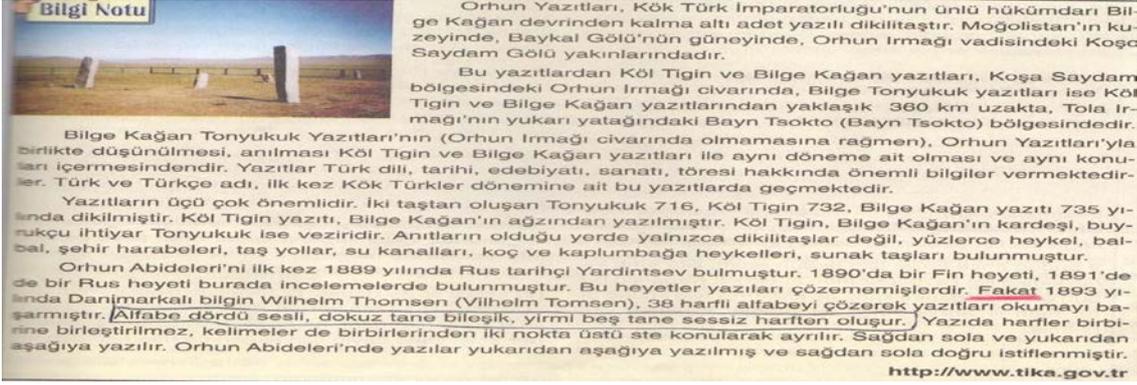
B ders kitabında, bazı sayfalarda tablo/ kutu içine alınmış metine yer verilmemiş, ancak bazı sayfalarda 4 ve 5 defa tablo içine alınmış metine yer verilmiştir. Sayfa içerisinde bir defa kullanılan ve içinde kısa metinlerin yer aldığı tablolar dikkat çekmede etkili olmuştur. Konu sonlarında öğrenciyi etkinlik yaptırmaya veya tartışmaya yönlendirmek amacıyla talimatlar tablo içerisine alınmış ve bunlar tüm konularda tutarlı kullanılmıştır. Aşağıdaki örnekte de görüldüğü gibi bu tablolar kısa metinlerden oluştuğu için dikkat çekme açısından etkili olmuştur.

Örnek:



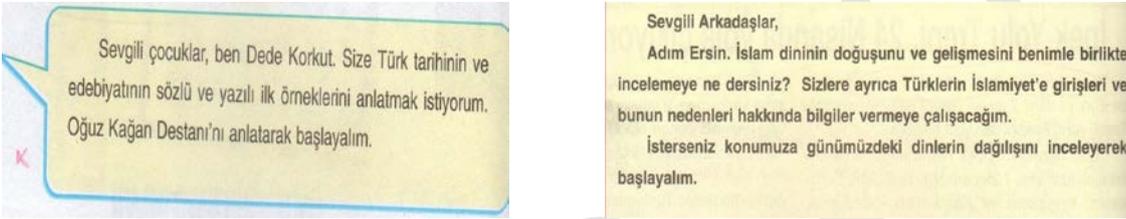
C ders kitaplarında, bilgi notları tablo içerisine alınmış, ancak bilgi notlarının uzun metinlerden oluşması etkili olmasını engellemiştir. Bazı sayfalarda metinlerin çoğunluğu tablo içerisine alındığı için, tablo içine alınmayan metin daha çok dikkat çekici olmuştur. Konu başlarında bazen öğrenciyi yönlendirmek amacıyla tablo içerisinde küçük metinlere yer verilmiştir. Bunların öğrencinin dikkatini çekmede daha etkili olduğu söylenebilir. Ancak aşağıda örneği verilen bazı tablo içine alınan metin kalabalık ve sıkıcı bir görüntü vermektedir.

Örnek:



Bu metnin uzun ve kalabalık olmasından dolayı tablo içine alınmasının etkili olmayacağı söylenebilir. Ancak aşağıdaki örnekte görülen metin daha kısa ve öz olduğu için etkili olabilir.

Örnek:



D ders kitabında, çizgi ya da tablo içerisine alınan metin sayısı oldukça azdır. Birkaç defa metin tablo/ çizgi içine alınmış ve bunlarda genellikle dikkati çekmede etkili olmuştur. Tablo ya da çizgi içerisine alınan metnin kısa olması tabloların etki gücünü artırmış, ancak, metnin arka planında ve sayfa içerisinde çok farklı renklerin kullanılması tablonun bu olumlu etkisini azalttığı söylenebilir. Bu konuya yönelik örnek aşağıda sunulmuştur.

Örnek:



Bu örnekler incelendiğinde ders kitaplarında tablo/ çizgi/kutular bazı sayfalarda sıkça kullanıldığı, bazen de tablo içerisinde uzun metinlere yer verildiği görülmektedir. Ders kitaplarında metin örgütleyici olarak kullanılacak kutu; küçük, içindeki yazı az ve görünümü genel sayfa tasarımına uygun olmalıdır (Yalın, 2001). Tablolar, çizgiler ya da kutular süs amaçlı gereksiz çerçeveler biçiminde kullanılmamalıdır. Gerekirse metinden ayrı olarak dikkat çekmesi istenen özet, soru, öykü, senaryo gibi etkinliklerde sayfa tasarımına uygun olarak kullanılmalıdır (Alpan, 2004).

#### IV. Sonuç ve Öneriler

Ders kitaplarında dikkat çekme araçları etkili kullanılmamıştır. Ders kitaplarında dikkat çekme araçlarının kullanım sıklığı değişmektedir. İtalik yazı A, büyük harf, koyu yazı, altı çizili ve tablo içine alma B, renkli yazı C, turnak içine alma D ders kitabında en sık biçimde kullanılmıştır. Dikkat çekme araçları hem ders kitapları arasında hem

de kitap içerisinde çoğunlukla yetersiz ve tutarsız bir biçimde kullanılmıştır. Keser'in (2004) yaptığı bir araştırmada "dikkat odaklayıcı sözcük ya da sözcüklerin etkili tasarlanması" ilkesinin tüm ders kitaplarında dikkate alınmadığı sonucuna varılmıştır.

Ders kitaplarının hazırlanmasında başta dikkat çekme araçları olmak üzere tüm mesaj tasarım ilkelerine uyulmalı ve mevcut ders kitaplarındaki mesaj tasarımı ilkeleri ile ilgili hatalar ve eksiklikler giderilmelidir. Ders kitaplarının hazırlanması ve değerlendirilmesi sürecinde mesaj tasarımı ilkeleri bir bütünlük içinde ele alınmalıdır. Ders kitabı hazırlama komisyonunu oluşturacak kişiler özenle seçilmeli ve bu kişiler kitap hazırlama sürecine başlamadan önce mesaj tasarımı ile ilgili eğitime alınmalıdır. Mesaj tasarım ilkelerine uygun olarak hazırlanmış ders kitaplarının uygulamadaki etkililik derecesinin araştırılmalıdır. Mesaj tasarım ilkelerinin öğrenci başarısına olan etkisi farklı derslere göre araştırılmalıdır.

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# DESIGN OF SELECTED PARTS OF NON-CONVENTIONAL STIRLING ENGINE WITH FIK MECHANISM

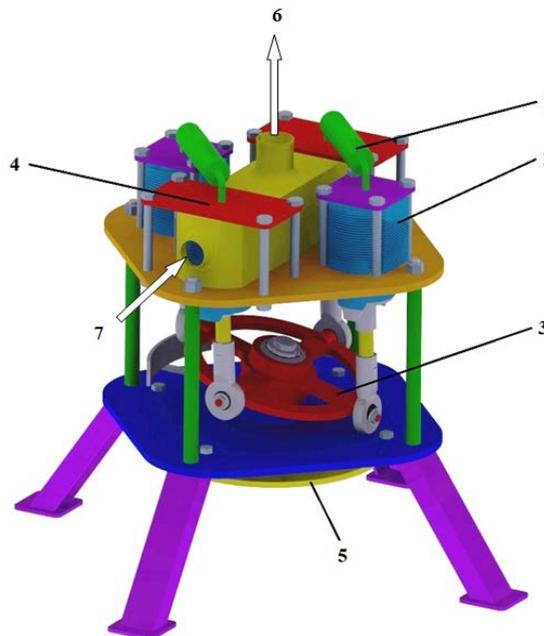
Dalibor Barta, Juraj Saniga, Martin Mruzek, Martin Kendra  
 University of Zilina  
 Faculty of Mechanical Engineering  
 Slovakia  
 dalibor.barta@fstroj.uniza.sk

**Abstract:** This paper deals with a design implementation of Stirling engine with a non-conventional FIK mechanism, contains a description of its operation and discusses the possibilities of compression ratio changes. It presents the results of a research focused on individual parts of the engine, including the regenerator, FIK mechanism and heat transfer. These results have been obtained by calculation, simulation and experiments performed directly in the selected engine parts. The FLUENT software was used for the simulation.

**Key words:** Stirling engine, FIK, regenerator, CFD simulation

## Introduction

One of many applications of the patented FIK engine construction with non-conventional mechanism with a swing plate is its modification for the Stirling engine (Kukuca et al., 2002). In this configuration, the Stirling engine uses air, which is heated in the heat cylinder of the cylinder wall and cylinder head, as a power medium.



**Figure 1:** Virtual model of non-conventional mechanism FIK: 1 – regenerator, 2 – cooled cylinder, 3 – swing plate, 4 – heated cylinder, 5 – flywheel, 6 – heat output, 7 – heat input

Two heated and two cooled cylinders connected with a regenerator form the basic concept of the Stirling engine with the non-conventional FIK mechanism with a swing plate. The basic dimensions of the piston group were taken from the an air-cooled vehicle engine with cylinder diameter of 75 mm and a stroke of 72 mm. When designing this engine, theoretical calculations were used. Subsequently, the proposal of the swing plate and other main engine dimensions were made. The project continued with the creation of 3D models using the Catia V5R20 software. Figure 1 shows a virtual model of non-conventional FIK mechanism. The other parts are described below.

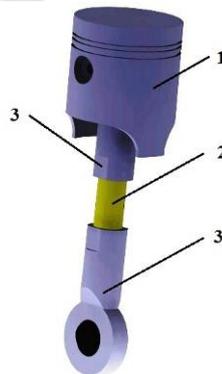
## Description of constructive units

The basic supporting structure of the engine consists of two steel plates with a thickness of 10 mm. At the top plate, there are holes for cylinders and holes for screws connection.



**Figure 2:** Top plate with cylinders and heads

The bottom plate performs several functions. The gearing that is there is used to assure kinematic movement of the swing plate. The bearing housings where the crankshaft is housed are there too and also the holes for fastening of the stabilization feet. The top and bottom plates are connected with four capped pipe beams with shoulder on the top. Inserting washers under the top plate can change the engine compression ratio and other performance parameters as well. The plate is screwed with four threaded rods M14.



**Figure 3:** Piston group: 1 – piston, 2 – thread rod, 3. – rod end

The piston group of Stirling engine with non-conventional FIK mechanism was used from the air cooled engine. The ribs of the air-cooled cylinders allow regular and steadier heating of heated cylinders in order to keep the optimal working temperature. On the other hand it allows better cooling down of cooled cylinders where the temperature must be stable – isothermal.

The connecting rod of swing mechanism consists of three parts, two rod ends SKF SI 20ES and a thread rod M20, as can be seen in the figure 3. In the mechanism of the FIK engine the swing plate makes a movement in three axes. Therefore the crank bearings and piston-pin bearings use the rod ends. The rod length is variable. The designed length of connecting rod is  $L = 164\text{mm}$  (Kukuca et al., 2006).



**Figure 4:** Swing plate with rod ends and gear

The swing plate in the figure 4 and 5 transfers the straight-line reciprocating motion of the piston to the crankshaft. In the swing plate, there are bearing housings for conical bearing, in which the crankshaft is supported. The same type of conical bearings is used in the bottom plate.



**Figure 5:** Swing plate with rod ends, crankshaft, bearings and gear wheels

The position of the swing plate stabilizes the helical gearing which transmits forces on the bottom plate and defends the rotation of the swing plate around its own axis. The design of the swing plate is lightweight in order to achieve lower mass and lower inertia forces.



**Figure 6:** Crankshaft

The crankshaft is cranked in the angle  $15^\circ$  – this value was calculated. The pitch diameter of the cylinders and the piston stroke were used as the input data for calculation. The bigger pitch diameter of the cylinders, the lower crankshaft crank at the constant piston stroke. The flywheel for steady running of the engine is located in the lower end of the crankshaft. Below the flywheel, there is an engine-speed sensor.

An important part of non-conventional mechanism FIK is a balancing mechanism. Balancing equipment must secure the balance of inertia forces and moments in the engine. When this is not balanced, the participating mass makes the running around the engine axis unstable. The process of balancing depends on the mass of pistons, connecting rods, piston pins and the swing plate and on the values of basic kinematic parameters. Balancing is realized with counterweight. The counterweight is connected with the crankshaft. The radius of the counterweight arm is bigger than the radius of the swing plate. The correct position and mass of the counterweight reduce the inertia forces and moments. The values of position and mass were calculated from the input parameters. The methodology and process of calculation of FIK mechanism balancing can be found in literature (Kukuca et al., 2003, Kukuca et al., 2004).

The engine was designed for maximum operating speeds of 2000 rpm. The maximal engine power depends on the quantity of the input heat and the efficiency of the regenerator. The regenerator consists of the body and the filling. Figure 7 shows the cut of the engine.

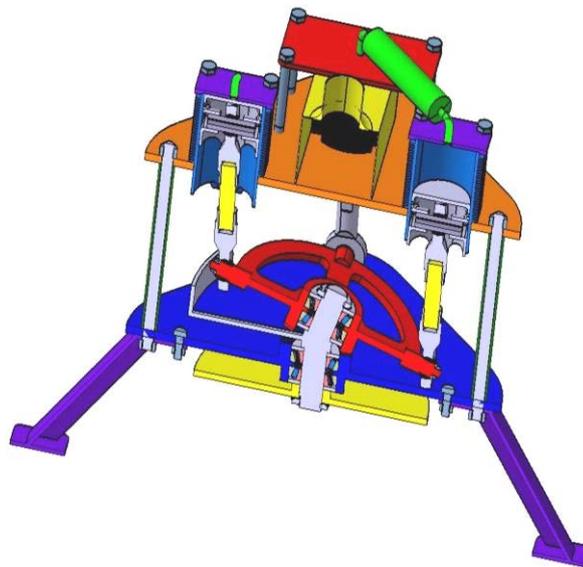


Figure 7: Cut of the engine

## Working principle

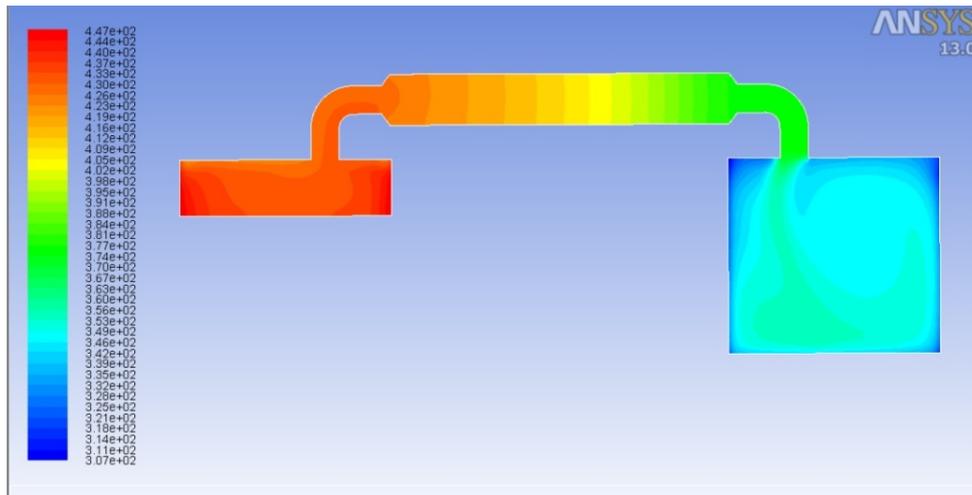
Both heated cylinders are heated from outside with directed flow of heat air from two independent hot-air devices. The parameters of hot-air devices are: performance 2000W, air flow 650l/min and temperature of heated air from 50 to 600°C. Also other sources of heat can be used for heating, for example, a gas-jet. For directing the flow of hot air around the heated cylinder walls was designed the cylinders sheathing. The limiting factor of heating the cylinders is the temperature at the internal wall of the cylinder, due to the maintaining of lubricating properties of oil. The oil could not go over 240°C. The cooled and heated cylinders are connected with the regenerator by pipes. The phase shift between the pistons in heated and cooled cylinders is 90°. In order to achieve the highest thermal stability in the cylinders, the highest engine efficiency and performance and the best heat utilization, the engine design includes the heat regenerator.

## Regenerator

The basic requirement for the regenerator is to capture the maximum amount of heat contained in the air as a working medium when the heated air is moving from the heated cylinder to the cooled cylinder and then to reabsorb it when the cooled air is moving from the cooled cylinder to the heated cylinder.

It is therefore necessary to propose a regenerator with a space large enough and with a reasonable volume, lowering the final compression engine ratio (Bigos, Puskar, 2008). The first regenerator concept showed the need to synchronize its size and the engine speed.

The simulation of regenerator work was made by Fluent software (Sojcek et al., 2005).



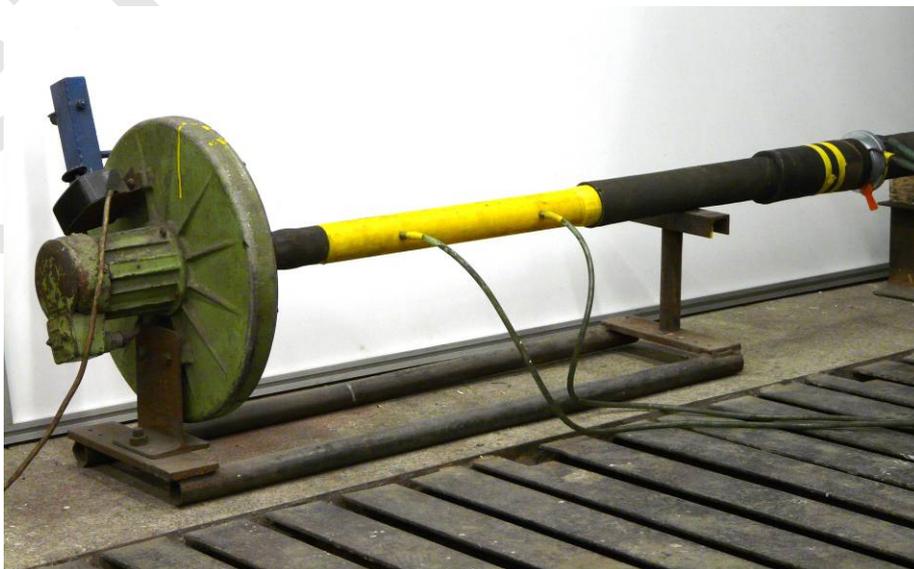
**Figure 8:** Distribution of temperatures in the cylinders and regenerator - porosity 0.961

Program Fluent use these main steps of CFD analysis:

- the basic formulation of the task (problem definition),
- creating a geometric model and the control area (use of CAD system),
- creating boundary and initial conditions,
- set the correct physical model with regards to the studied problem,
- creation and generation of adequate mesh (structure, size, or local concentration),
- CFD calculation (the assessment of convergence solution, eventually review of model parameters),
- data processing to obtain results,
- comparison with other results (experimental when available),
- critical evaluation of the obtained results.

In this case was used a standard turbulence  $k - \epsilon$  model. This model is simplest "complete model" of turbulence with two-equation models in which the solution of two separate transport equations allows the turbulent velocity and length scales to be independently determined. The  $k - \epsilon$  standard model in FLUENT software falls within this class of turbulence model and has become the workhorse of practical engineering flow calculations in the time since it was proposed by Launder and Spalding. Robustness, economy, and reasonable accuracy for a wide range of turbulent flows explain its popularity in industrial flow and heat transfer simulations.

For our problem was created 2D geometry of cylinders, pipes and regenerator in Catia software. Sketch was exported as a step file to the Gambit program, which is used to computing grid creating. Results of 2D simulations showed the problems which must be solved in 3D simulation. It was found how the geometry of the regenerator inlet and outlet sections influences flow in the regenerator and how to determine the regenerator volume to avoid an excessive heating of the medium in the cold cylinder as seen in the figure 8. 2D simulation showed also how the porosity and material of regenerator filling influences the function of regenerator.



**Figure 9:** Measuring equipment for measurement of flow resistance in regenerator

It is necessary to know the flow resistance values caused by regenerator filling to get more accurate simulation calculations in 3D geometry. These values are in figure 11 and they were obtained by real measurement on the test model shown in figure 9. Coefficients  $C_2$  and  $1/\alpha$  determining the regenerator filling properties were calculated from the values of flow resistance as follows:

Experimental data that is available in the form of pressure drop against velocity through the porous component, can be extrapolated to determine the coefficients for the porous media

Then a p-v curve can be plotted to create a trend line through these points yielding the following equation

$$\Delta p = 11,592v^2 + 7E-13v$$

where  $\Delta p$  is the pressure drop and  $v$  is the velocity.

For the coefficients we can write

$$11,592 = C_2 \frac{1}{2} \rho \Delta n$$

with  $\rho=1,1845 \text{ kg/m}^3$  at  $25^\circ \text{ Celsius}$ , porous media thickness  $\Delta n = 0,19 \text{ m}$ , inertial resistance factor

$$C_2 = 103$$

$$7.10^{-13} = \frac{\mu}{\alpha} \Delta n$$

with air kinematic viscosity  $\mu = 1,56E-5 \text{ m}^2/\text{s}$ , the viscous inertial resistance factor

$$\frac{1}{\alpha} = 2,3616 \cdot 10^{-7}$$

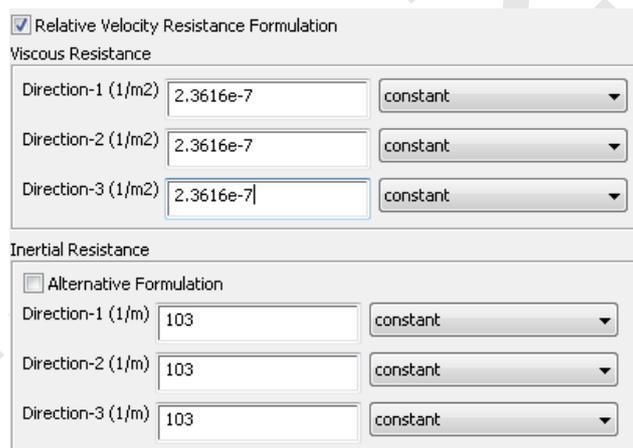


Figure 10: Formulation of porous media coefficients in Fluent software

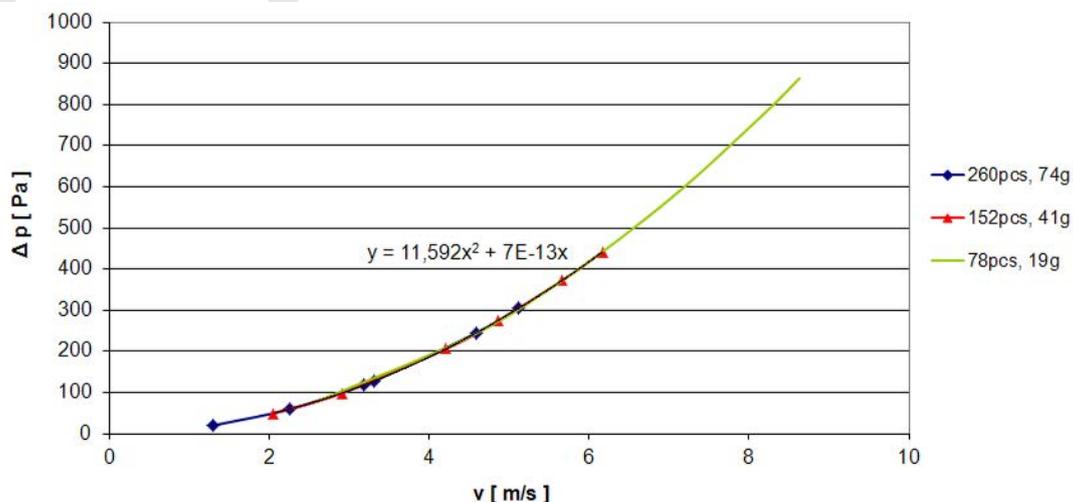
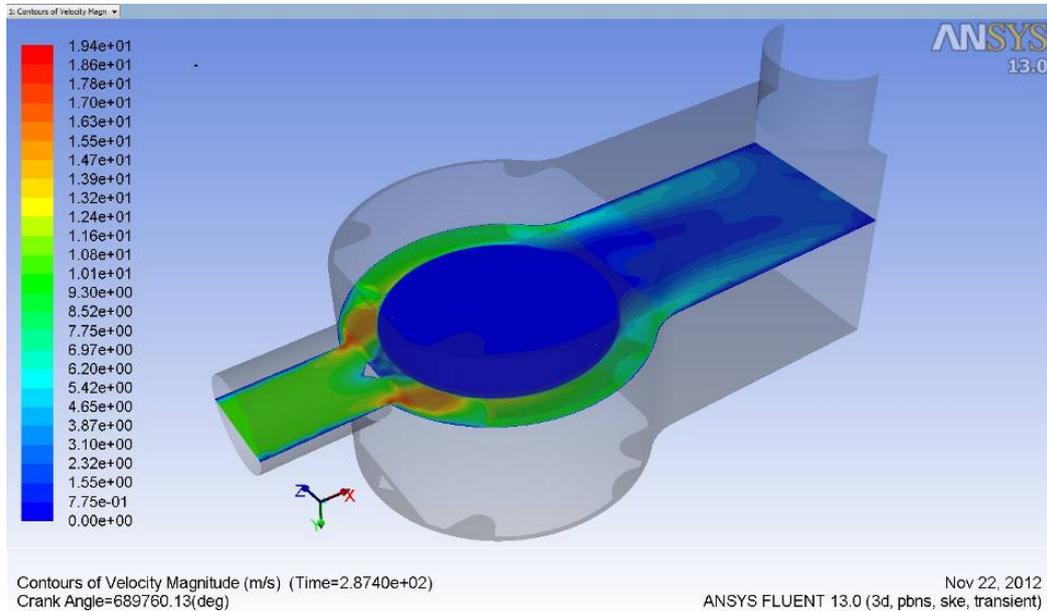


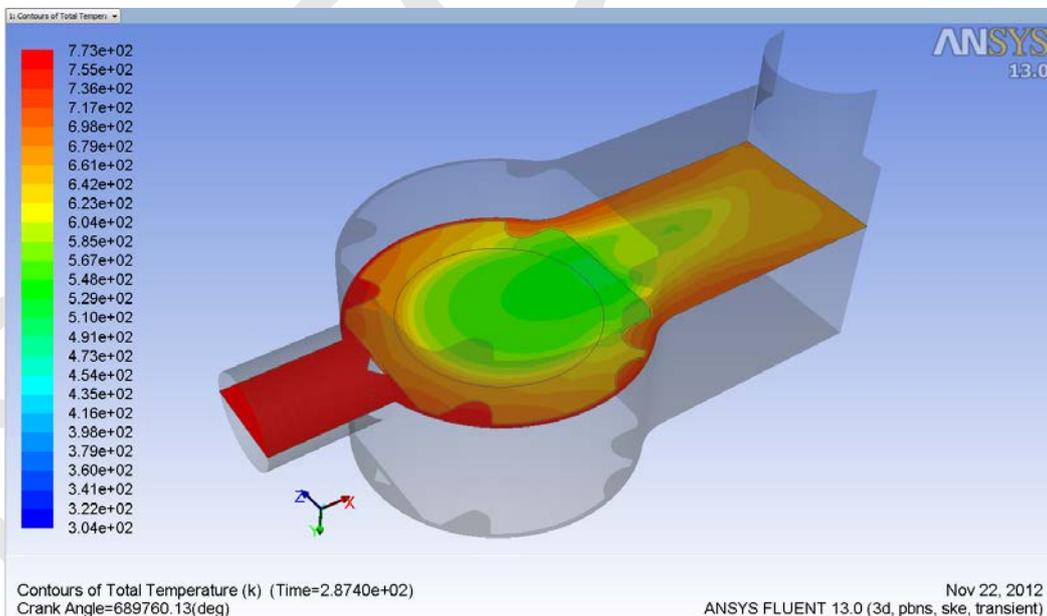
Figure 11: Measuring equipment for measurement of flow resistance in regenerator

## Cylinders

It is important to put a maximum of input heat in the shortest time. The heat transfer through the cylinder wall and ribs was simulated. To avoid the local overheating of the cylinder from the source of hot air, the deflector, which directs the hot air flow around the cylinders, had to be used. To ensure the flow of the air through the cylinder ribs and more even distribution of temperature on the whole surface of the cylinder the sheathing with a minimum gap (1mm) between the cylinder ribs and sheathing was designed. Figure 12 shows the airflow around the cylinder and its guidance to hot air exhaust.

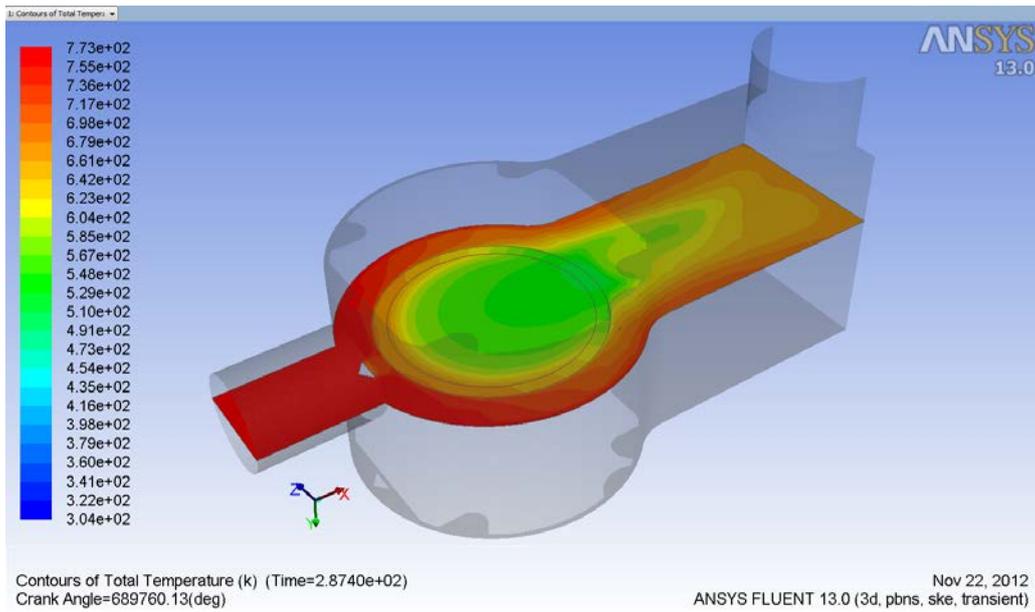


**Figure 12:** The course of velocity of hot air flowing between the cylinder ribs

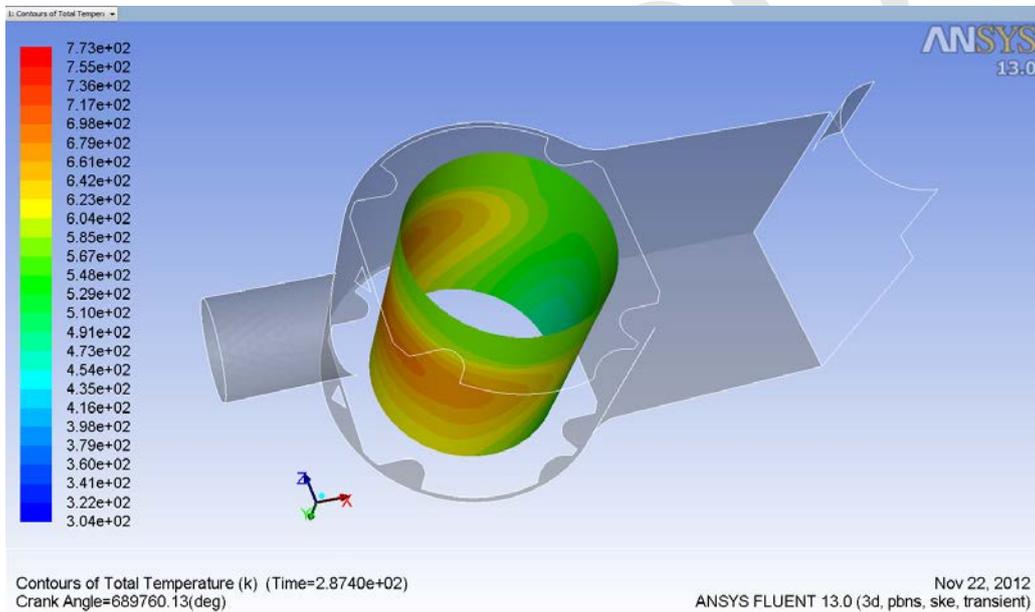


**Figure 13:** The course of temperatures of heated air and the cylinder through the ribs

As seen in the figure 13, about 65% of the cylinder surface flowed around by hot air reaches approximately identical temperature, about 680 K. The lowest temperature is achieved on the back of the heated cylinder, approximately 540 K, what is quite significant temperature difference.

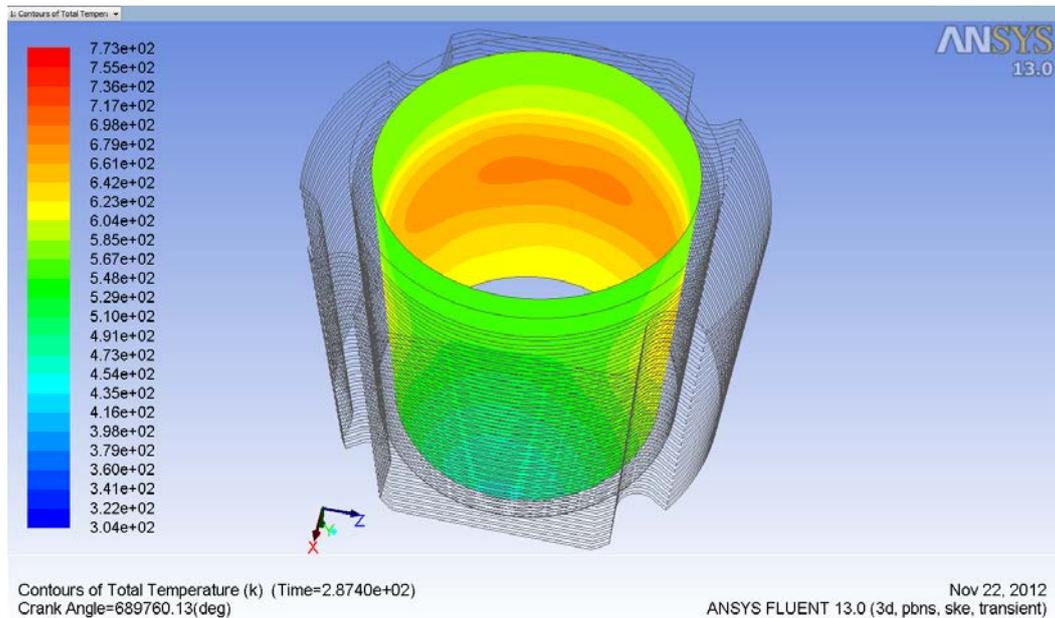


**Figure 14:** The course of temperatures of heated air and the cylinder through the volume between the ribs.



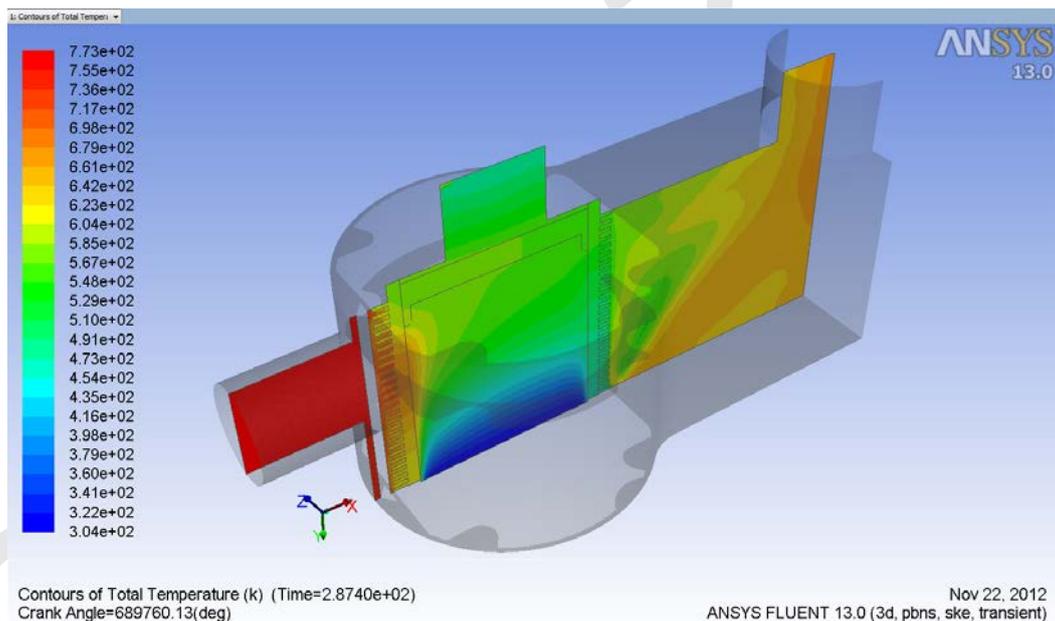
**Figure 15:** The course of temperatures inside the heated cylinder

As seen in figure 15, which shows the inner surfaces of the cylinder, the back part of the cylinder where miss the sheathing and guidance the flow of hot air remain significantly cooler. Because the sheathing is common for both heated cylinders the simulation was solved as symmetrical. The simulation showed that the designed shape of sheathing can not ensure more even heating of the cylinder on the whole surface and that the hot air flowing the opposite cylinder do not cause sufficient change of the flow in the area between the cylinder and the air outlet of the sheathing. As a result, the hot air will be not guidance on the back of the heating cylinder. To achieve better temperature distribution on the cylinder surface will be necessary to modify the sheathing form and to verify it by next simulations.



**Figure 16:** The course of temperatures inside the heated cylinder with ribbing

Figure 17 shows the heating of the cylinder and piston in the current position in top dead center. The simulation was performed at a moving piston and speed  $400 \text{ min}^{-1}$ .



**Figure 17:** The course of temperatures in the cross-section of heated cylinder with ribbing

## Conclusions

The design of the non-conventional Stirling engine with the FIK mechanism was created as a part of the VEGA 1/0763/11 project. The paper describes the current state of the project. The project's goal is the construction of a functional engine. The engine parts that are already available are shown in the figures above. Simulations by the Fluent software were used when designing some heat-affected parts such as the regenerator, cylinders, cylinder sheathing. The regenerator Simulations showed a need to modify some regenerator parts to improve the flow and to ensure a sufficient regenerator output. It will be needed to perform a 3D simulation of the real state with accurate computation input conditions.

Laboratory measurements of the flow resistance for a specific regenerator type that were taken will be used in a 3D model simulation calculation. The determination of the heat input for the Stirling engine function was another task of

the solution. That was based on the heat transfer simulation calculations for the heated engine cylinder with the optimal airflow of heating medium – hot air coming from heat guns through the cylinder ribs. The calculations showed insufficient heating of the cylinder back on approximately 35% of its circumference even when the hot air flow from another heated cylinder was taken into account.

## Acknowledgements

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# DETERMINATION OF OPTIMUM COLLECTOR SURFACE AREA FOR SOLAR ASSISTED HEAT PUMP SYSTEM WITH SIMULATION: ENERGY AND EXERGY ANALYSIS

İbrahim ATMACA and Sezgi KOÇAK  
Department of Mechanical Engineering  
Faculty of Engineering  
Akdeniz University, Turkey  
atmaca@akdeniz.edu.tr sezgikocak@akdeniz.edu.tr

**Abstract:** Energy is the primary need for human life and the requirements of energy increases every day. Even though fossil fuels are the most common resource to meet those requirements, almost every country in the world agrees on common ground that even if they have not been depleting, viable alternatives to conventional sources should be found. It is because that the greenhouse gases produced by the fossil fuels causes global warming. Therefore, clean and renewable energy sources are getting more attention. In addition to the research over alternative energy sources, systems which are assisted or operated by these are also being investigated. Heat pumps are the most popular of these systems and combining solar energy and heat pump technology is a very viable concept. In this study, solar-assisted heat pump system (SAHPS) with flat plate collectors is investigated with simulation. The case study is applied for February in Antalya, Turkey and solar radiation values in the selected region are estimated with the simulation. The system is designed to meet 7.5 kW heating load of an office building with 100 m<sup>2</sup> surface area. The effect of change in the collector surface area over the storage tank temperature, consumed power of the compressor and COP of heat pump are investigated for concerning system. In addition, exergy analysis is performed for 30, 35 and 40 m<sup>2</sup> collector areas and exergy destruction rates of the components are compared. The results of the simulation are also compared with available experimental data in the literature in order to present reliability of the model.

**Key words:** solar collector, heat pump, energy, exergy, simulation

## Introduction

World is running out of fossil fuel resources and their side effects over the nature are getting unacceptable. Therefore, clean and sustainable energy sources gaining more attention and being considered as the new solution. Energy efficient applications not only should use the renewable energies but also should be designed to use conventional energy sources more efficiently. Heat pumps can meet those requirements by means of their technology. Heat pumps can offer efficient and nature friendly options from domestic use to industrial applications. Heat pumps can use air, soil or geothermal energies as a heat source along with the solar energy while having low electric power consumption. The use of solar energy is a considerable interest because it is non-pollution, renewable and endless source which can be used everywhere.

Several computer models and experimental studies for describing the performance characteristics of SAHPS have been proposed over the literature (Dikici and Akbulut, 2008; Ozgener and Hepbasli, 2005b and Badescu 2002). In order to improve the present understanding of the system dimensions and productive usage of solar energy, much more investigation still has to be done. As a result of continuous increase in the energy costs, trying to improve the energy efficiency is inevitable. It is expected that the studies on heat pump technologies will allow researchers to reach the stated goal and help improving the usage of these systems.

In this study solar-assisted heat pump system with flat plate collectors is investigated with simulation. The case study is applied for February in Antalya, Turkey and solar radiation values in the selected region are estimated with the simulation. The system is designed to meet 7.5 kW heating load of an office building with 100 m<sup>2</sup> surface area. The effect of change in the collector surface area over the storage tank temperature, consumed power of the compressor and COP of heat pump are investigated. In addition, exergy analysis is performed for 30, 35 and 40 m<sup>2</sup> collector areas and exergy destruction rates of system components are compared. The results of the simulation are also compared with available experimental data in the literature in order to present reliability of the model.

## Materials and Method

Solar energy modelling is designed to determine hourly storage tank temperatures. In order to estimate the storage tank temperature, the rate of instantaneous radiation on a tilted surface for selected region needs to be calculated. With the help of this data, the amount of solar radiation received by solar collectors and transmitted to storage tank is determined. As known, the solar radiation on horizontal surface divides into 2 parts: beam and diffuse radiation. Both of these types are determined and used to reach the values for tilted surfaces. It should be kept in mind

that there is an additional type of solar radiation on tilted surfaces called reflected radiation. The required equations to calculate total instantaneous radiation on tilted surfaces are as below:

$$I_{\text{tot}} = I_{\text{b}} + I_{\text{d}} \quad (1)$$

$$I_{\text{tot}} = I_{\text{b}} \frac{1 + \rho_{\text{g}} \cos^2 \theta}{2} \quad (2)$$

$$I_{\text{refl}} = I_{\text{b}} \left( \frac{1 - \rho_{\text{g}} \cos^2 \theta}{2} \right) \quad (3)$$

$$I_{\text{tot}} = I_{\text{b}} + I_{\text{d}} + I_{\text{refl}} \quad (4)$$

Solar collectors are modelled with the equation suggested by Duffie and Beckman (1980):

$$\dot{Q}_{\text{c}} = A_{\text{c}} [\rho_{\text{g}} (I_{\text{b}} \cos \theta + I_{\text{d}}) - U_{\text{c}} (T_{\text{c}} - T_{\text{a}})] \quad (5)$$

where  $\dot{Q}_{\text{c}}$  is the useful solar energy collected in collectors,  $A_{\text{c}}$  is the collector area,  $\rho_{\text{g}}$  ( $\rho_{\text{g}}$ )<sub>c</sub> and  $U_{\text{c}}$  are the properties of collector. In this study, single glazed flat plate collectors with selective surface are considered. These parameters for this type of collectors are assumed as  $\rho_{\text{g}}$  ( $\rho_{\text{g}}$ )<sub>c</sub> = 0.70 and  $U_{\text{c}}$  = 3.3 (Ileri, 1995).

The SAHPS designed for this study includes a water storage tank which works as a heat source of heat pump. There is a continuous process between solar collectors, storage tank and heat pump evaporator. The storage tank gains energy from solar collectors while losses energy to evaporator simultaneously. As a result of the temperature difference between storage tank and its surroundings, there is also a heat loss to the ambient air. If the rate of energy gain and losses for a time period of  $\Delta t$  are assumed to be constant, equations can be written for each time interval as suggested by Duffie and Beckman (1980):

$$\dot{Q}_{\text{c},\text{net}} = \dot{Q}_{\text{c}} + \frac{\Delta T}{(\frac{1}{U_{\text{c}}})_{\text{net}}} \cdot [\dot{Q}_{\text{c}} - \dot{Q}_{\text{evap}} - (U_{\text{c}})_{\text{net}} (T_{\text{c}} - T_{\text{a}})] \quad (6)$$

In this equation,  $\dot{Q}_{\text{evap}}$  represents the amount of energy that the evaporator extracts from the storage tank,  $T_{\text{c}}$  is the storage tank temperature at the moment of calculation and  $m$  is the storage tank mass.  $U_{\text{c}}$  parameter stands for overall heat transfer coefficient and  $(\frac{1}{U_{\text{c}}})_{\text{net}}$  value is considered as 11.1 W/K as suggested by Duffie and Beckman (1980). The schematic diagram of the system is shown in Fig 1. As it can be seen from Fig 1, the heat pump system used in this design is an indirect type whereas there are two additional cycles to the heat pump cycle. It is assumed that the heat pump cycle uses R410a as a working fluid while its water on additional cycles. The system operates with conventional vapour compressed heat pump cycle and uses storage tank as a heat source which is heated by the solar collectors. On the condenser side of the system, fan-coil unit uses condenser's rejected energy to heat the room.

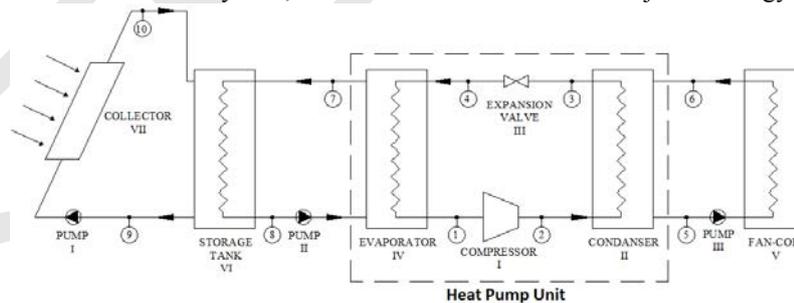


Figure 1. Schematic diagram of the solar assisted heat pump space heating system

To be able to accomplish first and second law analysis of the solar assisted heat pump system, several assumptions have to be considered:

- Steady-state and steady-flow with negligible potential and kinetic energy effects and no chemical reactions for all processes,
- The directions of heat transfer to the system and work transfer from the system are given positive,
- Since the lengths of pipelines between the components are assumed to be short, the pressure drops are negligible.

**Table 1** Mass, energy and exergy balance equations (Ozgener and Hepbasli 2005a; Dincer and Rosen 2007)

| Mass Balance                             | Energy Balance                           | Exergy Balance   |
|--|--|--|
| $\sum \dot{m}_{in} = \sum \dot{m}_{out}$ | $\sum \dot{E}_{in} = \sum \dot{E}_{out}$ | $\sum \dot{E}_{x,in} - \sum \dot{E}_{x,out} - \sum \dot{E}_{x,dest} = 0$ |
|  |  | $\dot{\square} = \dot{\square} \square$                                  |
|  |  | $\psi = (h - h_o) - T_o (s - s_o)$                                       |

**Table 2** The balance equations of mass, energy and exergy for each component of the system (Dikici and Akbulut 2008; Dincer and Rosen 2007; Ozgener and Hepbasli, 2005a)

| Component             | Mass analysis   | Energy analysis   | Irreversibility analysis  |
|-----------------------|---|---|---|
| Compressor (I)        | $\dot{m}_1 = \dot{m}_2 = \dot{m}_3 = \dot{m}_{ref}$                               | $\dot{W}_{comp} = \dot{m}_{ref} (h_2 - h_1)$                                | $\dot{E}_{x,dest,comp} = \dot{m}_{ref} (\psi_1 - \psi_2) + \dot{W}_{comp}$                                    |
| Condenser (II)        | $\dot{m}_2 = \dot{m}_3 = \dot{m}_{ref}$<br>$\dot{m}_5 = \dot{m}_6 = \dot{m}_{w1}$ | $\dot{Q}_{cond} = \dot{m}_{w1} c_p (T_5 - T_6) = \dot{m}_{ref} (h_2 - h_3)$ | $\dot{E}_{x,dest,cond} = \dot{m}_{ref} (\psi_2 - \psi_3) + \dot{m}_{w1} (\psi_6 - \psi_5)$                    |
| Expansion valve (III) | $\dot{m}_3 = \dot{m}_4 = \dot{m}_{ref}$   | $h_3 = h_4$   | $\dot{E}_{x,dest,valve} = \dot{m}_{ref} (\psi_3 - \psi_4)$  |
| Evaporator (IV)       | $\dot{m}_1 = \dot{m}_4 = \dot{m}_{ref}$<br>$\dot{m}_7 = \dot{m}_8 = \dot{m}_{w1}$ | $\dot{Q}_{evap} = \dot{m}_{w1} c_p (T_8 - T_7) = \dot{m}_{ref} (h_1 - h_4)$ | $\dot{E}_{x,dest,evap} = \dot{m}_{ref} (\psi_4 - \psi_1) + \dot{m}_{w1} (\psi_8 - \psi_7)$                    |
| Fan – coil unit (V)   | $\dot{m}_5 = \dot{m}_6 = \dot{m}_{w1}$  | $\dot{Q}_{fc} = \dot{Q}_{cond} = \dot{m}_{w1} c_p (T_5 - T_6)$              | $\dot{E}_{x,dest,fc} = \dot{m}_{w1} (\psi_5 - \psi_6) - \dot{Q}_{fc} \left(1 - \frac{T_0}{T_{air,in}}\right)$ |
| Storage tank (VI)     | $\dot{m}_7 = \dot{m}_8 = \dot{m}_{w1}$  | $\dot{Q}_{st} = \dot{Q}_{evap} = \dot{m}_{w1} c_p (T_8 - T_7)$              | $\dot{E}_{x,dest,st} = \dot{m}_{w1} (\psi_7 - \psi_8) + \dot{m}_{solar} (\psi_{10} - \psi_9)$                 |
| Collector (VII)       | $\dot{m}_9 = \dot{m}_{10} = \dot{m}_{solar}$                                      | $\dot{Q}_u = \dot{m}_{solar} c_p (T_{10} - T_9)$                            | $\dot{E}_{x,dest,coll} = \dot{m}_{solar} (\psi_9 - \psi_{10}) + A_c I_T \left(1 - \frac{T_0}{T_p}\right)$     |

During the analyses mass, energy and exergy balance equations are used to determine the amount of energy that the evaporator extracts from the storage tank, useful solar energy collected in collectors and exergy destruction rates of system components. The mass, energy and exergy balance equations are defined in Table 1. The balance equations of mass, energy and exergy for each component of the system are obtained by the equations presented in Table 1 and are defined in Table 2. In order to analyze solar assisted heat pump space heating system, a simulation is programmed by using JAVA language. Thermodynamic properties of each point in the system are estimated with the help of a sub-program that uses cubic linear interpolation mathematical method. Energy and exergy analysis are carried out with the data obtained from sub-program. All of the calculations are performed for 1 hour time intervals between 08:00 am and 18:00 pm. Following assumptions were made in the simulation program:

- Compressor's isentropic and mechanical – electrical efficiencies ( $\eta_{elec-mech}$ ) are assumed to be 75% and 76%, respectively,
- The working fluid is considered to be saturated both at the exits of the condenser and evaporator,
- Expansion of the working fluid is considered to be isenthalpic,
- Storage tank temperature is assumed to be nonstratified,
- The evaporation temperature is assumed to be 10 K less than the storage tank water temperature,
- The fan – coil inlet and outlet water temperatures are taken to be constant at 50 °C and 40 °C, respectively,
- The condensing temperature is assumed to be 15 K higher than the fan – coil return water temperature,
- Flow rate circulating in the collectors are taken to be 0.135 m<sup>3</sup>/h-m<sup>2</sup> collector area.

This investigation covers the environmental and atmospheric circumstances of Antalya ( $\phi=36.91^\circ$  N), Turkey. Solar radiation ( $I_T$ ) values for Antalya in February are calculated with the simulation and found out that the values changed between 279 and 113 W/m<sup>2</sup> with the mean value of 372 W/m<sup>2</sup>. The tilt angle of the collector is considered as 50° which is the optimum tilt angle for Antalya in winter. The outputs include storage tank temperature change, electrical power consumed by the compressor, COP of the heat pump along with the exergy destruction rates of the system components.

## Results and Discussion

The results from the simulation under determined design conditions are presented in this section. The tank size for the system is assumed to be 2250 kg. The effect of collector surface area on the storage tank temperatures, electrical power consumed by compressor, COP of heat pump and exergy destruction rates of system components are estimated. All of the calculations are carried out for February.

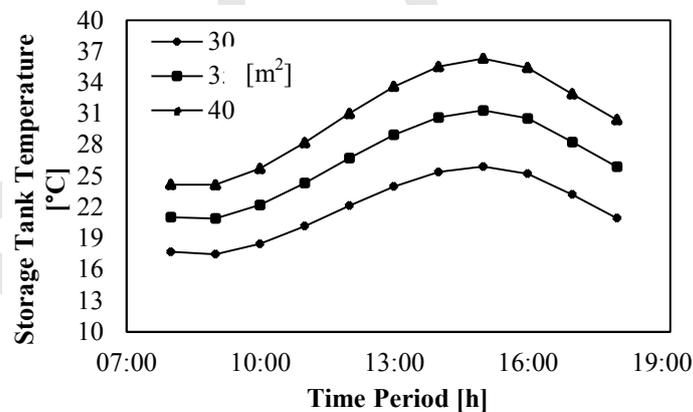


Figure 2. The effect of collector surface area on the storage tank temperatures

The effect of collector surface area on the storage tank temperatures is given in Fig 2. As expected, temperatures are increased with wider collector surface area. Daily mean temperature of the storage tank is calculated as 25.92, 31.32 and 36.31 °C for 30, 35 and 40 m<sup>2</sup> collector surface areas, respectively. It is obvious that the wider collector surface area provides more useful energy collected in the collectors, therefore storage tank temperature increases. Although, the optimum collector surface area needs to be selected to prevent collecting redundant energy. Fig. 3 shows the effect of collector surface area on the electrical power consumed by compressor. The compressor power changed depending on the storage tank temperature because the useful energy drawn by the evaporator also changes. As can be seen from Fig. 3, the wider collector surface area that resulted as higher storage tank temperatures decreased the electrical power consumed by the compressor. The effect of collector surface area on the COP of heat pump is given in Fig. 4. As shown in Fig. 4, COP values of the heat pump are increased with wider collector surface area. In addition, it is obvious from the figure that the mean COP value (3.297) of the heat pump is lower for 30 m<sup>2</sup> collector surface area but there is a small difference between the COP values during the operation period which resulted as more consistent operation.

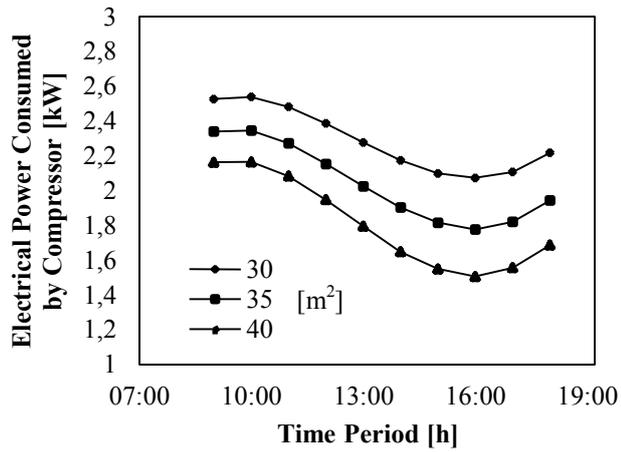


Figure 3. The effect of collector surface area on the electrical power consumed by compressor

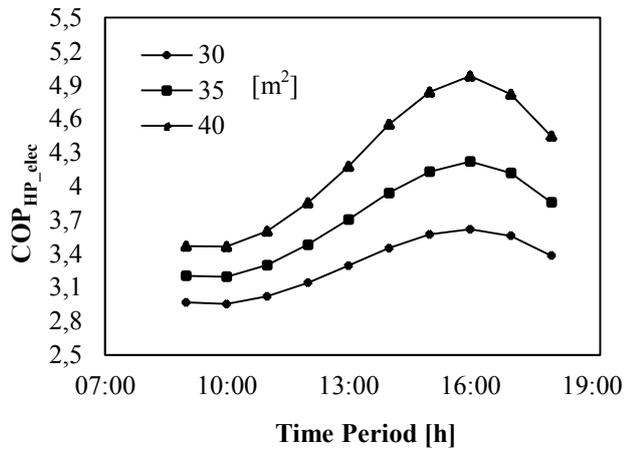


Figure 4. The effect of collector surface area on the COP of heat pump

If the 40 m<sup>2</sup> collector surface area is considered, it can be seen that the mean COP value (4.22) is higher but there is a significant fluctuation during the operation period. According to the Fig. 4, the designer is able to decide the optimum collector surface area for the required system. For the current study it appears as the 30 m<sup>2</sup> collector surface area is sufficient because several experimental analysis data shows that the COP value of solar assisted water source heat pump systems are usually between 2.00 and 3.13 (Dikici and Akbulut, 2008; Ozgener and Hepbasli, 2005b; Hepbasli and Akdemir, 2004; Kuang et. al., 2003). Therefore, 35 m<sup>2</sup> collector surface might be preferred as well depending on the cost limits of the designer. It is obvious from these results that the sizing of the required system is crucial in order to accomplish efficient system designs.

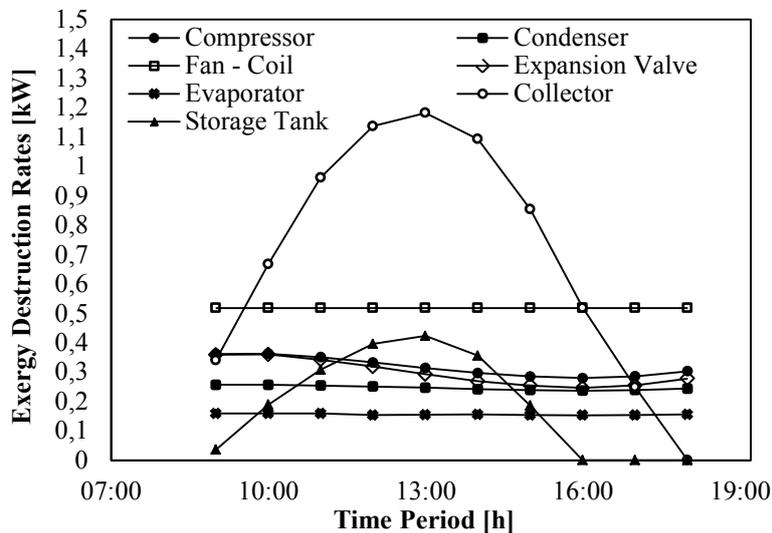


Figure 5. Exergy destruction rates of system components for 35 m<sup>2</sup> collector surface area

Exergy analysis is an important and useful tool for system designs. Applying a dynamic exergy analysis to a system that will be sized, allows the designer to see the behaviour of system during the entire operating period. Therefore dynamic exergy analysis is performed with the simulation and the exergy destruction rates of system components are estimated.

The restricted dead state temperature and pressure are considered as 9.9 °C and 100 kPa for both of the working fluids R410a and water during the analysis. The restricted dead state temperature is considered as the mean ambient temperature of February in Antalya, Turkey. Exergy destruction rates of system components for 30, 35 and 40 m<sup>2</sup> collector surface areas are calculated with the simulation and the results of the 35 m<sup>2</sup> collector area is given in Fig. 5. It can be seen from Fig. 5 that for the heat pump unit, the highest irreversibility occurred in compressor and expansion valve followed by the condenser and evaporator. If the entire system is considered, solar collectors had the highest irreversibility. These results are common for all different collector surface areas considered. The irreversibility of the solar collectors and storage tank is increased with wider collector surface areas while it decreased for all of the other components. When the exergy destruction figure is analyzed, it can be observed that at the end of operating period, collector and storage tank exergy destruction values are reached to zero. But it is clearly known that any of the systems or their components under no circumstance could have zero exergy destruction while there is a temperature difference. The purpose here is to refer to a situation that the irreversibility is approaching to zero as a result of low temperature heat transfer. The most important outcome from the dynamic exergy analysis is to clearly see the behaviour of solar collector. It is obvious from Fig. 5 that at the midday when the solar radiation is high, irreversibility of collectors are drastically increased. In order to avoid this situation it can be suggested to use high temperature water on high temperature applications first and then deliver to the heat pump system gradually.

As mentioned before, exergy destruction rates of the heat pump components are obtained as compressor, expansion valve, condenser and evaporator in descending order. These results are in accordance with the available experimental data over the literature. As an example, Ozgener and Hepbasli (2005), are also determined that the highest irreversibility occurs in compressor followed by condenser and evaporator due to their experimental study. Differently from Ozgener and Hepbasli's study, the second highest irreversibility is occurred on expansion valve. The reason of that is because of the high pressure difference between inlet and outlet of expansion valve by the use of R410a refrigerant. If we consider overall system, it is clear that fan coil units and solar collectors have high exergy destruction values. Similar to the heat pump results, these values are also fairly close to experimental analysis. As shown in Dikici and Akbulut's (2008) experimental analysis where solar collectors used as a heat source of heat pump, have the highest exergy destruction rates of all system. As a result, it can be determined that the results from the simulation show the same behaviour and the simulation model is reliable.

## Conclusions

In this study, solar assisted water source heat pump space heating system is analyzed with the help of a simulation program. As a result of the literature comparison, it is concluded that simulation predictions are in accordance with the experimental data. Therefore, it can be determined that the simulation model is reliable. Simulation provides advantages for system designs such as it allows the designer to decide most efficient solar collector area for the required system even before the installation. Energy and exergy analysis are an additional help to investigate irreversibility of system components and allows designer to make adjustments to increase system efficiency. Especially with the help of dynamic exergy analysis, one can adjust the system operation to reduce the solar collector irreversibility and have the advantage of using high temperature water for high temperature applications. Eventually, the simulation model and results is a helpful guide to engineers for design of solar assisted heat pump systems.

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# DEVELOPED SEGMENTED-LSB IMAGE STEGANOGRAPHY

*Dr. Mohammed Abbas Fadhil Al-Husainy*

*Department of Multimedia Systems, Faculty of Sciences and Information Technology,  
Al-Zaytoonah University of Jordan.  
Amman-Jordan*

*E-mails: [dralhusainy@yahoo.com](mailto:dralhusainy@yahoo.com), [alhusainy@zuj.edu.jo](mailto:alhusainy@zuj.edu.jo)*

**Abstract:** Steganography is one of many techniques that are used to hide secret information to prevent any attackers to make damage in this information or use it in illegal form. Classic Least Significant Bit (LSB) is the most steganography technique that is using to hide secret information in the least significant bit of the pixels in the stego-image. In this paper, the author developed his previous Segmented-LSB technique through decreasing the time that is required in the hiding operation of the technique. Segmented-LSB technique splits the secret message into set of segments that have same length (number of characters), and finding the best matched LSBs of pixels in the stego-image to each segment. The main goal of this technique is minimizing the number of LSBs that are changed by substituting them with the bits of characters of the secret message. This will lead to decrease the distortion (noise) that is occurred in the pixels of the stego-image and as result increase the immunity of the stego-image against the visual attack. The main weak point of the previous Segmented-LSB technique is the long time that is spending in the hiding operation, to find the best matched LSBs of pixels in the stego-image to each pixel, when its compare with the Classic Least Significant Bit. In this work, an additional measure is used to decrease this time. The recorded results from the experiments show that the developed Segmented-LSB technique gives good enhancement to the previous Segmented-LSB technique and it really limits the long time problem.

**Keywords:** Security; Distortion; Embedding; Substitution

## Introduction

Recently, steganography is implemented by using digital media. Secret message is embedded inside digital cover media like text, images, audio, video or protocols depending upon the requirement and choice of the sender. Compared with the other types of steganography, the image steganography is most widely used. The reason behind the popularity of image steganography is the large amount of redundant information present in the images that can be easily altered to hide secret messages inside them, and because it can take advantage of the limited power of the human visual system (HVS). With the continued growth of strong graphics power in computer and the research being put into image based steganography, this field will continue to grow at a very rapid pace (Kaur, R. Dhir, 2009, Alvaro Martin, 2005, Bhattacharyya, 2009).

Steganography has a wide range of applications. The major application of steganography is for secret data communication. Covert channels in TCP/IP involve masking identification information in the TCP/IP headers to hide the true identity of one or more systems. Cryptography is also used for the same purpose but steganography is more widely used technique as it hides the existence of secret data. Another application of steganography is feature tagging. Captions, annotations, time stamps, and other descriptive elements can be embedded inside an image, such as the names of individuals in a photo or locations in a map (Bhattacharyya, 2009, EE. Kisik Chang, 2004).

The Steganography technique is the perfect supplement for encryption that allows a user to hide large amounts of information within an image. Thus, it is often used in conjunction with cryptography so that the information is doubly protected; first it is encrypted and then hidden so that an adversary has to first find the hidden information before decryption take place. The problem with cryptography is that the encrypted message is obvious. This means that anyone who observes an encrypted message in transit can reasonably assume that the sender of the message does not want it to be read by casual observers. This makes it possible to deduce the valuable information. Thus, if the sensitive information will be transmitted over unsecured channel such as the internet, steganography technique can be used to provide an additional protection on a secret message (C. Kessler, 2001, Gandharba Swain, 2010, Hideki Noda, 2006, Kathryn, 2007).

A good technique of image steganography aims at three aspects. First one is capacity (the maximum data that can be stored inside cover image). Second one is the imperceptibility (the visual quality of stego-image after data hiding) and the last is robustness (C. Kessler, 2001).

The idea in this paper is that when substitute the LSB of the pixels (in the stego-image) with the bits of all characters (in the secret message) as one segment, this will result a large number of changes that are happen in LSB of pixels. It is normally come from the truth that it is rarely find a best match between very long sequence of bits of all characters in the secret message and the LSB of the pixels in the stego-image. A Segmented-LSB was proposed in this paper to overcome this problem by splitting the secret message into set of segments of same length (same number of characters). And try to find the best match between the bits of the characters in each segment and the LSB of different sequences of pixels in the stego-image. When the proposed Segmented-LSB split the long secret message into number of small segments, this will lead to increase the probability of finding best matching between the bits of the characters in the

secret message and the LSB of the pixels in the stego-image. The best match between bits will decrease the number of LSB of the pixels that are changed when replace the bits of characters in the secret message in it. As a result of that, the distortion/noise that will appear in the pixels of the stego-image will be decrease and the immunity of the stego-image against the attack by human visual system (HVS) becomes strong.

## Related Works

When hiding information inside images usually Least Significant Bit (LSB) method is used. In the LSB method the 8th bit of every byte of the carrier file is substituted by one bit of every bit of the secret information (Motameni, 2007). The LSB method usually does not increase the file size, but depending on the size of the information that is to be hidden inside the file, the file can become noticeably distorted.

Ross J. Anderson and Fabien A.P. Petitcolas argued that every steganographic approach will have its limitations; they proposed an information theoretic approach using Shannon's theory for perfect secrecy (Ross J. Anderson, 1998). One can also embed the secret information in frequency domain by using Discrete Wavelet Transform method (Po Yuch Chen, 2006). In this method the embedding should be done at high frequency coefficients. P. Mohan Kumar and D. Roopa suggested that one can apply block matching procedure to search the highest similarity block for each block of the secret image and embed in LSBs of the cover image (P.Mohan Kumar, 2007). Mohammed A.F. AlHusainy employed different strategy in image steganography art by mapping the pixels of image to English letters and special characters (Mohammed A.F. AlHusainy, 2009). Lisa M Marvel and Charles G Boncelet proposed to hide at the inherent noise places (Lisa M Marvel, 1999). Ran-Zan Wang and Yeh-shun Chen also did the two way block matching for image in image steganography (Ran-Zan Wang, 2006). But this approach is suspicious to the hackers. Xinpeng Zhang and his colleagues proposed an approach called "multibit assignment steganography for palette images", in which each gregarious color that possesses close neighboring color in the palette is exploited to represent several secret bits (Xinpeng Zhang, 2008). In reference (Mohammad Ali Bani Younes, 2008) authors have discussed a double substitution algorithm for encrypting at sender and decrypting at receiver and the embedding process was at 7th and 8th bit positions alternatively. So LSB embedding is no more secured now-a-days. So, new embedding techniques are to be welcomed to the steganographic world. Due to the large number of steganographic tools available over the internet, a particular threat exists when criminals use steganography to conceal their activities with in digital images in cyber space.

## Classic-LSB Image Steganography Technique

The Least Significant Bit (LSB) steganography technique works by representing each character (byte) of the secret message as a set of 8-bits (where 1 byte = 8 bits). And then hide/replace the bits of the characters in the least significant bit of the pixels in the stego-image. When the secret message has n characters, then LSB technique need at least  $(n*8)$  pixels in the stego-image to hid the bits of the n characters.

By substitute LSB of each pixel in the stego-image with one bit (from the 8-bits) of each character in the secret message, this replacement operation will cause some distortion/noise in the stego-image. By using Human Visual System (HVS), the attackers may doubt that the stego-image contain a secret information in it. In general, whenever the length of the secret message (number of characters) increase, then the noise in the stego-image probably will increase as a result. This will make a restriction in hiding a very long message in a small stego-image. Therefore, we will tend to choose a short message to hide it in a large stego-image to minimize the noise that is happened in the pixels of the stego-image and to put aside the doubt about containing the stego-image any secret information.

Also, when any attacker success to know that the stego-image has a secret message, it is easy to get this message by reconstructed it from the LSB of the pixels in the stego-image.

## The Developed Segmented-LSB Image Steganography Technique

Mohammed A.F Al Husainy in (Mohammed A.F Al Husainy, 2012) proposed the Segmented-LSB technique. The main goal of Segmented-LSB technique is to enhance the performance of the Classic-LSB technique by supporting it with three strong points:

- Decrease the distortion/noise that will be appearing in the pixels of the stego-image.
- Increase the capability of hiding very long secret message in a small stego-image.
- Increase the immunity of the stego-image against the Human Visual System (HVS) attacks.

In the following paragraphs, the explanation of the operations that are doing by the developed Segmented-LSB will be given. Two definitions that are used in this technique for *secret message* and *stego-image* are listed below:

A *secret message* is an English message might be contains alphabetic letters ('a'...'z') or numbers ('0'...'9') or any special symbols like: ('space character', '!', ',', '(', ')').

A *stego-image*, for the purpose of testing, that is candidate to be used in this work is a bitmap images (.bmp) type. In general, each file of type (.bmp) is consisting of a header part which is containing much information like (Width and Height of the image, number Palette, number of bits for each pixel) followed by the data of the bitmap image pixels, follow that usually most image files have many unused bytes that are added by the operating system to keep the size of the image file measure (in Kilobyte). The pixels of each image are representing as a two dimensional array, but the

Segmented-LSB technique treat the pixels of the image as a one dimensional array list of bytes, (where each byte has a value between (0...255)), by reading the bytes of the two dimensional image row by row and stores them as a one dimensional array list.

Before listing the algorithm's steps that describe the operations of the developed Segmented-LSB, some data structures that are using in the algorithm are defined follow:

1. **MessageB**: is a list that contains a binary representation (bits) of all characters in the secret message. The number of elements (size) of this list is  $(n*8)$ , where  $n$  is the number of characters in the secret message.
2. **ImageB**: is a list of the Least Significant Bit (LSB) of all pixels in the stego-image. The number of elements (size) of this list is  $(m)$ , where  $m$  is the size of the image and its equal  $(Width \times Height \times Palette)$ .
3. **SegmentLength**: is a positive integer number between  $(2 \dots (n*8)/2)$  which represents the length of each segment (number of bits) in the **SegmentList**.
4. **SegmentsList**: is a list of segments that is created from the **MessageB** by splitting it to  $k$  segments, where  $k = (n*8) / SegmentLength$ . And each segment has number of bits equal **SegmentLength**.
5. **SegmentIndex**: is a list of indices, each index represents the first index of a sequence of bits in **ImageB** that is having a best match with the bits of one of the segments in **SegmentsList**. We must note that there is no overlapping between the sequences of match bits in this technique.

**Algorithm: Segmented-LSB**

// **Hiding Operation**

**Step1:** Calculate the **TotalSize** (in byte) that is required to store:

- (1) Length of secret message (number of character)
- (2) **SegmentLength**
- (3) Size of **SegmentList**

**Step2:** Set an error ratio **AcceptedErrorRatio** (between 0...100)

For  $i = 1$  To  $((n*8) / SegmentLength)$

{

    For  $j = ((TotalSize*8)+1)$  To  $m$

    {

$x = 1$

$BestMatch = 0$

$BestIndex = -1$

$w = j$

        Initially Assume  $Error = 100$ ;

        While  $(w < (j + SegmentLength))$  and  $(Error > AcceptedErrorRatio)$

        {

            Find the number of matched bits  $MBits$  in **Segment**[ $i$ ][ $x$ ] with the bits of **ImageB**[ $w$ ]

            Calculate error ratio  $Error$  between the bits of **Segment**[ $i$ ][ $x$ ] and **ImageB**[ $w$ ]

$x = x + 1$

$w = w + 1$

        }

        If  $(MBits > BestMatch)$  or  $(Error < AcceptedErrorRatio)$

        {

$BestMatch = MBits$

$BestIndex = j$

        }

    }  $SegmentIndex[i] = BestIndex$

    Substitute the bits of **Segment**[ $i$ ] instead of the bits in **ImageB** starting at  $BestIndex$

}

**Step3:** Store the bits representation of the above three information in the Least Significant Bit (LSB) at the start of the **ImageB** list (from bit #1 to bit # $(TotalSize*8)$ ).

// **Extracting Operation**

**Step1:** Read from the stego-image the information that is stored in Step 4 of the hiding operation.

**Step2:** Reconstruct the segments of the secret message by using the extracted information in Step1.

**Step3:** Reassembling the all the segments that are constructed in Step2 to regenerate the characters of the secret message.

## Experimental Results and Discussion

The performance of the developed Segmented-LSB image steganography technique has been tested by using both the Classic-LSB and the developed Segmented-LSB to hide some messages in different (.bmp) images and record the results to enable the reader makes a good comparison, in the performance, between these two techniques. Fig. 1 shows the stego-images, of different sizes, that are used in the experiments. Table I summarizes the recorder results from the experiments using **SegmentLength** = 10 and **AcceptedErrorRatio** = 1.5%.

To clarify the effect of **SegmentLength** on the performance of the proposed Segmented-LSB image steganography technique, different selected values of the **SegmentLength** are used on the above experiments. Fig. 2 shows the effect of the **SegmentLength** on (a) Number of LSB changed, (b) Signal to Noise Ratio (SNR) of the stego-image, (c) Time of hiding operation.

The required programs to implement the Classic-LSB and the Segmented-LSB techniques are written by using C++ programming language and executing them on a computer system of 2.53GHz processor with 4.0 GB memory and Microsoft Windows 7 operating system.

From Table 1, we note that the developed Segmented-LSB success to minimize the time that is spent, through exhaustive search to find the best matching between the bits of each segment with all non-overlapped bits sequences in the *ImageB* list, in the hiding operation of the previous Segmented-LSB technique. The error ratio *Error* measure that is used in the developed Segmented-LSB technique helped to speed up the hiding operation without big degradation in the performance of the previous Segmented-LSB technique.

When we see the three parts of Fig. 2, we can note that the developed Segmented-LSB save the stability in the performance when the *SegmentLength* changed:

- When the *SegmentLength* increase, the number of LSB changed increase and vice versa. This is because when the *SegmentLength* be large, the possibility of finding best match between bits becomes less.
- When the *SegmentLength* increase, the SNR become decrease and vice versa. This is because the value of SNR of the stego-image is proportional with the number of LSB changed in the pixels of the stego-image.
  - The time of hiding operation of each image was increase/decrease when the stego-image size changes. It stays suitable when the size of the stego-image is small, but it becomes long when the size of the stego-image becomes large. This is because the searching time for best matching becomes huge when we using a stego-image of large size.



Figure 1: Stego-Images (.bmp) of Size (Width × Height × Palette)

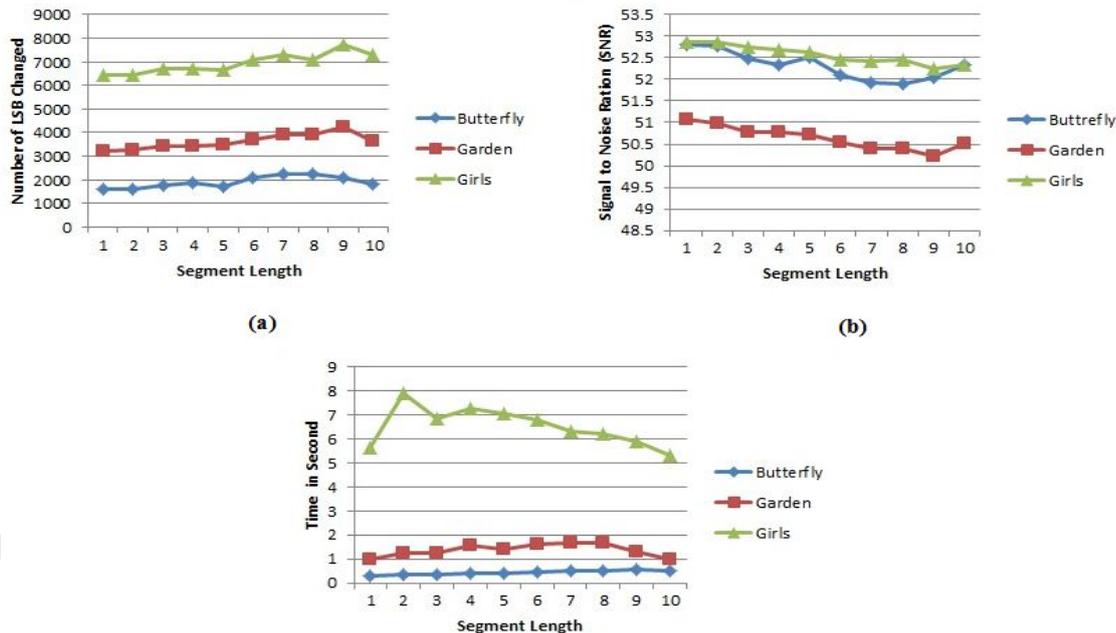


Figure 2: The effect of the *SegmentLength* on (a) Number of LSB changed, (b) Signal to Noise Ratio (SNR) of the stego-image, (c) Time of hiding operation.

Table 1: Recorded Results of Performance Experiments

| Stego-Image                                    | Classic-LSB Technique |        |        | Segmented-LSB Technique |        |        |
|--|-----------------------|--------|--------|-------------------------|--------|--------|
|  | Butterfly             | Garden | Girls  | Butterfly               | Garden | Girls  |
| Length of Secret Message (Characters)          | 500                   | 1000   | 2000   | 500                     | 1000   | 2000   |
| Number of LSB Changed                          | 1972                  | 4001   | 8081   | 1616                    | 3214   | 6459   |
| Signal to Noise Ratio (SNR) of the Stego-Image | 51.950                | 50.107 | 51.890 | 52.815                  | 51.059 | 52.863 |
| Time of Hiding Operation (Second)              | 0.047                 | 0.140  | 0.421  | 0.296                   | 0.982  | 5.647  |
| Time of Extracting Operation (Second)          | 0.110                 | 0.125  | 0.421  | 0.109                   | 0.124  | 0.421  |

## Conclusion

A good enhancement to the previous Segmented-LSB technique was presented in this paper. The **Error** measure was used in the developed technique to minimize the time that is spent in the exhaustive search in the hiding operation of the previous Segmented-LSB. By determine the **AcceptedErrorRatio** at desired ratio (between 0...100) before doing the search to find the best matching between the bits of each segment with all non-overlapped bits sequences in the **ImageB** list. By making a comparison between the calculated **Error** values with the predetermined **AcceptedErrorRatio** in each round of search, we can exclude unnecessary search round from the hiding operation.

The recorded results from the experiments showed that the development in the previous Segmented-LSB image steganography technique success to minimize the time that is required in the hiding operation without make a big degradation in the performance of the previous Segmented-LSB technique.

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# DEVELOPING A WILDLIFE GARDENING AND BUILD OF THE ECOSYSTEM AROUND PAGE IN HOUSES FOR FITOPHARMAKA ANTI CANCER (LEUKEMIA)

Sulistyo Mulyo Agustini

Medical Faculty of Muhammadiyah Malang University

[sm.agustini@gmail.com](mailto:sm.agustini@gmail.com); <http://dp2m.umm.ac.id>

## Abstract

Leukemia is a hematological malignancies including major public health problem that trend continues to increase. Etiology leukemia until now not known clearly and multifactorial, environmental factors that can induce, including: ionizing radiation, various chemical mutagen, carcinogen materials, and chemical drugs. Now entered the era of individualized therapy, requires a human approach to genome and technologies that lead to DNA sequencing, gene expression and proteomic. with appropriate induction therapy 50% to 70% achieved complete remission, although still present (<20%) the odds are very high occurrence of relapse. Indonesia Country has known traditional medicine that uses herbs natural ingredients including wild plants around us, along with the development Princip back to nature, because it is more economical, does not cause side effects such as chemical drugs. However, there are still many wild plants, the quality and content of the compound does not have obvious standards and specifications. Developing a Wildlife Gardening and Build of Ecosystem in Around Page Houses For Fitopharmaka Anti Cancer (Leukemia), the researchers hope to develop and save natural ecosystems with the advantages of wild plants as herbal medicines reasonable of anti-cancer and have any side effects are minimal

Key words: Leukemia, wildlife gardening, back to nature, herbal medicine

## Introduction

The incidence trend is expected to increase in the United States in total cancer incidence as 1,638,910 new cases and 577,190 deaths from cancer, such as leukemia 47,150 new cases and 23,540 deaths, AML 13,780 new cases and 10,200 deaths (Siegel et al., 2012). During the period 2005-2008 at the General Hospital Dr. Saiful Anwar Malang, of the 251 patients in the hematology doing bone marrow aspirate (BMP), there were 125 patients in the diagnosis of acute leukemia (Agustini., 2008). The incidence rate estimated third of all new cases of leukemia, with appropriate induction therapy 50% to 70% achieved complete remission, although still present (<20%) the odds are very high occurrence of relapse. Although the prevalence of AML is less than the type of ALL, if not immediately treated, there will be deaths due to infection and bleeding that lasts a few weeks to months. Therefore, development of more effective therapeutic strategies is essential (Walters, 2005). Etiology leukemia until now not known clearly and multifactorial. Environmental factors can include: ionizing radiation, various chemical mutagen, carcinogen materials, and chemical drugs. Genetic changes are considered as the center of the development of leukemia, which affects the number of abnormalities (ploidy) and abnormalities of chromosome structure consisting of translocations, inversions, deletions, point mutation, and amplification, as well as the failure of regulation of transcription factors in cell regulation of homeostasis haematopoietic (Abeloff. D, 2004)

Therapeutic approach in the era of individualized therapy, requires a human approach to genome and technologies that lead to DNA sequencing, gene expression and proteomic gives great hope for the implementation of data genotype-phenotype against clinic policy process in delivering cancer therapy (Nersting., 2011). Furthermore, therapeutic approaches require neoplasms by a combination of rational drugs against targets with a variety of cellular pathways and approaches that support the survival of cancer cells (Ocana., 2010). In developing countries, including in Indonesia, one of the problem therapy because of the socio-economic status and parents' behavior toward the success of ALL therapy in children (Mostert S, 2006). Since ancient country of Indonesia has been known traditional medicine that uses herbs natural ingredients including wild plants around us, along with the development Principle back to nature, because it is more economical, does not cause side effects such as chemical drugs (Sufriadi, 2006), But there are still many wild plants, the quality and content of compounds not yet possess a clear standard and specification.

With the background of that, the researchers intend to develop research with title "Developing a Wildlife Gardening and Building Ecosystem Around Page Houses For Fitopharmaka Anti Cancer (anti-leukemia), the researchers hope to develop and save natural ecosystems with the advantages of wild plants as medicine anti-cancer of herbal that is affordable, effective, smallest of risk, the side effects are very small and effectual.

## Objectives

1. Development and improve the effectiveness of wild plants as anti-cancer treatment (anti-leukemia)

2. Develop the cultivation of wild plants in the area to build an ecosystem home page
3. Increasing awareness of the principles of treatment of back to nature

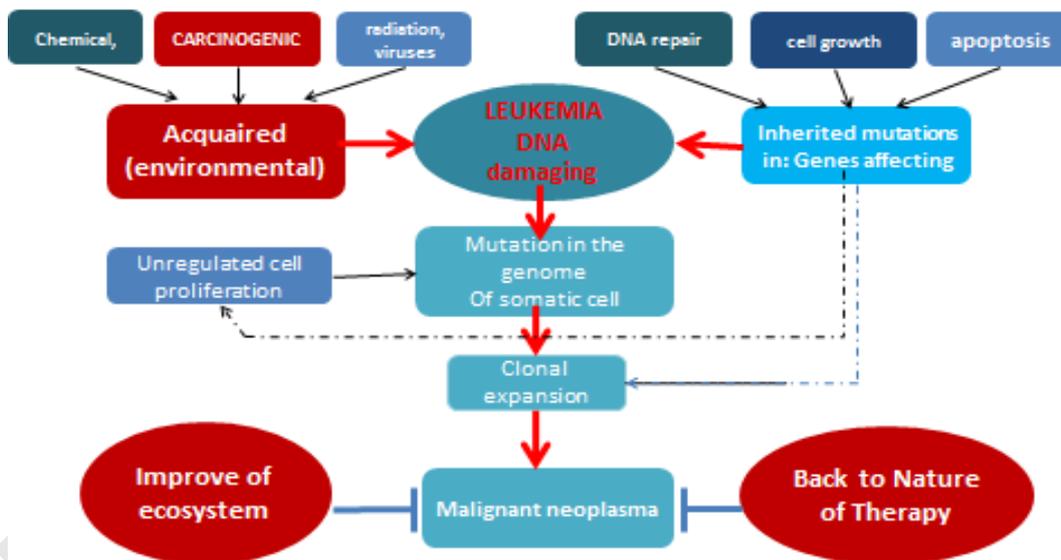
### Materials and Plan of Work

Data taken from 2005-2013 in Malang, East Java, there are several sources for cancer incidence data, derived from surveillance, epidemiology and program outcomes our dissertation on the area to be sampled. In this form of provision of information and education, providing training to develop farming of medicinal plants in the garden around it, then test and measure the materials and compounds as potential anti-cancer drug

### Future

the hope of cultivating wild plants as anti-cancer drug fitofarmaka can be produced with the principle of back to nature, Further research will be done and measure compounds of wild medicinal plants. the same time or simultaneously an act in order to save the ecosystem of the surrounding area including improved economic benefits. The results of this study will be continued in vitro of clinical trials, the effective dose of anti-cancer potential Compounds.

## PLAN of WORK



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# DEVELOPMENT OF PLASTIC DEFORMATION OF ANHYDROUS AND CALCIUM-SILICATE-HYDRATE OF CEMENT PASTE

Nasser Asroun<sup>a</sup>, Aissa Asroun<sup>a,\*</sup>, Habib Trouzine<sup>a</sup>

<sup>a</sup>Laboratoire Génie Civil et Environnement, Djillali Liabes University of Sidi Bel-Abbes, Algeria

\* Corresponding author: Tel.: +213 48 59 06 66; fax: +213 48 54 41 00.

E-mail address : a\_asroun@yahoo.fr (A. Asroun).

**Abstract :** In this work, a nanoindentation of cement paste through a two-dimensional (2-D) axisymmetric model was investigated using the capacities of the ANSYS finite element (FE) code. The indentation process under consideration involves anhydrous particles and three forms of calcium-silicate-hydrate (C-S-H) substrates indented by a rigid indenter under the condition of frictionless contact. For the 2-D model, the indenter has a half-angle of 70.3°, and thus has the same projected area-depth function as the standard Berkovich indenter. The model has the ability to simulate the trapezoidal load history with varying magnitude of peak indentation load, study the influence of mechanical properties on indentation response and simulate the development of plastic deformation during indentation. The simulation results show that the higher plastic deformation normalized over the total deformation was observed in the high density (HD) form of C-S-H of cement paste.

**Keywords :** Cement paste; Nanoindentation; plastic deformation.

## Introduction

Since many technologies have moved to ever smaller scale, characterization of the intrinsic mechanical properties of materials has become more difficult and complicated. Among the techniques to measure the mechanical properties of cementitious materials, nanoindentation techniques have been widely used to measure mechanical properties, for instance hardness, elastic modulus, creep and plasticity [1]. Recently, different numerical techniques have been developed to use in many fields of science and engineering and can be used in indentation problems. Finite element technique is used for studying very complex stress-strain fields of cementitious materials like cement paste in a nanoindentation process. Some investigators have studied the indentation process using the numerical approach of finite element method [2]. The finite element method has been verified to be an effective tool for simulating hardness and plasticity measurements.

In order to gain a better understanding of the plastic deformation of cement paste during the nanoindentation procedure, finite element modeling (FEM) was performed and discussed. The indentation modeling was performed with commercial ANSYS software [3].

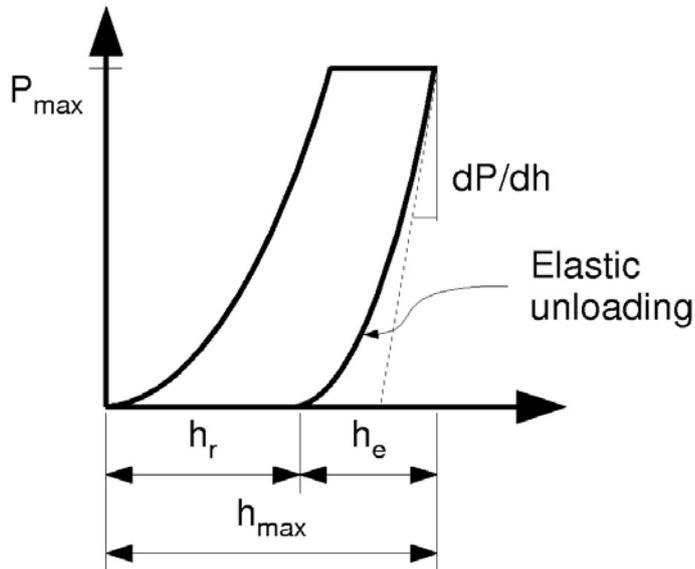
## Plastic deformation of cement paste at nanoscale

In recent molecular model studying the stress-strain behavior of C-S-H model in affine shear deformation (strain controlled), Ulm and Pellenq [4] were presented two configurations. The “wet” model, which water present particular in the inter-layer space, and the “dry” model, in which all water molecules have been removed. The stress-strain response shows that the presence of water in the inter-layer space leads to a localization of deformation into a narrow band defined by a “wet inter-layer”, akin to a fracture process. By contrast, the “dry” model shows a plastic deformation behavior, with irreversible (plastic) deformation upon unloading. This shows that there are some strength reserves at a molecular scale of C-S-H that could enhance strength and (ductile) deformation behavior of C-S-H. Practically, the measurement of the indentation creep and relaxation functions is impeded by the time-independent (plastic) deformation of the material beneath the indenter. Such plastic deformation cannot be avoided below a sharp probe (e.g., below a Berkovich three-sided pyramidal probe) and often also occurs below spherical and flat punches. Plastic deformation results in an increase in indentation depth (at a given load) or in a decrease in load (at a given depth). As a consequence, analytical solution overestimates the contact creep compliance and underestimates the contact relaxation modulus [5]. Except for materials of high creep compliance, for which the plastic deformation is negligible compared to the viscous deformation, and for which the relaxation modulus or the creep compliance of a material can be extracted with confidence using viscoelastic solutions [6], neglect of preceding or concurrent plastic deformation generally leads to an erroneous estimation of the viscous properties of the material.

## Theory

## Mathematical modeling

Using the Oliver and Pharr method [7], the elastic modulus of the indented sample can be inferred from the initial unloading contact stiffness,  $S = dP/dh$  i.e., the slope of the initial portion of the unloading curve, as shown in Figure 1.



**Figure 1:** Loading diagram.

Based on the relationships developed by Snedden [8] for the indentation of an elastic half-space by any punch that can be described as a solid of revolution of a smooth function, a geometry-independent relation involving contact stiffness, contact area, and elastic modulus can be derived as follows:

$$S = 2\beta \sqrt{\frac{A}{\pi}} E_r \quad (1)$$

Where  $\beta$  is a constant that depends on the geometry of the indenter. For Berkovich indenter,  $\beta = 0.034$  and  $E_r$  is the reduced elastic modulus, which accounts for the fact that elastic deformation occurs in both the sample and the indenter.  $E_r$  is given by

$$E_r = \frac{1-\nu^2}{E} - \frac{1-\nu_i^2}{E_i} \quad (2)$$

Where  $E$  and  $\nu$  are the elastic modulus and Poisson's ratio for the sample, respectively,  $E_i$  and  $\nu_i$  are the same quantities for the indenter. For an indenter with a known geometry, the projected contact area is a function of the contact depth. The area function for a perfect Berkovich indenter is given by

$$A = f(h_c) = 24.56h_c^2 \quad (3)$$

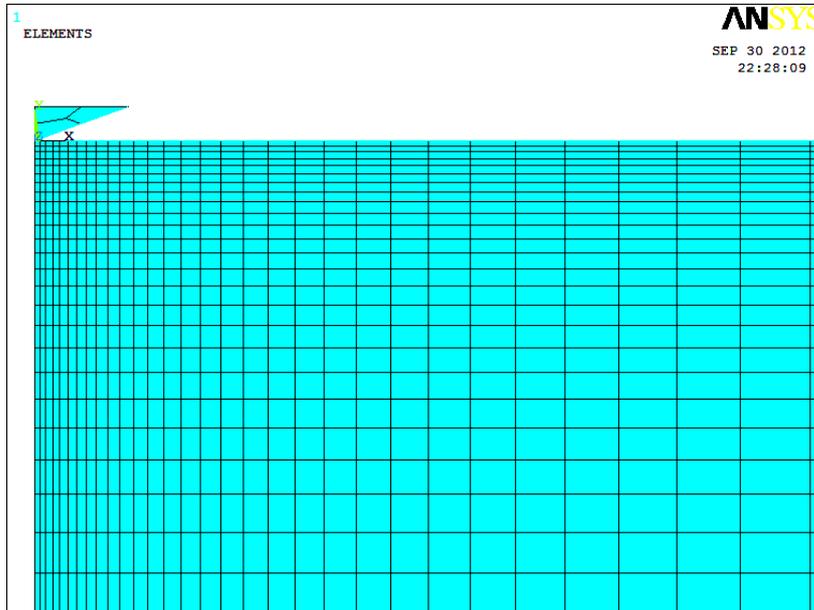
In case of analytical extraction of elastic properties through nanoindentation data it is possible to assess roughly the yield stress as being directly correlated with hardness value according to Tabor [9], and given by the following equation:

$$\sigma_y = H/C \quad (4)$$

Where coefficient  $C$  can change in the range of 2.6-3.0.

## Finite element modeling

The model consists of the simulation of nanoindentation test of cement paste on 2D planar model using the commercial finite element package ANSYS v.11.0. A Berkovich diamond indenter was used to perform the indentation test presented in this work. It had a pyramid shape with face angle of  $65.27^\circ$ . For simplicity purposes, the Berkovich indenter is commonly modeled as a conical indenter with a semi-apex angle of 70.3 degrees. This gives the same area to depth function as that of Berkovich indenter. A square area with dimensions including a base of  $600\ \mu\text{m}$ , a height of  $600\ \mu\text{m}$  was created to represent the cement paste specimens. The indenter and specimen are meshed by 2D structural PLANE182 element as shown in Figure 2.



**Figure 2:** FE model of indenter and test specimens.

Nodes along the centerline are constrained to move in  $x$ -direction and the nodes at the bottom line are constrained to move in  $x$  and  $y$ -directions. Axisymmetry conditions are applied along the centerline. The interaction of the indenter and the specimen is modeled as a contact pair with no friction. Contact element TARGET169 is applied to the Berkovich tip and CONTACT172 to the specimen. The specimen were subjected to a trapezoidal Load history with varying magnitude of peak indentation load not exceeding  $1250\ \mu\text{N}$ . the loading, dwelling and unloading periods were kept at 10, 2 and 10 seconds, respectively applied to the upper portion of the indenter in  $y$ -direction and the displacement in  $y$ -direction along the upper line of the specimen is measured.

For the diamond indenter an elastic linear isotropic model with Young modulus  $E_i = 1141\ \text{GPa}$  and Poisson ratio  $\nu_i = 0.07$  was used. For the cement paste, an elastic perfectly plastic material model with Von Mises yield criterion ( $\sigma_y$ ) and Bilinear isotropic time hardening with implicit creep was chosen to extract the creep and plastic strains of the material. Based on published cement properties, Indentation modulus, hardness [10] of different phases and Poisson's ratio [11] of cement paste were presented in Table 1.

**Table 1:** Indentation modulus and hardness of different phases of cement paste in GPa.

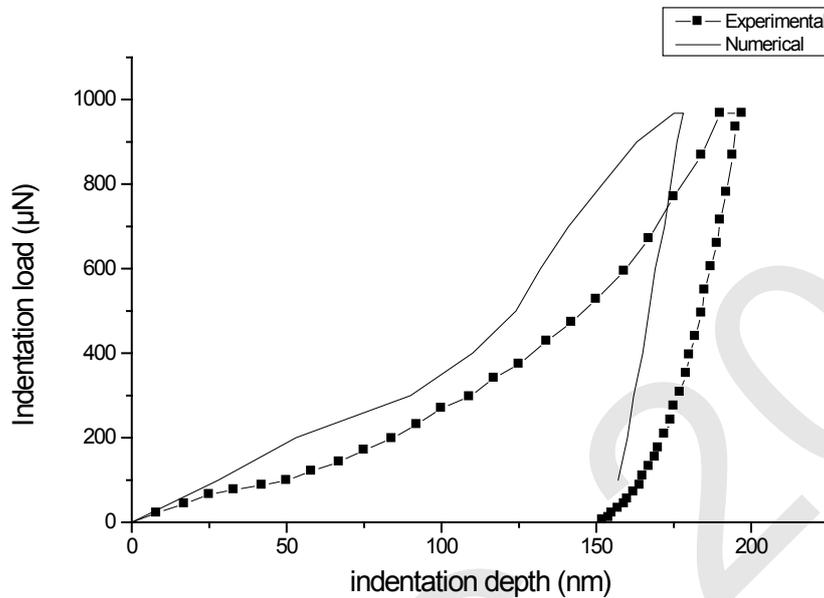
| Phase    | Anhydrous |      | LS C-S-H |      | MS C-S-H |      | HS C-S-H |      |
|----------|-----------|------|----------|------|----------|------|----------|------|
|          | E         | H    | E        | H    | E        | H    | E        | H    |
| Property |           |      |          |      |          |      |          |      |
| Mean     | 132.44    | 8.36 | 22.03    | 0.72 | 30.42    | 0.85 | 38.95    | 1.21 |

The load values of the experimental curves were prescribed to viscoelasto-plastic model of indentation in each load step (loading, holding and unloading steps). The plastic deformation during indentation normalized over total deformation for the each indentation load was calculated as  $h_f/h_{max}$ . The distribution curves of this plastic deformation over load for each phase of cement paste were dressed and compared with experimental ones.

## RESULTS AND DISCUSSIONS

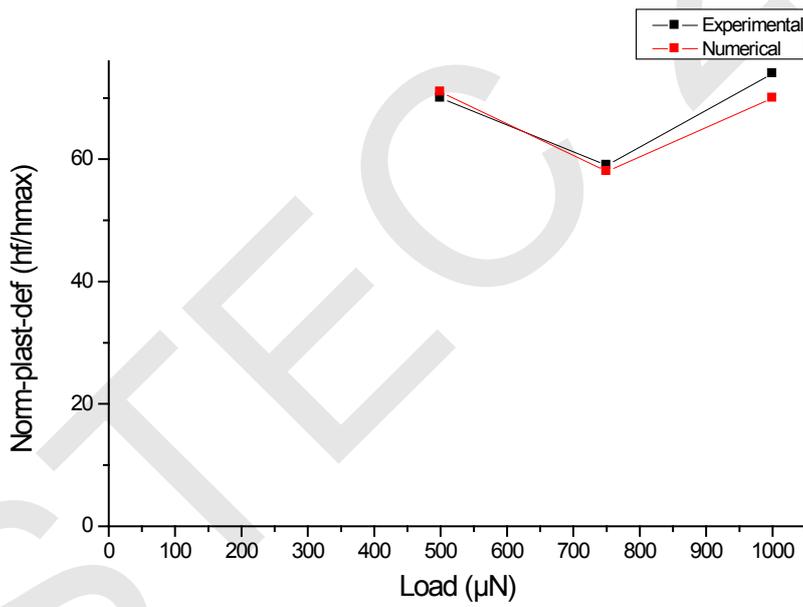
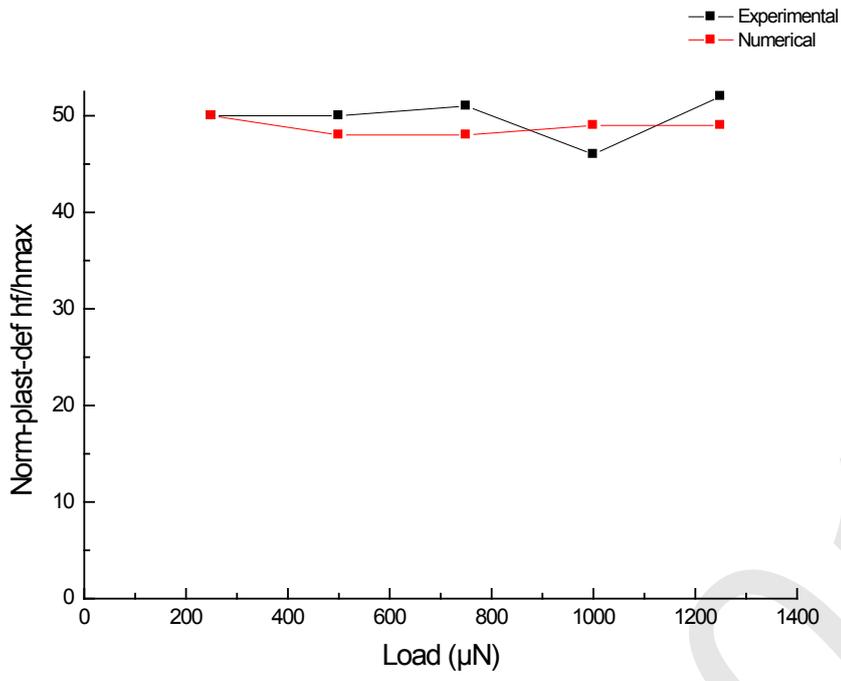
With the performance of finite element (FE) analysis, the nanoindentation loading-holding-unloading process of anhydrous and three forms of C-S-H cement paste was simulated. Figure 3 shows an example of the load-displacement curves that resulted from experiment of the high density forms of C-S-H of cement paste together with the prediction from the simulation modeling and the input data from Table 1.

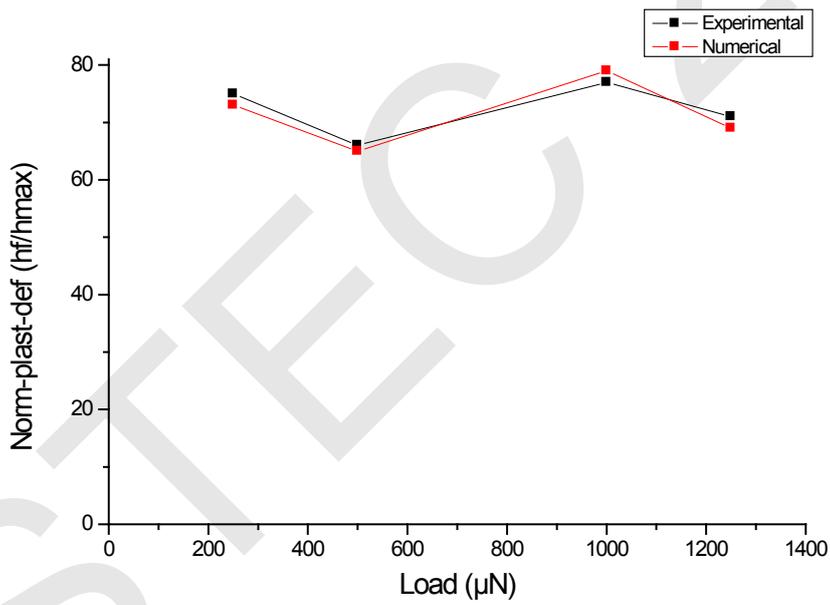
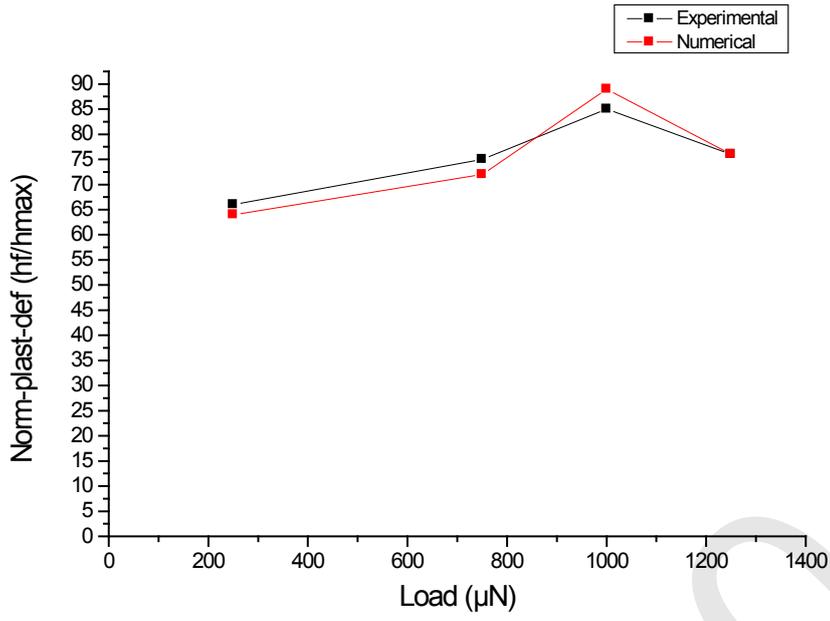
Since the experimental data were used as the basis of the simulation, such as Indentation modulus, hardness and Poisson's ratio, there is a good agreement between the simulation and experimental results.

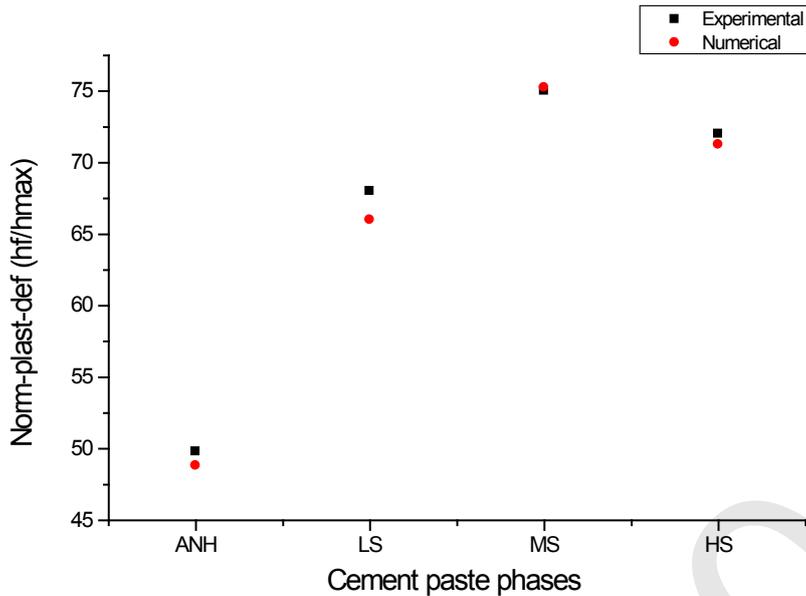


**Figure3:** Load-indentation depth curves of high density form of C-S-H

A further study was conducted in order to studying the evolution of the plastic deformation for the anhydrous phases and three forms of C-S-H (LD, HD and UHD) of cement paste using the developed FE model. The plastic deformation normalized over the total deformation for each load was extracted from the numerical and experimental curves as  $h_f/h_{max}$ . Figure 4 shows the comparison of the evolution of plastic deformation normalized over the total deformation for the anhydrous phase and the three forms of C-S-H phase of cement paste function of the applied load between the experiment and FEM. It is noted that the FEM is able to extract the plastic deformation of different phases of cement paste. Normalized plastic deformation was higher in the Medium stiffness (MS) or high density (HD) of C-S-H phases of cement paste and was lower in the anhydrous phases of cement paste. It is about 75% for the MS (HD) forms of C-S-H and 49% for the anhydrous phases which is in good agreement with the experimental ones.







**Figure 4:** Normalized plastic deformation of different phases of cement paste

### Conclusion

- (1) The FE model has been developed to simulate the plastic deformation for different phases of cement paste. The model is capable of simulating the loading-holding-unloading stages of the plastic deformation behavior during the indentation process.
- (2) Normalized plastic deformation was higher in the Medium stiffness (MS) or high density (HD) of C-S-H and was lower in the anhydrous phases of cement paste.
- (3) The applicability of the model has been investigated through nanoindentation of cement paste. The simulation results are in good agreement with the experimental ones.

### Acknowledgement

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## DIFFERENT TREATMENT TRAINS FOR RAINWATER PURIFICATION FOR HUMAN CONSUMPTION IN MÉXICO CITY

M. N. Rojas-Valencia<sup>1</sup>  
A. Cordero Ibarra<sup>1</sup>  
R. Gallardo Bolaños<sup>1</sup>  
M. Vaca Mier<sup>2</sup>.

<sup>1</sup>National Autonomous University of Mexico, Institute of Engineering, Coordination of Environmental Engineering, Post Box 70-472, Coyoacán 04510, Mexico, D.F. Mexico. Phone (52)(55)56233600 Ext. 8663. Fax number (52)(55)56162164 E-mail: nrov@pumas.iingen.unam.mx

<sup>2</sup> Departamento de Energía. Ciencias Básicas e Ingeniería, Universidad Autónoma Metropolitana- Azcapotzalco, Av. San Pablo 180, México. D. F. 02200

**Abstract:** This work offers options for harvesting and reusing rainwater. In order to know the quality of the various rainwaters, microbiological and physical-chemical analyses are conducted based on the Mexican standards. The microbiological results showed various types of bacteria such as bacilli, cocci, coliforms, among them *Escherichia coli* and *Enterobacter aerogenes*, while the physical-chemical analyses reported low concentrations of total suspended solids (8.9 mg/L), biochemical oxygen demand in five days (2.7 mg/L), chemical oxygen demand (6.7 mg/L) and total organic carbon (1.9 mg/L). This work also relates to the adaptation of a catchment system in an already build construction with a treatment train supplying appropriate water quality. The analyzed parameters are mostly within NOM-041 limits; however, treatment is needed to ensure optimum water quality. The results obtained in the instant research show that rainwater purity should not be taken for granted. Before alleging that rainwater is drinkable it is important to conduct microbiological analysis in order to determine the most appropriate treatment.

**Key words:** Catchment system, rain, treatment, reuse, quality.

### Introduction

In Mexico, water management has traditionally been poor, each family wasting on average 150 L/day due to bad habits, increasing thus the average consumption per person to 200 or even 300 L/day, when 100 L/day per head should be more than enough for urban domestic use.

In most urban areas, the appropriate supply of water to meet the growing needs of the population and ensure water access equity is an important and urgent challenge for the decision makers. Two solutions are available for ensuring water sustainable management. The first one is to find new alternative water resources, while the second is to use efficiently the limited water resources on hand. Up to now, the efforts have been focused on the first option and only limited attention has been given to the second (Ahmed et al; 2009).

An example of alternative resource is rainwater. Since only a catchment system is needed, it has some advantages such as energy savings because there is no need of extraction process and piping for the distribution system or pumping for transportation to the consumption areas. Besides, the treatment conditions for ensuring a quality appropriate for human consumption are relatively economical (Amin and Han, 2009). A disadvantage is that water availability is limited to high rainfall season and varies depending on the region of the country. Moreover, it depends on the size of the catchment area and on the size of the cistern in the building. Another obstacle is that there are no reports regarding rainwater quality and thus it should be used carefully for human consumption.

Taking into account the advantages and disadvantages of rainwater, as well as data shortages, the objective of this research was to determine the quality of rainwater from the southern area of the Federal District. It was also to establish an alternative rainwater catchment and treatment process through a system permitting to harvest as much water as possible and, after treating it, use it for cleaning, in sanitary buildings and even for personal use and drinking purposes.

## Materials and Method

The methodology comprised two phases: the first phase focused on the design and catchment of rainwater and the second phase focused on the physical-chemical and microbiological characterization of rainwater.

Rainwater samples were taken and stored in two harvesting systems currently working located in Tlalpan delegation in the medium height Ajusco in the southern zone of Mexico City. The two systems were called house 1 and house 2. It is marginalized zones where access to water through the supply network is not reliable and thus rainwater harvesting could solve the needs of this community. A study was conducted regarding the main contaminants present in rainwater. Moreover, five treatment trains were installed and used in order to identify the treatments stages leading to rainwater that fulfills the Mexican norm and thus appropriate for human consumption.

The in site pretreatment, catchment system and storage system for each sample source was different. In Table 1, the various characteristics of the sample site are listed.

**Table 1:** Characteristics of the catchment and storage systems

| Data                           | House 1  | House 2                                       |
|--------------------------------|--|---|
| Address                        | Becal Mz. 13 Lote 22.                            | Izamal Mz. 22 Lote 17.                        |
| Material of the catchment area | Ferrocement.                                     | Cistern rotoplas 600 L.                       |
| Exposition to sun light        | Buried in the ground.                            | Cistern exposed to the sun.                   |
| Chlorination                   | Cloralex 0.5 mL/L.                               | Trichloroisocyanuric acid, 10 g per 10,000 L. |
| Filters                        | None.  | 50 $\mu$ m filter.                            |
| Use                            | For plant watering, bathrooms and cloth washing. | For all domestic activities.                  |

In both cases, the catchment system had an interceptor.

The harvested rainwater was submitted to five treatment trains consisting of several stages in order to test which was the most appropriate for obtaining drinkable water fulfilling the norm in force and meeting the needs of the people.

Five different trains were designed with different stages for both houses and were assigned a letter for reference purposes:

A) Original sample

- B) Pump + 50  $\mu\text{m}$  cellulose paper filter
- C) Pump + 50  $\mu\text{m}$  cellulose paper filter + granular activated carbon filter
- D) Pump + granular activated carbon filter
- E) Pump + 50  $\mu\text{m}$  cellulose paper filter + granular activated carbon filter + 50  $\mu\text{m}$  polypropylene filter + 50  $\mu\text{m}$  activated carbon filter
- F) Pump + 50  $\mu\text{m}$  cellulose paper filter + granular activated carbon filter + 50  $\mu\text{m}$  polypropylene filter + 50  $\mu\text{m}$  activated carbon + UV

A 1-L sample was taken in each case, and thus globally twelve samples were obtained that were kept in 0.5-L sterile bags for further analysis.

The samples taken were analyzed on the sampling day in the laboratories. Water quality evaluation was determined using three indicators, BOD<sub>5</sub>, COD and TSS. Moreover, in the case of each sample, total Kjeldhal nitrogen and pH analyses were performed.

Figure 1, shows a summary of the second part of the methodology.

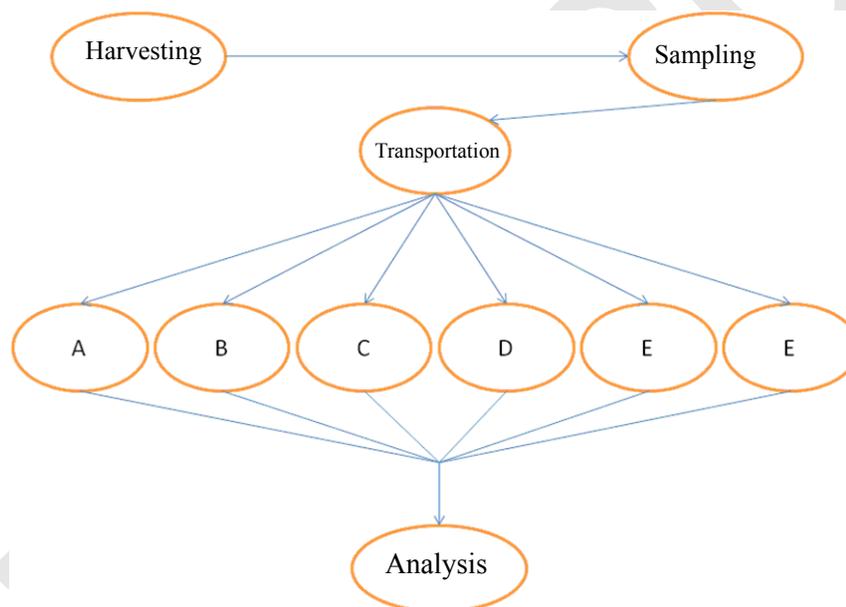


Figure 1: Flow chart of the second part of the methodology

The analytical methods used for each parameter are shown in Table 2.

Table 2: Analytical methods used

| Parameter              | Analytical Method    | Units      |
|------------------------|----------------------|------------|
| Total coliforms        | NMX AA-042-1987      | NMP/100 ML |
| Total BOD <sub>5</sub> | NMX AA-028-SCFI-2001 | mg/L       |
| Total COD              | NMX AA-030-SCFI-2001 | mg/L       |
| Total solids           | NMX AA-034-SCFI-2001 | mg/L       |

|                         |                                     |      |
|-------------------------|-------------------------------------|------|
| Total Kjeldhal nitrogen | NMX AA-026-SCFI-2001/EPA 351.2-1978 | mg/L |
| pH                      | Meter Orion 210A                    | ---  |

## Results and discussion

### *Microbiological results*

The microbiological results showed various types of bacteria such as bacilli, cocci, coliforms, among them the genera *Bacillaceae*, *Leuconostoc* and *Aerococcus*, which were reportedly widely distributed in the air, soil and water.

Other species identified in this research was *Escherichia coli* (*E. coli*) isolated from the selective medium for total coliforms. This is the most commonly bacteria species found in clinical laboratories and its presence has been reported in infectious diseases involving human tissues. Transmission is through contaminated foods, water and personal contact, the main habitat of this bacterium being the intestinal flora. In the same selective medium, *Enterobacter aerogenes* was found which is widely distributed in the respiratory apparatus, and is known for affecting skin wounds and occasionally may cause septicemia (blood poisoning) and meningitis (Lee et al; 2009).

In countries such as Korea, Nigeria, Australia, New Zealand and others, researchers have been interested in rainwater quality, and all the studies conducted, based on their own sampling methodology, coincide in the presence of biological indicators such as *E. coli* and total coliforms from rainwater. For example, in Korea, total coliforms (TC) and *Escherichia* (EC), were found in 91.6% and 72%, respectively, of the samples of harvested rainwater, at the upper levels of the guidelines for drinkable water (Lee et. al., 2009). In Australia, 65% of the samples taken from rainwater harvested from a roof were positive for *E. coli*, showing the following concentrations: 20% between 1 and 10 CFU/100 mL, 18% between 11 and 100 CFU/100 mL, 19% between 101 and 1000 CFU/100 mL and 7% >1001 CFU/100 mL, while 82% of the samples analyzed were positive for *enterococci* with the following concentrations: 18% between 1 and 10 CFU/100 mL, 31% between 11 and 100 CFU/100 mL, 23% between 10 and 1000 CFU/100 mL and 10% >1001 CFU/100 mL (Ahmed et. al., 2009). Other bacteria genus found in catchment cisterns in India is *Streptococci* with a total of 43 colony forming units (CFU) in non-treated water (Cochran and Ray, 2008). On the other hand, in two different sampling zones in Korea, the *E. coli* indicator was present in 96 and 72% of the samples harvested from the rainwater storage system (Amin et al., 2009).

Australia has reports of pathogen agents contained in harvested rainwater in which bacteria such as *Salmonella*, *G. lamblia* and *L. pneumophila* were found, besides *E. coli* strains (Ryan et al., 2009), while in New Zealand, *E. coli* was present in 12 from 18 samples.

In Nigeria, various levels of microbiological contamination were found in various samples. All the samples contained high concentrations of heterotrophic bacteria (from  $5.8 \times 10^1$  to  $7.6 \times 10^3$  UFC/mL) while *Pseudomonas* spp ranged from  $1.0 \times 10$  to  $4.0 \times 10^2$  UFC/mL (Nnene, 2000).

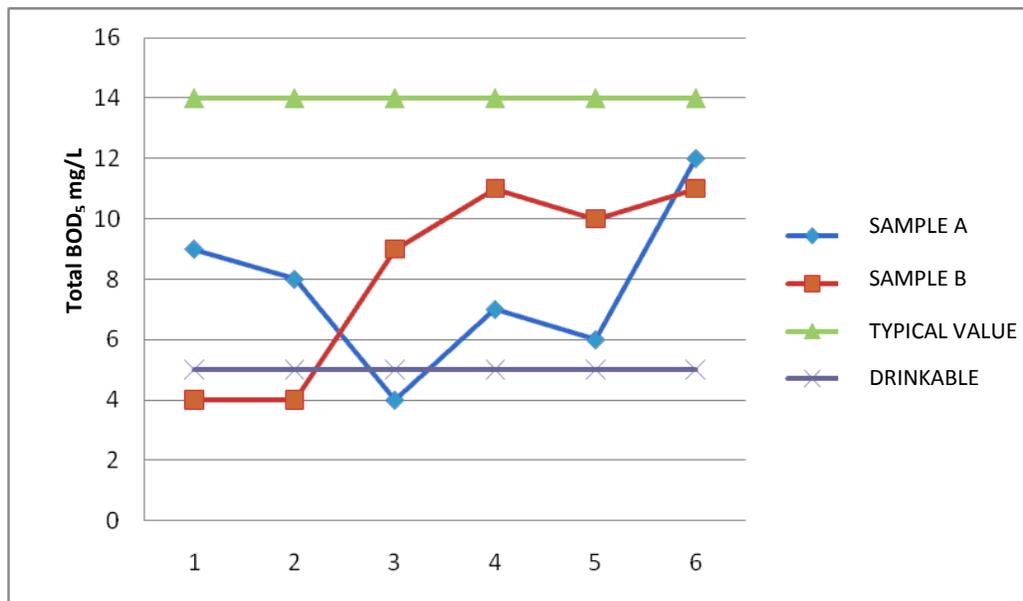
### *Physical-chemical parameters results*

The physical-chemical analyses reported low concentrations of total suspended solids (8.9 mg/L), biochemical oxygen demand in five days (2.7 mg/L), chemical oxygen demand (6.7 mg/L) and total organic carbon (1.9 mg/L). The pH varying from 5.5 to neutral according to the progress of the rainy season reaching a pH 7 and maintaining this level till the end of the rainy season.

In the case of total BOD<sub>5</sub>, the typical value reported for rain drainage is 100 mg/L, however water is considered drinkable if its total BOD<sub>5</sub> value is below 5 mg/L. Figure 4 shows that BOD<sub>5</sub> values obtained do not fulfill the standard except in some cases. When more stages are used in the treatment train, BOD<sub>5</sub> increases considerably and it can thus be concluded that the filtration train could have been contaminated with organic

material leading to an increase of total BOD<sub>5</sub> when stages were added to the treatment train. However, all the samples are below the typical value observed in most waters for human consumption insuring thus that rainwater has a low organic concentration.

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**Figure 2: BOD<sub>5</sub> variation**

In the case of total COD sample, the test was only conducted on the control samples i.e., the samples without treatment because the presence of this parameter is considered little probable and this was confirmed since it was undetectable in the studied samples.

With regard to the total solids analysis, the permissible limit according to Mexican Official Standard NOM-041-SSA1-1994 is 500 mg/L. The results obtained from both samples are not above the limit established by the standard. The values average 120 mg/L. However, there is no reduction in the total solids and it can thus be concluded that the treatment train is not appropriate for reducing the total solids contents in rainwater.

Non-treated rainwater is within the permissible limits according to Mexican Official Standard NOM-041-SSA1-1994, but the same case occurs as with regard to the BOD<sub>5</sub> parameter. Nitrogen quantity increases with the increase of the stages in the treatment train and thus at some stage of the filtration there must have been a large quantity of organic material. Despite the above, in the case of house 1, the treatment train in stages 5 and 6 is appropriate since the total nitrogen quantity is not detectable.

In the case of house 2, the first treatment trains are the ones that best fulfill the limits indicated in Mexican Official Standard NOM-041-SSA1-1994. i.e., only the physical treatment reduces considerably the total nitrogen quantity present in the sample.

The permissible limits reported are not over the limits indicated in Mexican Official Standard NOM-041-SSA1-1994 with regard to pH ranging from 6.5 to 8.5.

Currently, all over the world, large-scale efforts are made to harvest rainwater and use it in houses in urban zones for various purposes depending on its quality. Some examples are: the Ringdansen Project in Sweden, the multipurpose stadiums in Nagoya, and Fukoka Tokyo, Japan, the Millenium Dome Stadium in London, the Technological University of Nanyang in Singapore and the group of buildings Daimler Chrysler Potzdamer Platz in Berlin, Germany, to mention only a few of them.

In Ringdansen, a residential zone located in the southeastern part of Norrköping, Sweden, harvested rainwater has been destined to the following uses: WCs, water for cleaning clothing and washing cars as well as watering plants.

In Japan, there are several examples of large-scale rainwater catchment systems. The harvested water is used for WCs, and for watering plants. Rainwater catchment areas are 16.000, 25.900 and 35.000 m<sup>2</sup>, respectively. The tank volumes are 1000, 1800 and 1500 m<sup>3</sup>, respectively.

The Millenium Dome in London is another example of a large-scale rainwater catchment system. The roof of the cupola has a surface of about 100.000 m<sup>2</sup>, from which water is harvested through hoppers unloading into a series of main rings around the entire circumference of the dome. A study of the functioning of the system showed that rainwater meets about 10% of the water demand although harvesting is limited because of the site storage.

The residential area located in the central part of Fornebu, in Oslo, Norway, includes the building of 6 000 houses. There is an interest for using water as a revitalizing element within the structure of the park vegetation. This objective is reached substituting conventional urban drain piping through filters, storage and treatment systems designed for natural processes. All this is possible if some hydraulic and water quality criteria are met.

## Conclusions

The best rainwater purification option is the sequence: filtration, activated carbon, ionic exchange, UV radiation and ozonization. Various microorganisms that could represent a health hazard are bacteria *E. coli* and *Enterobacter aerogenes* that, despite their very low concentration, make it necessary to install a treatment system before reusing rainwater. According to NOM-003-SEMARNAT-1997, harvested rainwater fulfills the parameters established for direct contact with humans.

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## DISTRIBUTION OF SALINITY AND NUTRIENTS IN SOILS UNDER RECENTLY ENVIRONMENT CHANGE

Taha El-Maghraby and Mohamed Abdel-Wahab

Soils, Water and Environment Research Institute, Agricultural Research Center, Cairo, Egypt.

Email: [telmaghraby2005@yahoo.com](mailto:telmaghraby2005@yahoo.com)

**Abstract:** Many countries are facing environment change. This study aims to study the distribution of salinity and some nutrient (*i.e.* N, P, Fe, Mn, Zn and Cu) under recently environment change "climate factors, soil factors and human factors" in soils adjacent to North Delta, Idku region, Behra Governorate, Egypt between year 1986 and year 2011, whereas about 900 000 ha suffer from salinization problems, 6 % of Northern Delta region are salt-affected. Fourteen profiles (thirty nine samples), these representative profiles were transects vertical to Idko Lake. The study area is located between 31° 10' and 31° 40' N, and longitudes 30° 25' and 31° 20' E. The Idko Lake found on distance 1km the Mediterranean Sea.

The obtained results could be summarized as follows: Weight means to Electric conductivity (EC) in year 1986 were different the values in profiles. EC values of the studies soil were decrease with increase of soil depths. The highest values of EC were found in most profiles. The EC was between 1.30 to 51.70 dSm<sup>-1</sup>, in comparison with year 2011 in all profiles were between 0.70 to 3.10 dSm<sup>-1</sup> very slightly saline to non saline. In year 2011 available N in all profiles was medium whereas values were between 52.88 to 74.32 mg kg<sup>-1</sup>. In comparison, in year 1986 available N was very lowest whereas values were between 1.20 to 10.6 mg kg<sup>-1</sup>. In year 2011 was lowest available P in all profiles. In comparison with, year 1986 was between high and medium, whereas values were between 3.20 to 44.80 mg kg<sup>-1</sup>. Available Fe in year 2011 increase in mostly profiles, whereas range was between 2.00 to 32.6 mg kg<sup>-1</sup>. In comparison with, year 1986 was range was between 2.00 to 14.2 mg kg<sup>-1</sup>. Available Mn in year 2011 increases in profiles, whereas range was between 2.10 to 5.50 mg kg<sup>-1</sup>. In comparison with, year 1986 was range between 8.00 to 30.0 mg kg<sup>-1</sup>. Data in year 2011 show that range available Zn was 0.45 to 5.60 mg kg<sup>-1</sup>. In comparison with, year 1986 found profiles between 1.00 to 10.6 mg kg<sup>-1</sup>. Available Cu is given in year 2011 show that highest value was all profiles. Available Cu of the studied profiles was range between 1.00 to 19.6 mg kg<sup>-1</sup>. In comparison with, year 1986 all profiles were high, whereas range was between 3.20 to 11.8 mg kg<sup>-1</sup>.

**Keywords:** Salinity, nitrogen, phosphorus, iron, manganese, zinc, copper and environment change.

### Introduction

The world's population is estimated to increase from six billion about ten billion by 2050. To meet the food demand of the growing world population, a large increase in food production is required. Meanwhile, the increases in world population will result in a serious pressure on the existing agricultural land through urbanization and intensive cultivation (Ismail, 2002). FAO (2003) showed that the majority of salt-affected soils in Egypt are located in the Northern central part of the Nile Delta and on its Eastern and Western sides. About 900 000 ha suffer from salinization problems in cultivated irrigated areas, 6 % of Northern Delta region are salt-affected, 20 % of the Southern Delta and Middle Egyptian region and 25 % of the Upper Egypt region. Million hectares of arable land too saline for agriculture and hundreds of thousands hectares of agriculture productive land are lost annually for food production due to salinization (FAO, 2008). The factor affecting land are (climatic factors, soil factors and human factors). The three factors called natural or physical factors are affect natural vulnerability or potential degradation. The three factors affect the actual degradation (FAO, 1978). Dregne *et al.* (1995) reported that the land degradation processes occurring in the arid region of the world are vegetation, wind and water erosion, salinization and soil compaction. This mentioned that the geochemical land degradation processes especially salinization, alkalization and sodification are broadly occurring in the areas like arid and semi-arid climatic zone. Gaddes (1997) found that the following human activities have main impacts; poor range management, which leads to over-grazing through overstocking. Cultivation practices on unsuitable land area as a result of constant population growth, there is an extension of cultivation to soils less and suitable for this purpose (saline). An increase in temperature coupled with reduced rainfall will lead to predominantly up word water movement in soils, as currently seen in the more arid parts of the world and this will result in the accumulation of salts in the upper soil layers. Such effects will be intensified if poor quality irrigation water is used on agriculture soils. Climate change will increase inundation and salinity along coastal regions worldwide, through the influence of sea level rise (Pezeshki *et al.*, 1990). The impact of climate change on soil nutrients other than nitrogen, such as phosphorus and micronutrients, has largely been neglected (Legros *et al.*, 1994).

Increasing atmospheric CO<sub>2</sub> alone will increase soil organic matter (Loiseau *et al.*, 1994 and USDA, 2009). Abou El-Eneni *et al.* (2008) found that available nitrogen in soil after wheat plant cultivated in clay and calcareous soil were presented. The values of available nitrogen in soil after wheat in clay soil increased. Borhamy (2001) found that the distribution pattern of available P was almost similar to the obtained for the total amounts. *i.e.*, the highest value was obtained from the Nile alluvium, while the lowest one was obtained from the old lacustrine sediment, probably due to

the relatively high content of bound P-CaCO<sub>3</sub> in the old locustrine sediment. Mortvedt (2008) showed that iron deficiencies are found mainly on calcareous (high pH) soils. Cool, weather enhances Fe deficiencies, especially on soils marginal levels of available Fe. El-Maghraby *et al.* (2010) found that on study in the Northern West of Nile Delta available Fe varied from 1.8 and 22 mg kg<sup>-1</sup>. He found negative correlations occur available Fe and soil pH. Available Mn varied from 3.0 to 35.4 mg kg<sup>-1</sup>. Available Zn varied from 0.2 to 4.6 mg kg<sup>-1</sup>. Available Cu varied from 1.0 to 32.2 mg kg<sup>-1</sup>. This study aims to study the distribution of salinity and some nutrient (*i.e.* nitrogen, phosphorus, iron, manganese, zinc and copper) under recently environment change in some soils adjacent to Idko lake, Behra Governorate, Egypt between year (1986) and year (2011).

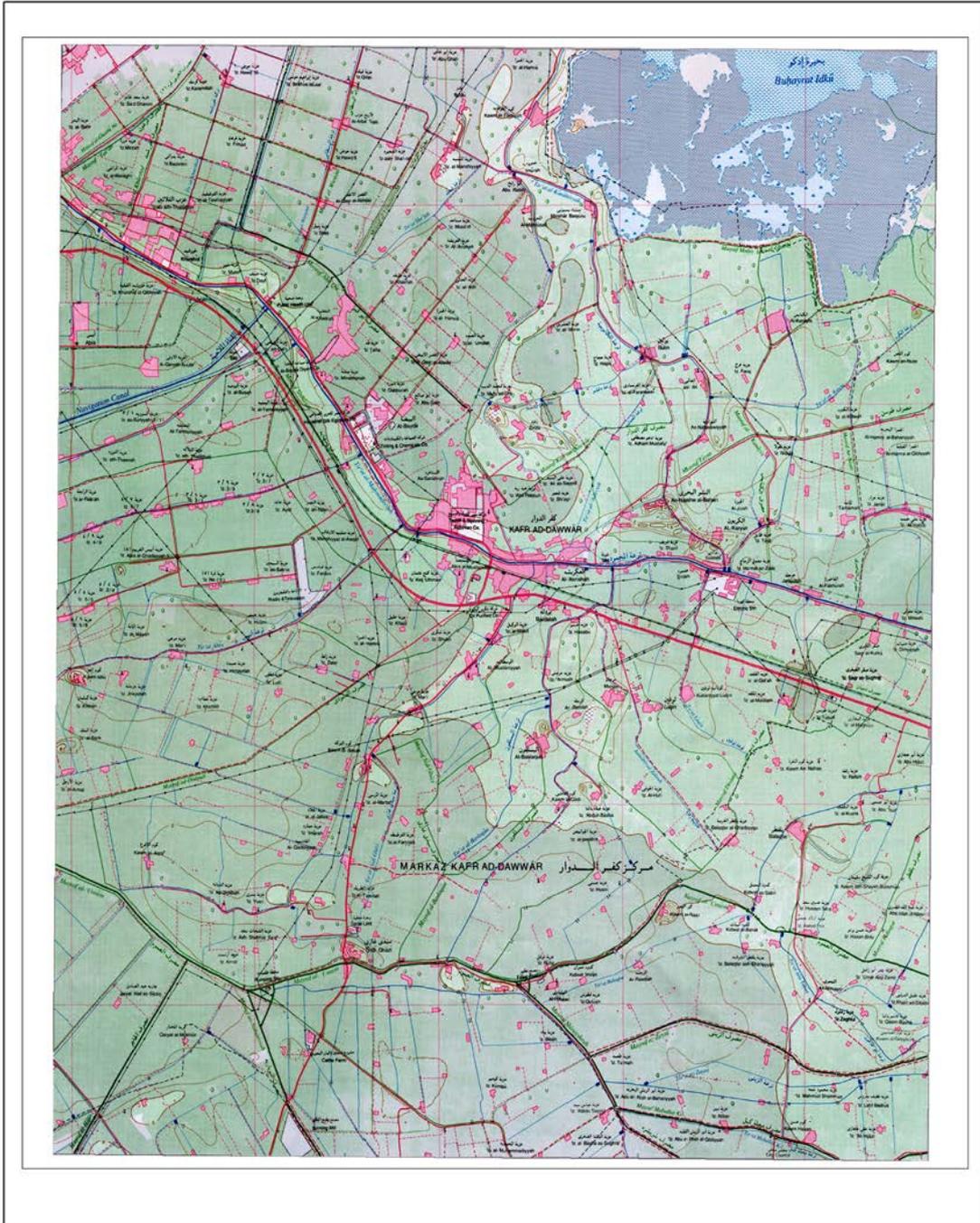
## Materials and method

The current study was carried out to investigate the distribution of salinity and some nutrient (*i.e.* nitrogen, phosphorus, iron, manganese, zinc and copper) under recently environment change in some soils adjacent to Idko Lake, Behra Governorate, Egypt between year (1986) and year (2011). To fulfill this purpose, fourteen profiles (thirty-nine samples, according to different layers "Table 3") were dug at different locations to represent physiographic units in the area according on a previous study in 1986 (Map 1). The collected soil samples were air dried, crushed, sieved to pass a 2mm sieve and preserved for further analyses. The sites of these deposits situated between 31° 10' and 31° 40' N, and longitudes 30° 25' and 31° 20' E. The Idko drain on the east, Abou Keir drain on the west, in the north found the Idko Lake, the Lake found on distance 1km the Mediterranean Sea and in the south El-Mahmodia canal. Meteorological data for the 1986 and 2011 in study period are given in Table 1. Electrical conductivity in soil paste extract and soluble cations and anions according to Page *et al.* (1982). Available micronutrients Fe, Mn, Zn and Cu were extracted with "NH<sub>4</sub>HCO<sub>3</sub>-DTPA" according to Soltanpour(1985) and determined by using Atomic Absorption Spectrophotometer apparatus, Perkin Elemer, Model 969AA. Nitrogen was determined by micerokjeldahl method as described by Chapman and Pratt (1978). Available phosphor was eastimated colorimetrically according to Olsen *et al.* (1954). Particle size distribution (Table 2) was carried out by pipette method by Gee and Bauder (1986). Statistical analysis for soil properties according to Snedecor and Cochran (1980). Oertal and Gille (1963) suggested three measures for parameter, namely the weighed mean (W). The weighed mean was calculated as parameter of each layer of the solum multiplied by the thickness of the layer and dividing the sum of these products by the total thickness of all analyzed layers. According to those authors the weighed mean is the most satisfactory measure of the parameter status of a soil profile. The weighed mean concentration of a parameter is probably determined by pedogenic processes (except where the parent material is markedly heterogeneous in element content).

**Table 1:** Mean monthly temperature, rainfall, relative humidity, evaporation in the studied area to year (1986 and 2011)

| Months | Temperature (C <sup>0</sup> ) |       |       |       |       |       | Rainfall (mm/month) |       | Relative humidity (%) |       | Evaporation (mm/day) |      | Wind Speed (Km) |      |
|--------|-------------------------------|-------|-------|-------|-------|-------|---------------------|-------|-----------------------|-------|----------------------|------|-----------------|------|
|        | 1986                          |       |       | 2011  |       |       | 1986                | 2011  | 1986                  | 2011  | 1986                 | 2011 | 1986            | 2011 |
|        | Max                           | Min   | Mean  | Max   | Min   | Mean  |                     |       |                       |       |                      |      |                 |      |
| Jan.   | 22.00                         | 11.30 | 16.65 | 19.60 | 6.10  | 12.80 | 20.25               | 14.20 | 47.69                 | 83.00 | 7.16                 | 2.20 | 0.772           | 1.30 |
| Feb.   | 22.60                         | 11.96 | 17.28 | 20.40 | 6.30  | 13.40 | 18.60               | 12.90 | 47.76                 | 83.00 | 7.32                 | 2.70 | 0.772           | 1.40 |
| Mar.   | 24.95                         | 13.60 | 19.28 | 23.00 | 7.90  | 15.40 | 12.73               | 6.70  | 49.17                 | 79.00 | 8.13                 | 3.50 | 0.772           | 1.70 |
| Apr.   | 26.10                         | 15.20 | 20.65 | 30.10 | 10.40 | 20.25 | 8.66                | 2.60  | 53.63                 | 71.00 | 9.80                 | 5.00 | 0.824           | 1.50 |
| May.   | 32.70                         | 20.42 | 26.56 | 35.20 | 14.20 | 24.70 | 3.64                | 2.90  | 57.98                 | 66.00 | 7.83                 | 6.50 | 0.824           | 1.50 |
| Jun.   | 33.00                         | 19.93 | 26.47 | 38.00 | 17.00 | 27.50 | 0.00                | 0.00  | 59.02                 | 69.00 | 6.97                 | 6.70 | 0.721           | 1.50 |
| July.  | 31.88                         | 19.12 | 25.50 | 43.00 | 19.00 | 31.00 | 0.00                | 0.00  | 60.66                 | 75.00 | 5.50                 | 5.70 | 0.721           | 1.30 |
| Aug.   | 32.55                         | 18.36 | 25.46 | 45.60 | 18.40 | 32.00 | 0.00                | 0.00  | 61.38                 | 77.00 | 4.44                 | 5.00 | 0.721           | 1.30 |
| Sep.   | 30.61                         | 17.09 | 23.85 | 44.90 | 17.71 | 31.31 | 0.17                | 0.15  | 55.85                 | 77.00 | 4.30                 | 4.80 | 0.824           | 1.10 |
| Oct.   | 31.00                         | 14.96 | 22.98 | 33.70 | 15.60 | 24.65 | 0.30                | 0.21  | 60.38                 | 78.00 | 4.23                 | 3.80 | 0.830           | 1.00 |
| Nov.   | 24.65                         | 13.90 | 22.00 | 25.90 | 12.60 | 19.25 | 12.33               | 6.90  | 54.33                 | 83.00 | 3.30                 | 2.80 | 0.856           | 1.10 |
| Dec.   | 21.11                         | 12.00 | 16.56 | 21.70 | 8.30  | 15.00 | 23.60               | 13.60 | 54.56                 | 86.00 | 3.18                 | 2.10 | 0.877           | 1.10 |

Source: Meteorological survey department, Egypt.



**Map 1:** Location of soil profiles in the studied soil

**Table 2:** The weight mean to partial size distribution and saturation percent of the studied soils between year (1986 & 2011)

| Location. No.  | C. Sand% |      | F. Sand% |       | Silt % |       | Clay % |       | SP    |       |
|----------------|----------|------|----------|-------|--------|-------|--------|-------|-------|-------|
|                | 1986     | 2011 | 1986     | 2011  | 1986   | 2011  | 1986   | 2011  | 1986  | 2011  |
| 1. Shebl.Iz    | 3.99     | 1.23 | 26.46    | 12.11 | 25.69  | 22.37 | 43.11  | 64.50 | 84.00 | 79.70 |
| 2. AlkaserAlh  | 9.62     | 2.89 | 46.72    | 17.04 | 17.53  | 37.58 | 26.16  | 42.48 | 51.00 | 81.80 |
| 3. Hawad 6     | 6.20     | 1.17 | 43.02    | 3.79  | 21.56  | 18.21 | 29.22  | 76.83 | 61.00 | 97.60 |
| 4. Zoqalih.Iz  | 11.83    | 4.00 | 41.48    | 16.60 | 15.57  | 46.80 | 30.86  | 32.60 | 61.00 | 80.00 |
| 5. Mini.Ba(1)  | 8.46     | 1.70 | 36.12    | 6.00  | 23.29  | 36.80 | 31.55  | 55.50 | 58.00 | 76.70 |
| 6. Mini.Ba(2)  | 6.90     | 1.90 | 25.66    | 10.90 | 22.13  | 21.20 | 45.31  | 66.00 | 86.00 | 77.50 |
| 7. Alashrin.Iz | 1.31     | 1.70 | 28.72    | 11.90 | 29.62  | 26.30 | 40.36  | 60.10 | 62.00 | 87.90 |
| 8. Alno. Alba  | 1.26     | 2.72 | 42.64    | 21.58 | 14.95  | 36.54 | 41.50  | 41.07 | 80.00 | 77.92 |
| 9. Sherf.Iz    | 1.74     | 1.17 | 42.13    | 10.97 | 23.36  | 29.00 | 32.24  | 59.05 | 53.00 | 77.48 |
| 10. Bawadi     | 0.96     | 2.40 | 20.15    | 9.10  | 32.14  | 34.20 | 46.40  | 54.30 | 78.00 | 79.90 |
| 11. farag.Iz   | 1.38     | 0.70 | 21.39    | 2.70  | 33.97  | 19.30 | 43.26  | 77.30 | 64.00 | 85.90 |
| 12. Alkanayes  | 0.92     | 2.10 | 16.62    | 16.10 | 31.36  | 32.20 | 48.77  | 49.60 | 74.00 | 81.80 |
| 13. Idku(1)    | 3.67     | 1.60 | 17.99    | 9.90  | 33.32  | 30.40 | 45.06  | 58.10 | 93.00 | 83.70 |
| 14. Idku(2)    | 7.88     | 1.20 | 21.97    | 5.70  | 20.83  | 22.20 | 47.30  | 70.90 | 82.00 | 91.00 |

**Table 3:** Location, depth of grand water and cultivated plants of the studied soil profiles

| Location. Name     | Profile No. | Depths cm             | Cultivated plant | Depth of grand water (cm) |      |
|--------------------|-------------|-----------------------|------------------|---------------------------|------|
|                    |             |                       |                  | 1986                      | 2011 |
| Shebl.Iz           | 1           | 0-30, 30-120, 120-150 | Wheat            | 120                       | 150  |
| Alqasr Alkhdr      | 2           | 0-30, 30-120, 120-150 | Wheat            | 120                       | 150  |
| Hawd.6             | 3           | 0-30, 30-120, 120-150 | Wheat            | 120                       | 150  |
| Zoqalih.Iz         | 4           | 0-30, 30-80           | Wheat            | 120                       | 80   |
| Minishit Basuone 1 | 5           | 0-30, 30-70           | Wheat            | 150                       | 70   |
| Minishit Basuone 2 | 6           | 0-30, 30-60           | Wheat            | 150                       | 60   |
| Al ashrin.Iz       | 7           | 0-30, 30-100, 100-150 | Wheat            | 100                       | 150  |
| Alnoshio Albahri   | 8           | 0-30, 30-120, 120-150 | Wheat            | 110                       | 160  |
| Sherf.Iz           | 9           | 0-30, 30-120, 120-160 | Wheat            | 150                       | 160  |
| Bawadi             | 10          | 0-30, 30-120, 120-160 | Wheat            | 150                       | 160  |
| Farag.Iz           | 11          | 0-30, 30-120, 120-160 | Wheat            | 150                       | 160  |
| Alkanays           | 12          | 0-30, 30-120, 120-150 | Wheat            | 85                        | 150  |
| Idku 1             | 13          | 0-30, 30-80, 80-150   | Wheat            | 150                       | 150  |
| Idku 2             | 14          | 0-30, 30-70, 70-150   | Wheat            | 150                       | 150  |

## Results and discussions

### 1. Weight mean of electric conductivity (EC) of the studied soils 1986 and 2011.

The presented data in Table (4) showed that the weight means to EC  $\text{dSm}^{-1}$  values of the studies soil samples in year 1986 were different the values in profiles. The highest values of EC were found in profile Idku 2, Idku 1 very saline whereas the values were 51.70 and 47.80  $\text{dSm}^{-1}$  respectively, profile Minishit Basuni 2 was EC vales saline whereas values 9.00  $\text{dSm}^{-1}$ , in profiles Alnoshio Albahri, Shebl Izba, Hawad 6 were EC moderately saline whereas values 7.80, 6.70, 4.50  $\text{dSm}^{-1}$  respectively, and profiles Bawadi, Minishit Basuni 1, Alashrin Izba, Alkanayes and Zoqalih Izba were EC slightly saline whereas values 3.20, 3.10, 3.10, 2.70 and 2.40  $\text{dSm}^{-1}$ , respectively, according to Richards (1954).

The profiles "Idku 1 and Idku 2" in year 1986 not cultivation, these profiles cultivated in year 1993 and increase human activity along time. The environmental conditions (temperature, evaporation, humidity, groundwater table (its depth and salinity) and activity human affect the salt balance of the soil and this is refelected directly on the exchangeable sites in soil complex. The range EC due to the long cultivation periods and increasing agriculture activity of Idku area, rainfall the rate of in year 1986 was 100.28mm/year, temperature the mean range to in year 1986 was 24.0C° and evaporation mean found range in year 1986 was 6.97mm/day.

In comparison with, data in Table (5) were the weight means to EC  $\text{dSm}^{-1}$  values of the studies soil samples in year 2011 were different the values in profiles. The highest values of EC were found in profile "Idku 1, Sherf Izba, Alnoshio Albahri, Shebl Izba" 2.60, 2.40, 2.30 and 3.10  $\text{dSm}^{-1}$  respectively, this data direction to profiles is very slightly saline. Other profiles values EC 0.70, 1.90, 0.70, 0.90, 1.50, 0.70, 1.30, 1.40, 1.80 and 1.60  $\text{dSm}^{-1}$  "Alkaser Alakhdar, Hawad 6, Zoqalih Izba, Minishit Basuni 1, Minishit Basuni 2, Alashrin Izba, Bawadi, Farag Izba, Alkanays and Idku 2" respectively, this profiles is non saline. The range EC was due to the long cultivation periods and increasing

agriculture activity of Idku area, rainfall the rate of in year (2011) 62.40 mm/year, Temperature the mean range to in year (2011) 26.56 C° and evaporation mean found range in year (2011) 4.85 mm/day. Areas were classified as non-to slightly-saline. This is probably due to it's relatively clay textured grade and well drainage conditions that enhanced the removal of the excess salts. Soil salinity is more associated with the inherited accumulations due to the intensive weathering, shallow water table, continuous lateral seepage from the relatively high areas and absence of adequate soil drainage system. **Nadi et al., (2010)** showed that EC<sub>e</sub> values in the Nile alluvial soils were ranged from 0.80 to 12.26 dSm<sup>-1</sup> indicate that the soils are non saline to moderately saline.

**Table 4:** The weight mean to electric conductivity and soluble ions of the studied soils (1986)

| Location. No.       | EC <sub>e</sub> dSm <sup>-1</sup> | Soluble cations (mmolc L <sup>-1</sup> ) |                  |                 |                | Soluble anions(mmolc L <sup>-1</sup> ) |                 |                               |
|---------------------|-----------------------------------|--|------------------|-----------------|----------------|--|-----------------|-------------------------------|
|                     |                                   | Ca <sup>2+</sup>                         | Mg <sup>2+</sup> | Na <sup>+</sup> | K <sup>+</sup> | HCO <sub>3</sub> <sup>-</sup>          | Cl <sup>-</sup> | SO <sub>4</sub> <sup>2-</sup> |
| 1.Shebl.Iz          | 6.70                              | 28.2                                     | 23.9             | 30.3            | 0.80           | 2.20                                   | 24.8            | 56.2                          |
| 2.Alqasr Alkhdar    | 2.10                              | 7.40                                     | 7.40             | 8.30            | 0.50           | 3.50                                   | 6.00            | 14.2                          |
| 3.Hawad 6           | 4.50                              | 7.20                                     | 10.9             | 26.7            | 0.60           | 3.30                                   | 25.3            | 16.9                          |
| 4.Zoqalih. Iz       | 2.40                              | 6.50                                     | 8.70             | 13.0            | 0.60           | 4.90                                   | 7.50            | 16.4                          |
| 5.MinishitBasuni(1) | 3.10                              | 19.7                                     | 13.2             | 6.90            | 0.40           | 2.30                                   | 3.80            | 40.2                          |
| 6.MinishitBasuni(2) | 9.00                              | 24.1                                     | 20.0             | 71.0            | 1.50           | 2.40                                   | 14.4            | 99.9                          |
| 7.Alashrin.Iz       | 3.10                              | 8.60                                     | 6.70             | 18.7            | 0.40           | 3.80                                   | 12.6            | 18.0                          |
| 8.Alnochio AlBahri  | 7.80                              | 5.90                                     | 9.40             | 63.4            | 0.90           | 4.00                                   | 45.1            | 30.6                          |
| 9.Sherf.Iz          | 1.60                              | 5.30                                     | 4.30             | 6.20            | 1.00           | 2.30                                   | 4.00            | 9.60                          |
| 10.Bawadi           | 3.20                              | 4.30                                     | 4.60             | 18.7            | 0.20           | 4.30                                   | 8.80            | 21.6                          |
| 11.Farag.Iz         | 1.30                              | 5.80                                     | 3.50             | 6.50            | 0.20           | 3.90                                   | 4.20            | 7.90                          |
| 12.Alkanays         | 2.70                              | 4.10                                     | 4.50             | 21.7            | 0.20           | 3.40                                   | 7.30            | 19.9                          |
| 13.Idku(1)          | 47.8                              | 34.8                                     | 111              | 432.9           | 9.20           | 2.30                                   | 478.4           | 87.2                          |
| 14.Idku(2)          | 51.7                              | 49.5                                     | 76.8             | 480.6           | 8.20           | 1.00                                   | 493.6           | 120.5                         |

\*No detected CO<sub>3</sub><sup>2-</sup>

**Table 5:** The weight mean to electric conductivity and soluble ions of the studied soils (2011)

| Location. No.       | EC <sub>e</sub> dSm <sup>-1</sup> | Soluble cations(mmolc L <sup>-1</sup> ) |                  |                 |                | Soluble anion(mmolc L <sup>-1</sup> ) |                 |                               |
|---------------------|-----------------------------------|---|------------------|-----------------|----------------|---------------------------------------|-----------------|-------------------------------|
|                     |                                   | Ca <sup>2+</sup>                        | Mg <sup>2+</sup> | Na <sup>+</sup> | K <sup>+</sup> | HCO <sub>3</sub> <sup>-</sup>         | Cl <sup>-</sup> | SO <sub>4</sub> <sup>2-</sup> |
| 1.Shebl.Iz          | 3.10                              | 7.23                                    | 8.15             | 13.3            | 0.69           | 3.92                                  | 15.78           | 9.69                          |
| 2.Alqasr Alkhdar    | 0.70                              | 1.72                                    | 1.45             | 2.90            | 0.20           | 1.33                                  | 3.28            | 1.66                          |
| 3.Hawad 6           | 1.90                              | 4.92                                    | 3.89             | 6.91            | 0.46           | 2.22                                  | 9.67            | 4.29                          |
| 4.Zoqalih.Iz        | 0.70                              | 1.44                                    | 1.07             | 3.70            | 0.31           | 1.13                                  | 3.10            | 2.29                          |
| 5.MinishitBasuni(1) | 0.90                              | 2.11                                    | 2.01             | 4.58            | 0.50           | 1.77                                  | 5.19            | 2.28                          |
| 6.MinishitBasuni(2) | 1.50                              | 3.52                                    | 3.60             | 5.44            | 0.22           | 2.15                                  | 6.92            | 3.70                          |
| 7.Alashrin.Iz       | 0.70                              | 1.40                                    | 1.30             | 3.33            | 0.34           | 1.09                                  | 3.38            | 1.91                          |
| 8.Alnochio AlBahri  | 2.30                              | 4.75                                    | 3.58             | 9.12            | 0.20           | 2.30                                  | 14.0            | 4.35                          |
| 9.Sherf.Iz          | 2.40                              | 6.90                                    | 6.02             | 8.60            | 0.23           | 3.08                                  | 12.8            | 5.91                          |
| 10.Bawadi           | 1.30                              | 3.44                                    | 2.23             | 5.21            | 0.43           | 2.69                                  | 5.08            | 3.54                          |
| 11.Farag.Iz         | 1.40                              | 3.63                                    | 3.64             | 5.75            | 0.18           | 2.06                                  | 7.41            | 3.73                          |
| 12.Alkanays         | 1.80                              | 4.84                                    | 3.27             | 8.19            | 0.16           | 2.45                                  | 10.2            | 3.86                          |
| 13.Idku(1)          | 2.60                              | 5.71                                    | 6.46             | 9.19            | 1.90           | 4.05                                  | 13.8            | 7.35                          |
| 14.Idku(2)          | 1.60                              | 3.01                                    | 3.81             | 4.63            | 0.52           | 1.40                                  | 6.87            | 3.69                          |

\*No detected CO<sub>3</sub><sup>2-</sup>

## 2. Statistical analysis the weight mean of soil electric conductivity.

The presented data in Table (6) show that some statistical parameters of electric conductivity of weight mean of the some location in studied soils. Electric conductivity (EC) in mean year (1986) 10.57 increase from year (2011) 1.64.

Also, stander deviation (stDev) to electric conductivity EC in year (1986) 16.77 increase from year (2011) 0.76. Stander deviation (SE) to electric conductivity (EC) in year (1986) 4.48 increase from year (2011) 0.20.

**Table 6:** Statistical analysis the weight mean of soil electric conductivity

| Variable             | Mean  |      | Minumim |      | Maximum   |      |           |
|----------------------|-------|------|---------|------|-----------|------|-----------|
|                      | 1986  | 2011 | 1986    | 2011 | 1986      | 2011 |           |
| EC dSm <sup>-1</sup> | 10.57 | 1.64 | 1.30    | 0.70 | 51.70     | 3.10 |           |
|                      | StDev |      | SE      |      | SE        | T    |           |
|                      | 1986  | 2011 | 1986    | 2011 | Different | Test | Tabulated |
|                      | 16.77 | 0.76 | 4.48    | 0.20 | 4.43      | 2.02 | 2.16      |

### 3. Distribution availability of macronutrients (N and P) in surface layer of the studied soils 1986 comparison with 2011

Data presented in Table (7) show that of studied soils available macronutrients in years (1986 and 2011), in year (2011) available nitrogen was improved on all profiles, the results indicated that the available nitrogen in all profiles were medium. In comparison with, year (1986) available nitrogen was very lowest, because the farmers changed the fertilization strategies whereas now farmers added  $\text{NH}_4\text{NO}_3$  (N 33%) and Urea (N 46.5%) fertilizers throw through year in soil and cultivation crops which help on catch nitrogen on roots for example, clover and bean, these results agreement with Abou El-Eneni *et al.* (2008).

Also, to satisfy and meet the objectives of the present study, Table (7) showed that of the studied area in year (2011) was lowest available phosphor in all profiles except profile "Alnoshio Albahri" was medium available phosphor. In comparison with, year (1986) was between high and medium, because carelessness in phosphor fertilizer, poor range management to agriculture the cycle, misuses of irrigation, high temperature help on fast analysis to organic matter and cultivation practices were unsuitable land so a cause of consumed of available phosphor (Gaddes, 1997), according to be critical level of the studied available plant nutrient (Lindsay and Norvell, 1978). Shalabbi (1977) studying the effect of soluble divalent cations  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  individually on available phosphorus in Egyptian soils (Idku region).

**Table 7:** Available of nitrogen and phosphor ( $\text{mg kg}^{-1}$ ) in surface layer of the studied soils (1986 & 2011)

| Location No.        | N    |        |       |        | P    |        |      |        |
|---------------------|------|--------|-------|--------|------|--------|------|--------|
|                     | 1986 |        | 2011  |        | 1986 |        | 2011 |        |
|                     | AV.* | Clas.* | AV.*  | Clas.* | AV.* | Clas.* | AV.* | Clas.* |
| 1.Shebl.Iz          | 3.80 | Low    | 52.88 | Medium | 5.00 | Low    | 4.00 | Low    |
| 2.Alqasr Alkhdar    | 10.3 | Low    | 65.61 | Medium | 21.5 | High   | 3.50 | Low    |
| 3.Hawad 6           | 9.60 | Low    | 63.64 | Medium | 16.0 | High   | 2.80 | Low    |
| 4.Zoqalih.Iz        | 10.6 | Low    | 64.11 | Medium | 12.2 | High   | 4.30 | Low    |
| 5.MinishitBasuni(1) | 6.10 | Low    | 61.12 | Medium | 12.7 | High   | 2.10 | Low    |
| 6.MinishitBasuni(2) | 5.50 | Low    | 64.06 | Medium | 3.20 | Low    | 2.70 | Low    |
| 7.Alashrin.Iz       | 8.30 | Low    | 72.15 | Medium | 18.4 | High   | 3.10 | Low    |
| 8.Alnoshio AlBahri  | 8.30 | Low    | 59.01 | Medium | 8.40 | Medium | 7.00 | Medium |
| 9.Sherf.Iz          | 4.20 | Low    | 64.16 | Medium | 12.4 | High   | 2.70 | Low    |
| 10.Bawadi           | 7.60 | Low    | 65.11 | Medium | 10.4 | High   | 3.00 | Low    |
| 11.Farag.Iz         | 7.40 | Low    | 73.00 | Medium | 8.00 | Medium | 2.80 | Low    |
| 12.Alkanays         | 8.30 | Low    | 74.32 | Medium | 44.8 | High   | 2.80 | Low    |
| 13.Idku(1)          | 1.30 | Low    | 61.66 | Medium | 4.90 | Low    | 2.00 | Low    |
| 14.Idku(2)          | 1.20 | Low    | 67.13 | Medium | 6.10 | Medium | 1.90 | Low    |

\*Note: AV.\*=available, Clas.\*=classification. Critical level of the studied available plant nutrients ( $\text{mg/kg}$ ), after Lindsay and Norvell (1978), [N <40.0 Low, 40.0-80.0 Medium, >80.0 High; P <5.0 Low, 5.0-10.0 Medium, >10.0 High.

### 4. Distribution of micronutrient availability in surface layer of the studied soils 1986 comparison with 2011

Data in Table (8a&b) showed the AB-DTBA extractable of some micronutrient in surface layers of the studied soils in year (2011) and year (1986), the amount of available Fe extracted with DTPA in the studied soils year (2011) increase in mostly profiles, whereas range was between 2.00 to 32.6  $\text{mg kg}^{-1}$ . In comparison with, year (1986) was range between 2.00 to 14.2  $\text{mg kg}^{-1}$  it could be attributed that the most soil was farms tree guava, it greedy iron fertilizer so farmers add iron compounds to collect increase mass production. Also, other layers were range between 1.80 to 4.60  $\text{mg kg}^{-1}$  amounts of available Fe increased by increasing clay (Nadi *et al.*, 2010).

The presented data in year (2011) show that standard available Mn in surface layers of studies soils. All surface layers in the studies soils were high between range 2.10 to 5.50  $\text{mg kg}^{-1}$ . In comparison with, year (1986) was range between 8.00 to 30.0  $\text{mg kg}^{-1}$ . Data showed that ratio of Mn in year (2011) were decrease in comparison year (1986). It could be attributed that the because carelessness in organic matter, poor range management to agriculture the cycle, misuses of irrigation, high temperature help on fast analysis to organic matter and cultivation practices were unsuitable land. The obtained resultes are in agreement with Nadi, *et al.* (2010) as she found that Mn values in the sand, silt and clay fraction in the Nile alluvial soils highest values are detected in the surface layer, while the lowest values are associated with the deepest layers.

Data in year (2011) show that standard available Zn in surface layers of studies soils. Found standard Zn is low in some profiles "Hawad 6, Alnoshio Albahri, Sherf Izba and Bawadi" whereas range between 0.45 to 0.71  $\text{mg kg}^{-1}$ . Also found profiles standard Zn was medium in profiles "Farag Izba and Idku 1" whereas range 0.98 and 2.20  $\text{mg kg}^{-1}$  respectively, ever lasting the profiles is high content whereas range between 1.83 to 5.60  $\text{mg kg}^{-1}$ . In comparison with, year (1986) found profiles between medium and high, whereas range between 1.00 to 10.6  $\text{mg kg}^{-1}$ . It could be attributed that the lowest amount of silt and organic matter.

Data of available copper are given in year (2011) show that highest value was all profiles. Available copper of the studied profiles were range from 1.00 to 19.6  $\text{mg kg}^{-1}$ . In comparison with, year (1986) all profiles were high, whereas range between 3.2 to 11.8  $\text{mg kg}^{-1}$ . These values are relatively higher than those of El Sayed (1983) and

Rashad (1986) may be due to seepage from Idko lake. Too the availability of soil copper may be due to the presence of hydroxyl acid produced by microorganisms from the organic material present in the soils (El Damaty *et al.*, 1973). According to the deficiency limits of available Fe, Mn, Zn and Cu given by Soltanpour (1985) all the studied soils contained adequate to high levels of Fe, Mn, Zn and Cu to support normal plant growth.

**Table 8a:** Available of some micronutrients (mgkg<sup>-1</sup>) in surface layers of the studied soils (2011)

| Location.<br>No.       | Fe   |        | Mn   |       | Zn   |        | Cu   |       |
|------------------------|------|--------|------|-------|------|--------|------|-------|
|                        | Av.  | Clas.  | Av.  | Clas. | Av.  | Clas.  | Av.  | Clas. |
| 1. Shebl.Iz            | 15.6 | High   | 4.30 | High  | 2.32 | High   | 6.20 | High  |
| 2. Alkaser AlKdar      | 32.6 | High   | 3.20 | High  | 1.83 | High   | 9.00 | High  |
| 3. Hawad 6             | 23.6 | High   | 3.50 | High  | 0.46 | Low    | 3.20 | High  |
| 4. Zoqalih.Iz          | 27.4 | High   | 4.40 | High  | 5.60 | High   | 19.6 | High  |
| 5. Minishit Basuni (1) | 7.40 | High   | 2.10 | High  | 1.83 | High   | 4.60 | High  |
| 6. Minishit Basuni (2) | 20.8 | High   | 5.50 | High  | 2.61 | High   | 3.80 | High  |
| 7. Alashrin.Iz         | 5.20 | High   | 3.90 | High  | 1.83 | High   | 1.80 | High  |
| 8. Alnoshio Albaahri   | 12.8 | High   | 4.50 | High  | 0.45 | Low    | 2.20 | High  |
| 9. Sherf.Iz            | 14.4 | High   | 3.80 | High  | 0.63 | Low    | 2.20 | High  |
| 10. Bawadi             | 6.20 | High   | 3.90 | High  | 0.71 | Low    | 1.00 | High  |
| 11. farag.Iz           | 2.00 | Low    | 3.90 | High  | 0.98 | Medium | 1.20 | High  |
| 12. Alkanayes          | 10.6 | High   | 3.90 | High  | 1.83 | High   | 1.00 | High  |
| 13. Idku(1)            | 2.40 | Low    | 3.80 | High  | 1.41 | Medium | 2.20 | High  |
| 14. Idku(2)            | 4.20 | Medium | 4.20 | High  | 2.16 | High   | 4.20 | High  |

Note: \*Av.=Available /Clas.=Classification " mg kg<sup>-1</sup>" ( Fe 0-3.0 Low, 3.1-5.0 Medium and > 5.0 High; Mn 0-0.5 Low, 0.6-1.0 Medium and > 1.0 High; Zn 0-0.9 Low, 1.0-1.5 Medium and > 1.5 High; cu0-0.2 Low,0.3-0.5 Medium and >0.5 High)According to Soltanpour(1985).

**Table (8b):** Available of some micronutrients (mg kg<sup>-1</sup>) in surface layers of the studied soils (1986)

| Location.<br>No.       | Fe   |        | Mn   |       | Zn   |        | Cu   |       |
|------------------------|------|--------|------|-------|------|--------|------|-------|
|                        | Av.  | Clas.  | Av.  | Clas. | Av.  | Clas.  | Av.  | Clas. |
| 1. Shebl.Iz            | 4.80 | Medium | 12.0 | High  | 1.40 | Medium | 5.00 | High  |
| 2. Alkaser AlKdar      | 4.60 | Medium | 16.0 | High  | 6.40 | High   | 11.8 | High  |
| 3. Hawad 6             | 8.60 | High   | 30.0 | High  | 10.6 | High   | 11.2 | High  |
| 4. Zoqalih.Iz          | 13.4 | High   | 18.3 | High  | 5.40 | High   | 10.3 | High  |
| 5. Minishit Basuni (1) | 8.80 | High   | 10.0 | High  | 1.60 | High   | 6.50 | High  |
| 6. Minishit Basuni (2) | 10.8 | High   | 14.5 | High  | 1.00 | Medium | 6.70 | High  |
| 7. Alashrin.Iz         | 5.00 | Medium | 13.8 | High  | 1.20 | Medium | 4.60 | High  |
| 8. Alnoshio Albaahri   | 9.20 | High   | 18.1 | High  | 1.80 | High   | 5.80 | High  |
| 9. Sherf.Iz            | 3.00 | Low    | 10.3 | High  | 1.60 | High   | 4.50 | High  |
| 10. Bawadi             | 10.5 | High   | 16.0 | High  | 1.40 | Medium | 5.80 | High  |
| 11. farag.Iz           | 2.00 | Low    | 14.0 | High  | 1.60 | High   | 4.40 | High  |
| 12. Alkanayes          | 14.2 | High   | 8.00 | High  | 1.00 | Medium | 7.80 | High  |
| 13. Idku(1)            | 5.00 | Medium | 12.0 | High  | 1.20 | Medium | 3.20 | High  |
| 14. Idku(2)            | 11.2 | High   | 24.0 | High  | 2.40 | High   | 7.80 | High  |

## Conclusion

The results obtained in the study showed that:

- 1-The electric conductivity in year 2011 decreased in compares with 1986
- 2-Available nitrogen in year 2011 increased in compares with year 1986. However available phosphors in year 2011 decreased in compares with 1986.
- 3-Available iron in year 2011 increased in compares with year 1986. However available manganese, zinc and copper in year 1986 increased in compares with 2011.

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# Divriği Kalesi: Hasar Değerlendirme ve Güçlendirme Önerileri

Zeki ÖZCAN  
Sakarya Üniversitesi  
Mühendislik Fakültesi  
İnşaat Mühendisliği Bölümü  
Türkiye  
[ozcan@sakarya.edu.tr](mailto:ozcan@sakarya.edu.tr)

**Özet:** Bu çalışmada Sivas ili, Divriği ilçe merkezinde yer alan, bir ortaçağ savunma yapısı olan Divriği Kalesi için hasar değerlendirmesi ve güçlendirme önerileri sunulmuştur. Kale Mengücekoğulları döneminde (1080-1228) Ahmet Şah tarafından yenilenen Paulikian-Bizans kalesidir. Kale, şehrin doğusundaki tepeye yaklaşık 55000 m<sup>2</sup> alana, oval formda planlı, çoğunlukla kesme taşla inşa edilmiş, askeri amaçlı kurulmuş bir yapıdır. Kale surlarının izi bütün kale çevresinde belirgin şekilde görülmekle birlikte beden duvarlarının önemli bir kısmı tahrip olmuştur. Sur duvarlarının yüksekliği 14 m ye kadar ulaşmaktadır. Kale surlarında gözlenen hasarlar insan eli ile yapılan müdahaleler ve çevre/iklim şartlarından kaynaklanan hasarlar olarak iki grupta toplanmıştır. Kale beden duvarlarının onarım ve güçlendirilmesinde uygulanacak yöntemler belirlenen hasar türleri için ayrı ayrı verilmiştir. Yapılan bu çalışma ile tarihi kalenin restorasyonu sırasında sur duvarlarının hasarlı ve eksik bölgelerine yapılacak müdahale yöntemleri belirlenerek uygulamaya yönelik yöntemler verilmiştir. Kale içinde Cumhuriyet Üniversitesi tarafından yürütülen arkeolojik kazılar devam etmektedir.

**Anahtar Kelimeler:** Divriği Kalesi, Hasar Belirleme, Onarım ve Güçlendirme, Röleve ve Restorasyon

## 1. Giriş

Yurdumuz dünyanın en eski ve zengin kültür mirasının bulunduğu bir coğrafyada bulunmaktadır. Bu topraklarda birçok topluluk yaşamış ve eserler inşa etmişlerdir. Bu eserlerden biri de Divriği kalesidir. Anadolu'da ki ilk Türk eserlerinden olan ve günümüze kadar ulaşan nadir eserlerden biridir. Ancak bakımsızlıktan ve kötü kullanımdan dolayı yok olmaya yüz tutan Sivas Divriği Kalesi esaslı bir restorasyona ihtiyaç duymaktadır. Son yıllarda yaygınlaşan tarihi yapıların restorasyonu ve kullanıma açılması çalışmaları çok sevindiricidir. Bu kapsamda yapılan rölöve, hasar belirleme, restorasyon ve bunlara bağlı olarak önerilen onarım güçlendirme ile Divriği kalesi aşındırıcı, bozucu iklim şartlarına karşı daha dayanıklı hale getirilmiş olacaktır. Ziyaretçilere ve turizme açılması, tahribatın durdurulması ve gelecek kuşaklara ulaşması da böylece mümkün olacaktır.

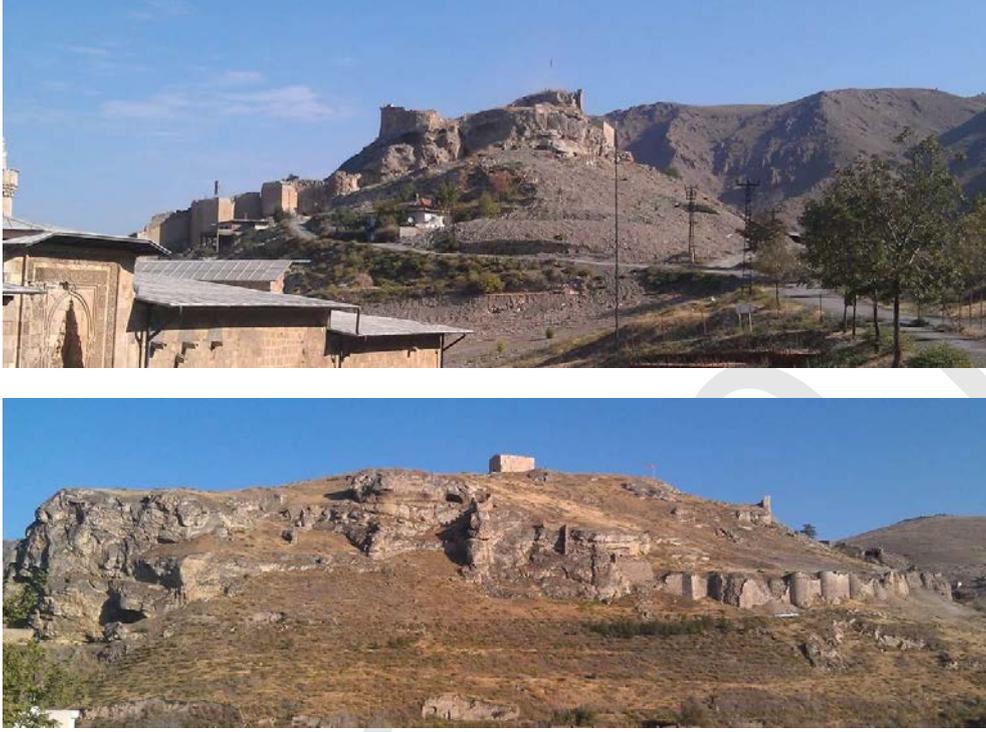
Taş yığma yapıların basınç dayanımı oldukça yüksek olmasına karşın çekme dayanımları oldukça düşüktür. Bu yüzden, yığma yapılarda çekme bölgeleri özenle incelenmelidir. Tarihi yığma yapıların davranışı üzerine pek çok araştırmacı tarafından çalışmalar yapılmaktadır (Ural 2008), (Doğangün 2012), (Branco 2011) (Senthivel & Lourenço 2009) ve (Betti 2011)

## 1. Divriği Kalesinin Konumu

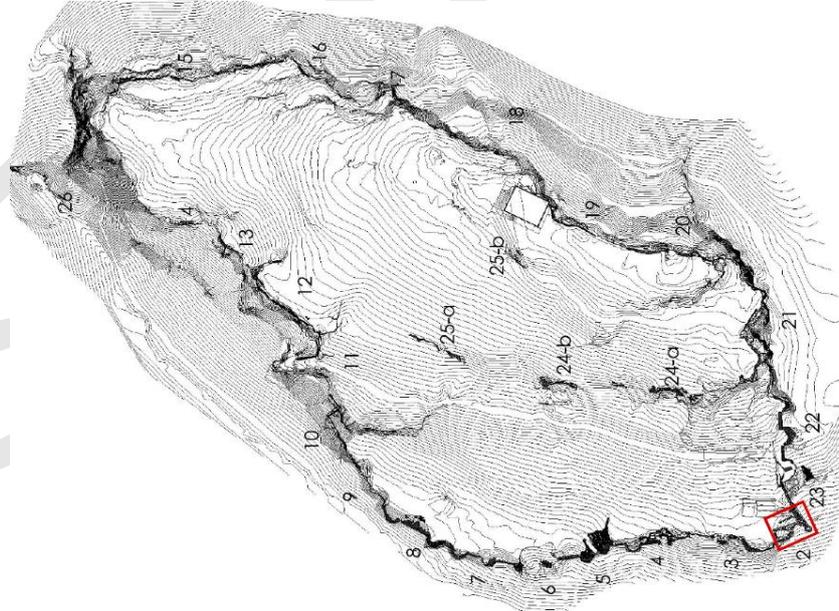
Divriği Kalesi, Sivas ili, Divriği ilçe merkezinde yer alan bir ortaçağ savunma yapısıdır. Mengücekoğulları dönemine (1080-1228) kadar eski Paulikian-Bizans kalesi olarak korunmuştur. Moğol istilasından korunmak için surlar ve iç kale Ahmet Şah tarafından yenilenmiştir. Kale, şehrin doğusundaki tepeye askeri amaçlı kurulmuş olmakla birlikte 1880'lere kadar sivil yerleşim yeri olarak da kullanılmıştır. (Şekil 1).

Kale 200m genişliğinde, 450m uzunluğunda oval formda bir plana sahiptir. Kalenin çevresi yaklaşık 1200m olup çoğunlukla kesme taşla inşa edilmiş beden duvarları ile sarılmıştır. Kuzey ve doğu cepheler dik uçurumlar halinde Çaltı Vadisi'ne indiğinden kalede barınanların can güvenliği için yer yer basit duvarlar örülmüştür.

Kale sur duvarları içinde kalan alan yaklaşık 55000 m<sup>2</sup>, kale alanının en düşük ve en yüksek kotları arası 90m dir (Şekil 2) (ASIR PROJE). Günümüzde kale alanında herhangi bir yerleşim bulunmamaktadır. Kale içinde Cumhuriyet Üniversitesi tarafından yürütülen arkeolojik kazılar devam etmektedir.



Şekil 1. Kalenin güney-batı ve kuzey-batı cephelerden görünüşü



Şekil 2. Sivas, Divriği Kalesi planı (ASIR PROJE)

## 2. Sur Duvarları:

Kale surlarının izi bütün kale çevresinde belirgin şekilde görülmekle birlikte beden duvarlarının önemli bir kısmı tahrip olmuştur. Tahribatlar insan eli ile yapılan müdahalelerden ve tabiat şartlarından kaynaklanmaktadır. Kalenin bulunduğu Divriği ilçesi, Deprem Bölgeleri Haritasında 3. Derece deprem bölgesinde yer almaktadır. Kale çevresinde ve sur duvarlarında depremden kaynaklanan önemli bir bulguya rastlanmamakla birlikte zaman içinde olan depremlerden de etkilendiği ve olacak depremlerden etkileneceği açıktır. Kalenin inşa edildiği yükselti çoğunlukla kayalardan oluştuğu için beden duvarlarında zeminden kaynaklanan eşit veya farklı temel oturması, heyelan veya toptan göçme görülmemiştir.

Sağlam bir kaya tabakası üzerine inşa edilen kale duvarlarının dış yüzleri düzgün kesme taşlarla örülmüş arka yüzleri ise genellikle kireç harcı ve moloz taş/iri çakıl kullanılarak dolgu yapılmıştır (Şekil 3). Yapılan dolgunun malzeme ve bağlayıcı kalitesi oldukça yüksektir. Bundan dolayı sur duvarlarına dolgu tarafından etkilenen yatay toprak basıncı oldukça düşük seviyelerdedir. Surların bazı bölümlerinde dış yüzeydeki kesme taşların alt bölgeleri boşalmasına rağmen dolgu ve üst bölgelerin stabilitesini koruduğu gözlenmektedir. Surların bir kısmında ise dolgularda yüzeye yakın bölgelerde ayrışmalar gözlenmiştir. Kullanılan blokların yüksekliği 40-50 cm, derinlikleri ise 50-70cm arasında değişmektedir. Sur duvarlarının yüksekliği 14 m ye kadar ulaşmaktadır.



Şekil 3. Sur duvarları ve dolgular

## 3. Sur Duvarlarında Gözlenen Hasarlar:

Sur duvarlarındaki hasar incelendiğinde homojen bir dağılımın olmadığı, çok farklı seviyelerde hasarlar olduğu gözlenmektedir. Bunun nedeni olarak, kalenin yapımından buyana farklı zamanlarda onarım ve yenilemelerin yapıldığı şeklinde değerlendirilebilir. Kale surlarında gözlenen hasarları insan eli ile yapılan müdahaleler ve çevre/iklim şartlarından kaynaklanan hasarlar olarak iki grupta toplamak mümkündür.

Kale duvarlarındaki kesme taşların zaman içinde bina temeli veya yeni bina inşa etmek için sökülmesi, buluntu aramak için yapılan bilinçsiz, kaçak kazılarda yapılan tahribatlar, iyi niyetle fakat tekniğine uygun olmayan onarım müdahaleleri ve ziyaretçiler tarafından yapılan resimler ve yazılar insan eli ile yapılan tahribatlar olarak sıralanabilir (Şekil 4).



Şekil 4. Sur duvarlarına yapılan yanlış müdahaleler

Kale duvarlarında çevre şartlarından meydana gelen bozulmalar daha çok iklim şartlarına ve malzeme yapısına bağlı olarak gelişmektedir. Isınma-soğuma, yüzeysel suların bünyeye girmesi ve donma-çözülme gibi dış etkenler ile taş ve bağlayıcı malzemenin kimyasal ve fiziksel özelliklerine bağlı olarak sur duvarlarında bozulmalar meydana gelmektedir. Bu hasarlar; toptan veya kısmi göçme, düşey çatlaklar ve ayrılmalar, yatay derzler boyunca hareketler ve malzeme kayıpları şeklinde gruplandırılabilir.

Hasarların belirlenmesi ve sınıflandırılmasında ICOMOS International Scientific Committee for Stone (ISCS) tarafından hazırlanan “*Illustrated glossary on stone deterioration patterns*” de verilen tanımlamalar ve sınıflandırmalar kullanılmıştır (ICOMOS-ISCS, 2008).

### 3.1. Toptan veya kısmi göçme

Çevre şartlarının etkisi ve insanlar tarafından yapılan değişik amaçlı müdahaleler sonucunda ortaya çıkan sur duvarlarının dış yüzeyinin kısmen veya tamamen bozulmasıdır (Şekil 2 ve 3). Sur duvarları tabanında yapılan kazılar, duvar gövdesinden taş alınması, yağmur ve kar sularının duvar içinde ilerlemesi, özellikle kış aylarında tekrarlı donma ve çözülme ile ortaya çıkan basıncın taş örgüyü ve bağlayıcı malzemeyi bozması gibi etkenler duvarların stabilitesini kaybetmesine ve arkasındaki dolguların bozularak yayılmasına neden olmaktadır. Yapıda duvar ile dolgu arasına giren yüzeysel suların tahliyesi için bir drenaj sisteminin düzenlendiği anlaşılmaktadır. Ancak bu sistemin zaman içinde bozulduğu ve işlevini yitirdiği değerlendirilmiştir. Şekil 5 de duvar içinde biriken suların tahliyesi için düzenlenmiş az sayıdaki barbakandan biri görülmektedir.



Şekil 5. Duvar temelinde yakın düzenlenmiş barbakan

### 3.2. Düşey çatlaklar ve ayrılmalar

Dış etkenlere bağlı olarak dolgu tabakalarında oluşan basıncın etkisi ile beden duvarlarında düşey doğrultuda milimetre boyutunda çatlaklar yer yer de santimetre boyutuna yaklaşan ayrılmalar gözlenmektedir. Bu ayrılmalar düşey derzleri takip ederek ortaya çıktığı gibi düz bir doğrultu boyunca taşları keserek ilerlediği de görülmektedir (Şekil 6).

### 3.3. Yatay derzler boyunca hareketler

Beden duvarlarının bağlı yatay hareketi az olmakla birlikte temele yakın bölgelerde rastlanmaktadır. Duvar temelinde meydana gelen yer değiştirmeler ve zayıf derzler hareketlenmenin nedenleri olarak değerlendirilmiştir (Şekil 7).

### 3.4. Derz boşalması

Derz boşalması en çok rastlanan hasar türlerinden biridir (Şekil 3, 4, 7 ve 8). Donma-çözülme gibi iklim şartları ve taş blokların yatay/düşey hareketleri sonucunda ortaya çıkmaktadır. Oluşan boşluklar sebebi ile düşey yönde kuvvet aktarılamamakta ve yapı stabilitesi bozulmaktadır.

### 3.5. Malzeme kayıpları

Malzeme kayıpları, taş bloklarda iç basıncın aşırı artması sonucu birbirine temas eden köşelerde veya kenar boyunca taş parçalarının yonga şeklinde koparak ayrılması (kesit azalması) olarak gözlenmiştir. 150-200 mm derinliğe varan kayıplar tespit edilmiştir. Bu hasar türü taş bloğun örgü şekline ve dayanımına bağlı olarak ortaya çıkmaktadır (Şekil 9).

Ayrıca malzeme kayıpları taş yüzeyinde düzensiz şekil ve farklı boyutlarda yerel boşlukların (alveoller) oluşması şeklinde de gözlenmiştir (Şekil 10). Boyutları 50-80mm derinliğe kadar giden malzeme kayıpları, aşınmalar tespit edilmiştir. Aşınma/erozyon taşın fiziksel ve kimyasal özelliklerindeki heterojen (homojen olmayan) dağılımdan ortaya çıkan bir ayrışma türüdür. Bu olgu daha çok sert ve boşluklu alanları birlikte bünyesinde barındıran heterojen yapıdaki kaya bloklarında (sedimanter ve volkanik kayalar) ortaya çıkmaktadır. Kurak iklimlerde metre boyutunda görülebilir.



Şekil 6. Sur duvarlarında gözlenen düşey çatlaklar ve ayrılmalar



Şekil 7. Sur duvarlarında gözlenen yatay hareketlenmeler ve ayrılmalar



Şekil 8. Sur duvarlarında gözlenen derz ve temel boşalmaları



Şekil 9. Taş bloklarda gözlenen malzeme kayıpları (kesit azalmaları)



Şekil 10. Taş bloklarda gözlenen farklı boyut ve türlerde malzeme kayıpları (erozyon)

## 4. Yapının Onarım ve Güçlendirilmesi

Bu bölümde kale beden duvarlarının onarım ve güçlendirilmesinde uygulanacak yöntemler sunulmuştur. Daha önce belirlenen hasar türlerinin onarım ve güçlendirilmesinde hangi yöntemin kullanılacağı aşağıda ayrı ayrı verilmiştir.

### 4.1. Yeni yapım

Toptan göçme hasarların belirlendiği bölgelerde yeni beden duvarları inşası yoluna gidilmelidir. Bu uygulamada duvar gövdesi sağlam kaya zemine oturtularak, mevcut beden duvarları ile uyumlu boyutlarda kaya bloklar kullanılarak inşa edilmelidir. Laboratuvar deneyleri için mevcut yapıdan alınan taş ve bağlayıcı numuneleri üzerinde yapılan deney sonuçları ile uyumlu bağlayıcı kullanılmalıdır. Duvar imalatı sırasında mevcut moloz dolgu ile duvar arasında kalan boşluklar harçlı moloz ile doldurulmalıdır. Kısmi göçme veya boşalma olan bölgelerde de gereken temizlik yapıldıktan sonra kaya bloklar yerleştirilip boşluklar Bölüm 4.2. de verilen enjeksiyon uygulaması yapılarak doldurulmalıdır. Daha sonra yüzey derzleri yapılmalıdır. Yüzey derzleri hidrolik esaslı bağlayıcı veya taş malzemenin bünyesi ile uyumlu genişleyen tamir harcı ile yapılabilir.

### 4.2. Enjeksiyon uygulaması

Enjeksiyon işlemi yapıya özgün mekanik özelliklerini kazandırmak için çatlak/boşluk içine uygun fiziksel ve kimyasal özellikte sıvı malzeme enjekte etmekten ibarettir. Enjeksiyon ile duvar içerisinde bulunan boşlukların ve çatlakların doldurularak duvar kesitinin sürekliliği sağlanır. Böylece duvar yükleri kesintisiz olarak temellere aktarılır ve olası dökülmeler ve kayıplar engellenmiş olur. Kullanılacak enjeksiyon malzemesi yapıyı oluşturan mevcut malzemelerle uyumlu olmalıdır. Hidrolik kireç esaslı enjeksiyon malzemeleri çatlak onarımları için en uygun ürünlerdir. Duvar içindeki boşlukları doldurabilmek için kullanılan malzemenin inceliği ve akışkanlık özellikleri gelişmiş olmalıdır. Mekanik özellikleri iyi olan ancak çözünmeyen tuzlar içeren ve yüksek hidrasyon sıcaklığında çimento şerbeti ya da epoksi reçinelerinin kullanılması açıklanan ilkelere uygun olmadığı için bu uygulamalardan kaçınılmalıdır.

Bu yöntem, bu yapı için 10 mm den küçük kaya çatlakları için uygulanacaktır. Bununla birlikte büyük boyutlarda oluşan derz boşluklarını doldurmak için koyu kıvamlı enjeksiyonlar da uygulanabilir. Bölüm 3.4 de “Derz boşalması” olarak tanımlanan hasar türü de bu uygulama ile onarılmalıdır. Mevcut duvar içinde değiştirilmesi gereken kaya blokların bağlanması için de bu yöntemden faydalanılabilir.

### 4.3. FRP (Lifli Polimer) çubuk uygulaması

Bu yöntemde duvar derzlerinde 40-50 mm derinlikte boşluklar açılarak bu boşluklara özel reçine ya da kireç esaslı harçlar kullanılarak FRP karbon çubuklar yerleştirilir (Şekil 11). FRP çubuklar ile duvar yüzeyinde oluşan çekme gerilmeleri karşılanmış olur. FRP çubuklar çelik donatılara göre çok yüksek mekanik dayanımlara sahip ve korozyona dayanıklı olmaları nedeniyle çok uzun ömürlüdürler. Çubuk çapları 5-12 mm arasında değişen daire kesitli veya 1.4x10 mm ölçülerinde dikdörtgen kesitli olarak üretilmektedir (BASF).



Şekil 11. FRP çubuk ve kireç esaslı harçla duvar derzlerinde yapılan güçlendirme (BASF)

Bu yöntem, bu yapı için beden duvarlarında düşey doğrultuda meydana gelen 10 mm den büyük çatlakların onarım ve güçlendirilmesinde uygulanacaktır. Yatay derzler boyunca 90-100 cm aralıklarla veya her iki yatay derzde bir olacak şekilde düzenlenecektir. Çapları 10 mm olan FRP çubukların boyları çatlak bitiminden itibaren 1 m daha uzatılarak belirlenecektir. Yerleştirme işleminden sonra FRP çubuğun üzeri derz dolgusu ile tamamen kapatılacaktır. Bu yöntem ile Bölüm 3.2 de “Düşey çatlaklar ve ayrılmalar” ve Bölüm 3.3 “Yatay derzler boyunca hareketler” de tanımlanan hasarların onarım ve güçlendirilmesinde uygulanmalıdır.

## 5. Malzeme kayıplarının onarımı

Bölüm 3.5 de “Malzeme kayıpları” olarak tanımlanan hasar türlerinin onarımı için Bölüm 4 de verilen yöntemler birlikte veya ayrı ayrı uygulanabilir. Malzeme kaybının olduğu durumlarda çatlaklı yada serbest parçalar temizlendikten sonra boşluğa uygun yeni kesme taş blok kesilerek yerleştirilmeli, enjeksiyon yöntemi ile derzleri doldurulmalıdır. Gerekli durumlarda FRP çubuklar kullanılarak da güçlendirme yapılabilir. Etrafındaki boşluklar enjeksiyon yöntemi ile doldurulmalıdır.

## 6. Sonuç:

Anadolu'daki en eski kültür varlıklarımızdan biri olan Sivas Divriği Kalesi bakımsızlıktan ve kötü kullanımdan dolayı yok olmaya yüz tutmuştur. Divriği kalesi için yapılan rölöve, hasar belirleme, restorasyon ve bunlara bağlı olarak önerilen onarım güçlendirme yöntemlerinin uygulanması ile kalenin yapısal güvenliğinin sağlanması, aşındırıcı, bozucu iklim şartlarına karşı daha dayanıklı hale getirilmesi sağlanmış olacaktır. Ziyaretçilere ve turizme açılması, tahribatın durdurulması ve gelecek kuşaklara ulaşması da böylece mümkün olacaktır.

## 7. Teşekkür:

Yazar, kale planları için “Divriği kalesi röleve restorasyon ve restitüsyon projesi” müellifleri Mimar Hasan Fevzi ÇÜĞEN ve Y. Mimar, Restorasyon Uzm. Mehmet Emin YILMAZ'a teşekkür eder.

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## DUAL TYPE COMPLEMENTARY COLORED ELECTROCHROMIC DEVICES BASED ON POLY(2,5-DITHIENYLPYRROLE) DERIVATIVES

Pinar Camurlu\*, Cemil Gültekin

Akdeniz University, Department of Chemistry, 07058, Antalya, Turkey

**Abstract** In this study, four different, dual type polymer electrochromic devices (ECDs) based on homopolymers and copolymers of 4-(2,5-di-thiophen-2-yl-pyrrol-1-yl)-N-(ferrocenyl methyl)-phenylamine (SNS-An-Fc) and 1-(2-ethyl-hexyl)-2,5-di-thiophen-2-yl-2,3-dihydro-1H-pyrrole (SNS-HE) were constructed. ECDs were assembled in ITO/poly(SNS-R)//PEDOT/ITO configuration and characterized for their performance via spectroelectrochemistry, switching, coloration efficiency, open circuit, stability studies and colorimetry measurements. Generally, the switching speeds and stability of ECDs having copolymers as their active layer were found to be higher than the devices of corresponding homopolymers. Among all the ECDs P(SNS-An-Fc-co-EDOT)/PEDOT device had relatively higher stability and it retained about 84 % of its optical and electrical activity even after 1000 cycles.

**Keywords:** dual type electrochromic device, dithienylpyrrole; poly(3,4-ethylenedioxythiophene);

## DUNES SAND BEHAVIOR UNDER TRIAXIAL LOADS

**Rahmouni Zine el Abidine, Meddah Abdelaziz, Khemissa Mohamed**

Geomaterials Development Laboratory, Civil Engineering Department,  
 Faculty of Technology, M'sila University, P.O. Box 166 Ichbilia 28000 M'sila, Algeria  
 Corresponding Author: khemissa@univ-msila.dz

**Abstract:** This paper has the aim of characterizing the behavior of a dunes sand collected in Boussaâda city (wilaya of M'sila, Algeria), where important disorders were observed in the road works and in the small buildings. Triaxial drained shear tests results performed on this sand using a servo-controlled triaxial press are presented and described. Simulation results of the sand behavior using two hyperbolic models and their application to calculate the bearing capacity of strip footing resting on a sand massif of geotechnical characteristics comparable with those of Boussaâda dunes sand are also presented and analyzed. It is concluded that the numerical results are concordant with the experimental results for the considered hyperbolic models. But, these two models lead to bearing capacity values lower than those given by Terzaghi's formula.

**Key words:** Dunes sand, triaxial drained shear test, hyperbolic model, simulation, strip footing.

### Introduction

Urban areas of Boussaâda city (wilaya of M'sila, Algeria) extends more and more towards of dunes sand zones less favorable than those already urbanized, from where appearance more or less important of some disorders in the constructions founded on their surface. These disorders come essentially from the active lateral earth pressures exerted by the sand dunes on the low parts of the constructions and by the settlements of the subjacent massif.

This paper aims at characterizing the experimental and numerical behavior of a dunes sand collected in northern zone of Boussaâda city (wilaya of M'sila, Algeria), where important constructions (buildings, roads, houses, etc) were built these last years. Triaxial drained shear tests results obtained on this soil using a servo-controlled triaxial press are presented and its critical state behavior is analyzed. Numerical simulation results conducted on this sand using Duncan et al. (1980) and Schanz et al. (1999) hyperbolic models are also presented and analyzed. Calculation results of a strip footing anchored in a sand massif of characteristics comparable with those of Boussaâda dunes sand is finally examined.

### Experimental approach

The experimental data used here are extracted from a rheological study carried out on samples collected near an elementary school in Boussaâda city, whose foundations were anchored in a sand massif resulting from a stacking of dunes on a few meters of depth. In addition to classification tests, the carried out experimental program comprised five triaxial drained shear tests performed by using a servo-controlled triaxial press. Implemented experimental procedures in these tests were in conformity as much as possible with Algerian testing methods (comparable to French testing methods). Interpretation techniques of the test results are many inspired from the knowledge obtained on sand soils throughout the world. Table 1 gives the identification characteristics values of Boussaâda dunes sand. These values indicate that it is about clean and well-graded sand. Table 2 gives the properties values of resistance and deformability of this sand deduced from shear curves corresponding to the triaxial drained shear test results above mentioned (figure 1). It can be noted that the shear curves do not present a peak, but tend towards an asymptote. They characterize the typical behavior of meanly dense sands, whose shear strength is defined by the ultimate deviator stress. Corresponding volumetric strain curves present an initial contractance followed quickly of a phase of marked enough dilatancy. Corresponding strain paths confirm in addition the drained behavior of samples during the tests. These results confirm the essential of knowledges acquired on the behavior of sands. They show in addition that the behavior parameters of this sand are largely influenced by the initial conditions of compactness in which it is and by confining stress to which it is subjected.

**Table 1.** Identification characteristics of Boussaâda dunes sand

| Parameters                    | Symbols                         | Range of variation | Mean values |
|-------------------------------|---------------------------------|--------------------|-------------|
| Dry unit weight               | $\gamma_d$ (kN/m <sup>3</sup> ) | 15.27 – 15.31      | 15.3        |
| Specific unit weight          | $\gamma_s$ (kN/m <sup>3</sup> ) | 25.50 – 25.70      | 25.6        |
| Sand equivalent   with piston | E.S.P (%)                       | 78.8 – 94.2        | 91.5        |

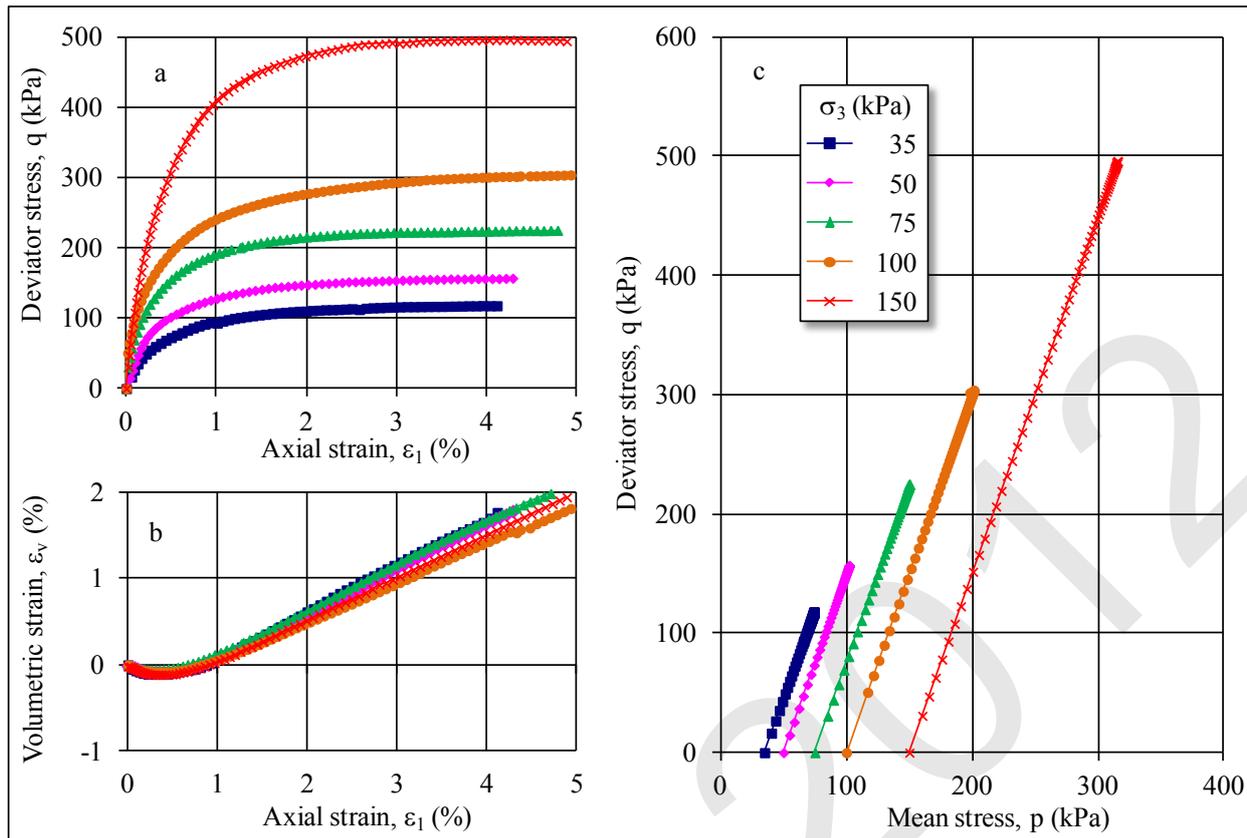
|                           |        |           |             |      |
|---------------------------|--------|-----------|-------------|------|
|                           | visual | E.S.V (%) | 86.7 – 93.0 | 90.7 |
| Maximum void ratio        |        | $e_{max}$ | 0.67 – 0.68 | 0.67 |
| Minimum void ratio        |        | $e_{min}$ | 0.49 – 0.50 | 0.50 |
| Coefficient of uniformity |        | $C_u$     | -           | 1.83 |
| Coefficient of curvature  |        | $C_c$     | -           | 1.08 |

**Table 2.** Mechanical properties of Boussaâda dunes sand

| Test  | CID-1 | CID-2 | CID-3 | CID-4 | CID-5 |
|---|-------|-------|-------|-------|-------|
| $\sigma_b$ (kPa)  | 35    | 50    | 75    | 100   | 150   |
| $I_D$ (%)   | 59    | 59    | 59    | 56    | 56    |
| $(\sigma_b)_{ult}$ (kPa)  | 118.1 | 157.1 | 225.3 | 305.3 | 496.0 |
| $E_{0.2}$ (MPa)   | 22.3  | 31.5  | 50.1  | 62.3  | 90.6  |
| $E_{50}$ (MPa)  | 18.4  | 28.7  | 50.1  | 51.3  | 76.7  |
| $\nu$   | 0.26  | 0.33  | 0.36  | 0.31  | 0.26  |
| $\alpha$  | 10.7  | 11.7  | 11.7  | 11.0  | 11.3  |
| $\beta$   | 38    |       |       |       |       |
| $\sigma_b$ – confining stress, $I_D$ – density index, $(\sigma_b)_{ult}$ – ultimate deviator stress,<br>$E_{0.2}$ –secant modulus corresponding to 0.2 % from axial strain,<br>$E_{50}$ –secant modulus corresponding to 50 % from ultimate deviator stress,<br>$\nu$ – Poisson's ratio, $\alpha$ – dilatancy angle, $\beta$ – effective interne friction angle |       |       |       |       |       |

## Numerical modeling

Structural computation has for a long time been approached from the standpoint of stability. However, incorporating deformations prior to rupture proves to be increasingly necessary in studies of geotechnical structures. Various mathematical formulations are proposed to characterize the behavior of soils. These formulations are based on the stress-strain relations according to the principles of continuum mechanics and to experimental data gathered starting from usual laboratory test results. However, because of spatial and temporal variability of in-situ geotechnical properties of soils, rare are the formulations whose experimental validity would be complete. Duncan et al. (1980) and Schanz et al. (1999) hyperbolic models are two typical examples of the behavior models adapted to sands. These two models, characterized by the Mohr-Coulomb failure criterion, were developed in order to describe the behavior of sands for which the stress state depends on both the current strain state and the stress path followed, yet time is not included explicitly. Their parameters are fully identifiable on typical laboratory tests and easy to implement within geotechnical computer codes. The principal results of their use for simulation of the triaxial drained shear test and calculation of a strip footing resting on a sand massif of geotechnical characteristics comparable with those of Boussaâda dunes sand are presented and analyzed hereafter.



**Figure 1.** Triaxial drained shear tests results for Boussaâda dunes sand

### Constitutive models

Theoretical bases of Duncan et al. (1980) and Schanz et al. (1999) hyperbolic models and their application are described in detail within the cited reference publications. Also, only parameters interesting the object of this paper are pointed out hereafter.

#### Duncan et al. (1980) model

This model relies upon a stress-strain elastic relation of the hyperbolic type as well as on Mohr-Coulomb failure criterion. It is defined by a tangent elastic modulus  $E_t$  for loading shear phase (figure 2a), a modulus  $E_{ur}$  for unloading-reloading shear phase (figure 2b) and a tangent bulk modulus  $K_t$ . These parameters are given by the following expressions:

$$E_t = \left[ 1 - \frac{R_f(1 - \sin \phi')(\sigma_1 - \sigma_3)}{2(c' \cos \phi' + \sigma_3 \sin \phi')} \right]^2 E_i \quad (1)$$

with  $E_i = K_h p_a (\sigma_3 / p_a)^n$  as the initial tangent Young's modulus and  $R_f = (\sigma_1 - \sigma_3)_f / (\sigma_1 - \sigma_3)_{ult}$  the failure ratio (taken equal to 0.9 as a default value),

$$E_{ur} = K_{ur} p_a (\sigma_3 / p_a)^n \quad (2)$$

$$K_t = K_b p_a (\sigma_3 / p_a)^m \quad (3)$$

in which  $c'$  represents the drained cohesion,  $\phi'$  the friction angle,  $K_h$ ,  $K_b$ ,  $K_{ur}$ ,  $n$  and  $m$  experimental parameters and  $p_a$  a reference pressure (taken equal to atmospheric pressure  $p_{atm} = 101.4$  kPa).

Duncan et al. (1980) hyperbolic model contains nine parameters:  $K_h$ ,  $K_b$ ,  $K_{ur}$ ,  $n$ ,  $m$ ,  $R_f$ ,  $c'$ ,  $\phi'$  and  $p_a$ .

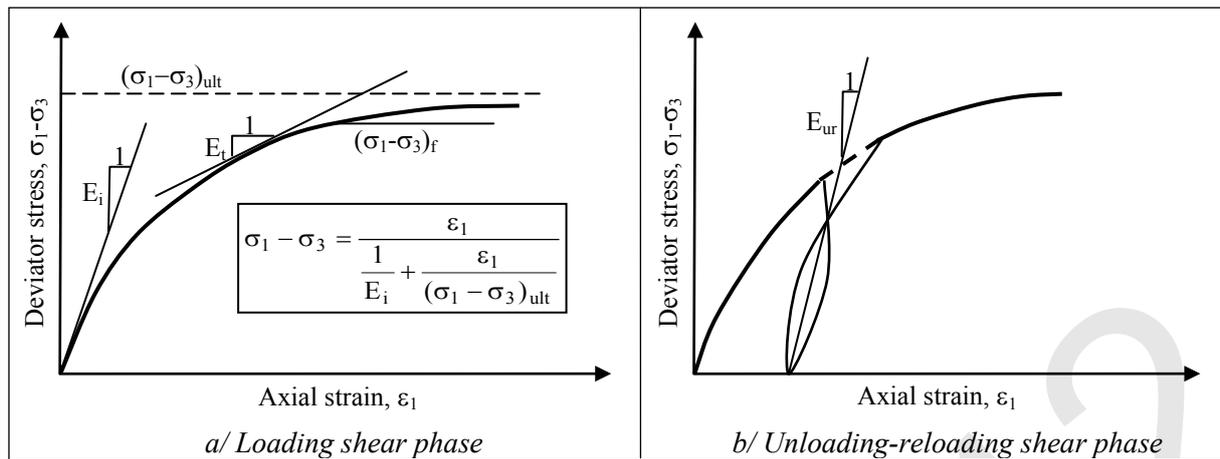


Figure 2. Shear curve representation for Duncan et al. (1980) model

### Schanz et al. (1999) model

This model relies upon a stress-strain hardening elastoplastic relation of the hyperbolic type as well as on Mohr-Coulomb failure criterion (Hardening Soil Model). It is defined by a secant modulus  $E_{50}$  corresponding to 50% of the ultimate deviator stress for loading shear phase, a modulus  $E_{ur}$  for unloading-reloading shear phase (figure 3a) and a oedometric compressibility modulus  $E_{oed}$  (figure 3b). These parameters are given by the following expressions:

$$E_{50} = E_{50}^{ref} \left[ \frac{c' \cot \varphi' - \sigma'_3}{c' \cot \varphi' + p^{ref}} \right]^m \quad (4)$$

$$E_{ur} = E_{ur}^{ref} \left[ \frac{c' \cot \varphi' - \sigma'_3}{c' \cot \varphi' + p^{ref}} \right]^m \quad (5)$$

$$E_{oed} = E_{oed}^{ref} \left[ \frac{c' \cot \varphi' - \sigma'_1}{c' \cot \varphi' + p^{ref}} \right]^m \quad (6)$$

in which  $E_{50}^{ref}$ ,  $E_{ur}^{ref}$  ( $=3 E_{50}^{ref}$  as a default value) and  $E_{oed}^{ref}$  represent the reference stiffness moduli corresponding to the reference confining pressure  $p^{ref}$  (taken equal to atmospheric pressure  $p_{atm}=101.4$  kPa),  $c'$  the drained cohesion,  $\varphi'$  the effective interne friction angle and  $m$  an experimental parameter (taken equal to 0.5 for sands and silts).

The deviator stress at failure is given by the following expression (Mohr-Coulomb failure criterion):

$$(\sigma_1 - \sigma_3)_f = (c' \cot \varphi' - \sigma'_3) \frac{2 \sin \varphi'}{1 - \sin \varphi'} \quad (7)$$

and the ultimate deviator stress is equal to:

$$(\sigma_1 - \sigma_3)_{ult} = \frac{(\sigma_1 - \sigma_3)_f}{R_f} \quad (8)$$

with  $R_f$  represents the failure ratio (taken equal to 0.9 as a default value).

Schanz et al. (1999) hyperbolic model contains nine parameters:  $E_{50}^{ref}$ ,  $E_{ur}^{ref}$ ,  $E_{oed}^{ref}$ ,  $R_f$ ,  $m$ ,  $c'$ ,  $\varphi'$ ,  $\varphi'_c$  and  $p^{ref}$ .

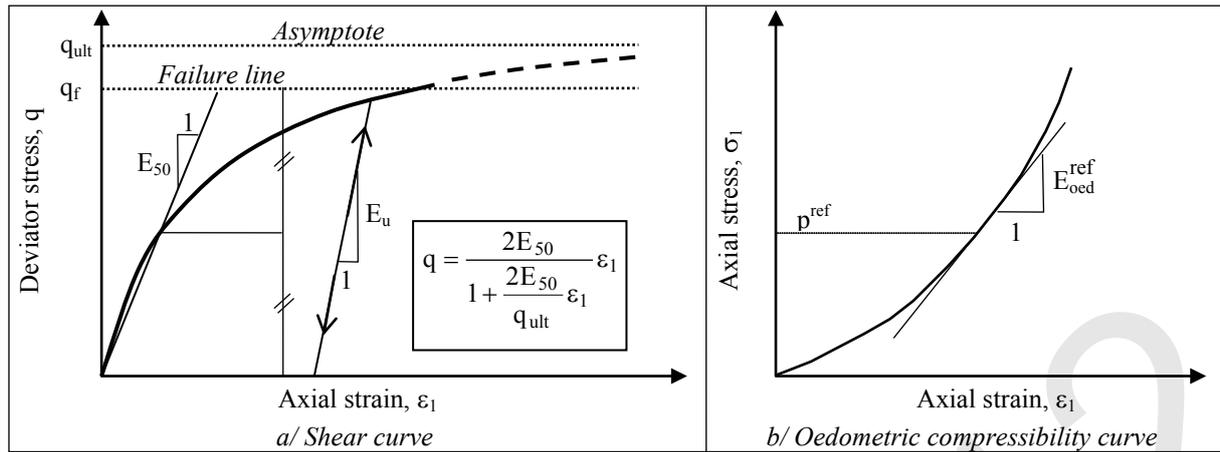


Figure 3. Shear and oedometric compressibility curves representation for Schanz et al. (1999) model

### Design parameters

Tables 3 and 4 give the parameters values of Duncan et al. (1980) and Schanz et al. (1999) hyperbolic models retained for a simulation program of the triaxial drained shear test identical to the carried out experimental program.

Table 3. Parameters values of Duncan et al. (1980) model

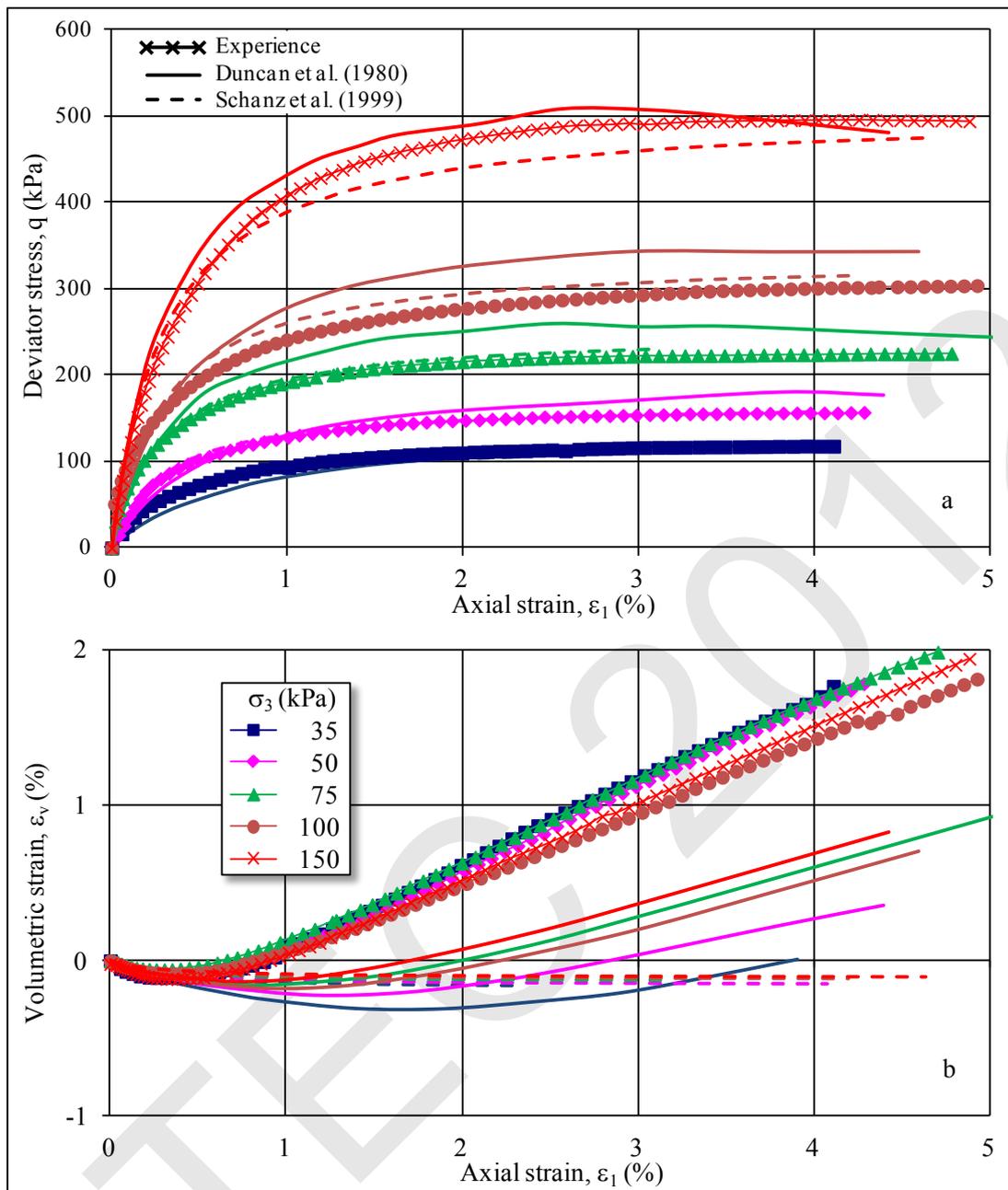
| $\sigma_{\text{ref}}$ (kPa) | E (MPa) | $\alpha$ | $K_b$ | $K_{ur}$ | n    | $K_b$ | m    | $c'$ (kPa) | $\phi'$ (°) | $\phi$ (°) | $R_f$ | $p_a$ (kPa) |
|-----------------------------|---------|----------|-------|----------|------|-------|------|------------|-------------|------------|-------|-------------|
| 35                          | 22.3    | 0.26     | 625   | 625      | 0.97 | 9.09  | 1.37 | 0          | 38          | 10.7       | 0.9   | 101.4       |
| 50                          | 31.5    | 0.33     | 625   | 625      | 0.97 | 9.09  | 1.37 | 0          | 38          | 11.7       | 0.9   | 101.4       |
| 75                          | 50.1    | 0.36     | 625   | 625      | 0.97 | 9.09  | 1.37 | 0          | 38          | 11.7       | 0.9   | 101.4       |
| 100                         | 62.3    | 0.31     | 625   | 625      | 0.97 | 9.09  | 1.37 | 0          | 38          | 11.0       | 0.9   | 101.4       |
| 150                         | 90.6    | 0.26     | 625   | 625      | 0.97 | 9.09  | 1.37 | 0          | 38          | 11.3       | 0.9   | 101.4       |

Table 4. Parameters values of Schanz et al. (1999) model

| $\sigma_{\text{ref}}$ (kPa) | $E_{50}^{\text{ref}}$ (MPa) | $\alpha$ | m   | $E_{\text{oed}}^{\text{ref}}$ (MPa) | $c'$ (kPa) | $\phi'$ (°) | $\phi$ (°) | $R_f$ | $p^{\text{ref}}$ (kPa) |
|-----------------------------|-----------------------------|----------|-----|-------------------------------------|------------|-------------|------------|-------|------------------------|
| 35                          | 18.4                        | 0.26     | 0.5 | 27.3                                | 0          | 38          | 10.7       | 0.9   | 101.4                  |
| 50                          | 28.7                        | 0.33     | 0.5 | 46.6                                | 0          | 38          | 11.7       | 0.9   | 101.4                  |
| 75                          | 50.1                        | 0.36     | 0.5 | 84.2                                | 0          | 38          | 11.7       | 0.9   | 101.4                  |
| 100                         | 51.3                        | 0.31     | 0.5 | 86.4                                | 0          | 38          | 11.0       | 0.9   | 101.4                  |
| 150                         | 76.7                        | 0.26     | 0.5 | 110.8                               | 0          | 38          | 11.3       | 0.9   | 101.4                  |

### Simulation of the triaxial drained shear test

Geometrical model consists of a cylinder of twinge 2 (diameter  $D=10$  cm and height  $h=20$  cm) identical to that of sample submitted for testing. Mesh of this model consists of triangular finite elements and its loading comprises a confining phase by application of isotropic stress followed by a shear phase by application of an increasing axial stress while the radial stress is maintained fixed until the rupture. Figure 4 presents the numerical results of the triaxial drained shear test and their comparison with the experimental results.



**Figure 4.** Experimental and calculated triaxial drained shear curves for Boussaâda dunes sand

Simulation of the triaxial drained shear test performed on Boussaâda dunes sand seems to give satisfactory results as well for the nonlinear elastic Duncan et al. (1980) model as for the hardening elastoplastic Schanz et al. (1999) model. Results of this simulation are also in concord with the experimental results. However, the best agreement is obtained with Schanz et al. (1999) model, because of the dilating behavior of material and the plastic strains developed starting from a certain threshold of loading of the geometrical model. Then, we can think that the two models can be indifferently used to characterize the behavior of the sands subjected to small deformations. While for the great deformations, Schanz et al. (1999) model seem to better be appropriate for the plastic designs. The behavior models, compared between-them, do not give concordant results inevitably, because of the possible differences in their relevance. However, the shift observed between the experimental and simulated curves corresponding to the most relevant model of between-them result from the influence of the selected values of certain mechanical parameters which characterize it.

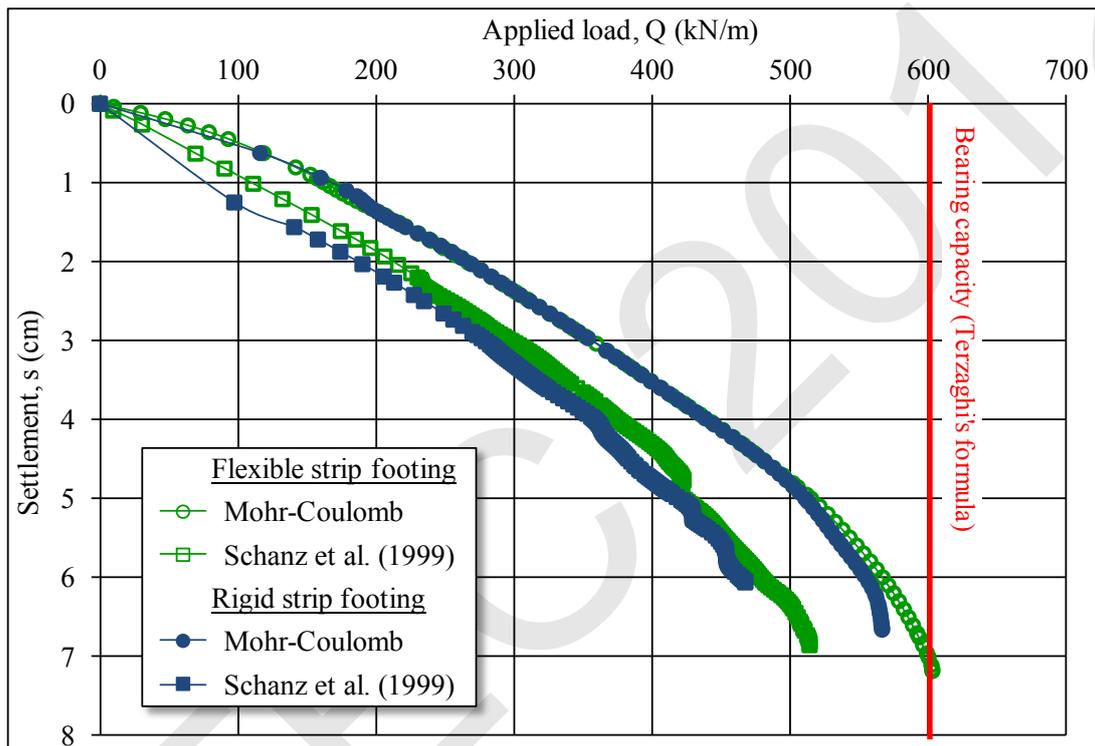
#### *Application to the strip footing calculation*

Geometrical model consist of a strip footing of width  $B=1$  m resting directly on a horizontally sand massif of

geotechnical characteristics comparable with those of Boussaâda dunes sand. The selected side borders are sufficiently far away from the foundation so that the conditions at the borders do not have any influence on behavior of the model. Calculations carried out interest two cases of figures:

- a flexible strip footing, represented by a uniform condition of pressure applied directly to the surface of the massif (vertical and horizontal displacements being free and the pressure applied growing continuously until the rupture);
- a rigid strip footing, represented by a condition of imposed vertical displacement (horizontal displacement being free and vertical displacement growing continuously until the rupture).

Calculations of bearing capacity were carried out under the two-dimensional conditions. They related to strip footing resting directly on a sand massif of characteristics comparable with those of Boussaâda dunes sand. Purpose of these calculations are to compare results obtained by the hardening elastoplastic Schanz et al. (1999) model and the perfectly plastic elastic Mohr-Coulomb model with results of the calculations obtained by Terzaghi's theory of bearing capacity (Terzaghi's formula). Figure 5 presents the loading curves for the flexible and rigid strip footings according to Mohr-Coulomb and Schanz et al. (1999) models and their comparison with the bearing capacity calculated by Terzaghi's formula.



**Figure 5.** Calculated loading curves

For a given footing type, the ultimate stress values calculated by Mohr-Coulomb model are higher than those calculated by Schanz et al. (1999) model. For a given behavior model, evolution of the load applied to the footing according to corresponding settlement is higher for the flexible footing than for the rigid footing. The ultimate stresses determined by two models remain however lower than the limit stress determined by Terzaghi's formula. This probably comes owing to the fact that the model of behavior makes it possible to take again part of the efforts, the footing being then charged. Analysis of settlements does not show notable differences between the behaviors of a rigid footing and a flexible footing. However, we can note that the parameters of initial state (Young's modulus  $E$  and Poisson's ratio  $\nu$ ) and the parameter of dilatancy  $\lambda$  have a considerable effect on the loading curve.

## Conclusion

This paper had as a finality to characterize the behavior of a dunes sand collected in northern zone of Boussaâda (wilaya of M'sila, Algeria), where important disorders frequently appear in the road works and in the small buildings. This sand is identified like as clean and well-graded sand and is characterized by dilating behavior typical of meanly dense sands. Simulation of the triaxial drained shear test carried out on this sand seems to give satisfactory results so much for the nonlinear elastic Duncan et al. (1980) model that for the hardening elastoplastic Schanz et al. (1999) model. Numerical results are concordant with the experimental results. However, the best agreement is obtained with Schanz et al. (1999) model, because of the dilating behavior of material and the plastic strains developed starting from a certain threshold of loading. Sensitivity analysis to the mechanical parameters (not presented here) seems nevertheless to indicate that the Schanz et al. (1999) model is more sensitive to the variations of its constitutive parameters than the

Duncan et al. (1980) model, in which case the interpretation of the numerical results must be carried out with much prudence. Calculation results of a strip footing resting on a sand massif of geotechnical characteristics comparable with those of Boussaâda dunes sand make it possible to confirm that the plastic design is sedentary than calculation at limit equilibrium of it.

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## Düzensiz Geometriye Sahip Çerçevelerde, Dairesel Kesite Sahip Merkezi Çelik Çaprazların Performans Analizi

Berker ALICIOĞLU, Muharrem AKTAŞ, Muzaffer ELMAS, Zeynep YAMAN  
Sakarya Üniversitesi  
İnşaat Mühendisliği Bölümü  
Türkiye  
[muharrema@sakarya.edu.tr](mailto:muharrema@sakarya.edu.tr), [elmas@sakarya.edu.tr](mailto:elmas@sakarya.edu.tr), [zdyaman@sakarya.edu.tr](mailto:zdyaman@sakarya.edu.tr)

**Özet:** Bu çalışmada hedeflenen, düzensiz bir yapıda farklı geometriye sahip merkezi çelik çapraz perdelerin yatay yükler altında yapı davranışına olan etkilerinin araştırılmasıdır. Bu araştırma, hem çelik perde türleri hem de perde profilinin kesit geometrisi arasında yapılmıştır. Perde profilleri dairesel kesit seçilirken farklı perde türleri kullanılmıştır. Yapılan analizler sonucunda yapı performansının farklı çapraz türlerindeki limit değeri incelenmiştir. Çalışmanın yapısal analiz ve sonlu eleman modellemesinde, doğrusal olmayan statik analiz yöntemi kullanılmıştır. Böylece çalışmada düzensiz geometrisi olan yapının perdesinde kullanılan dairesel kesitin, diogonal ve ters V çapraz sistemi ile yapıda oluşturduğu davranış incelenmiştir.

**Anahtar Kelimeler:** Push-over, merkezi çelik çaprazlar, performans analizi

### Giriş

Yapı, deprem etkisine maruz kaldığı zaman, depremin yapıya uygulamış olduğu enerji ve yapının enerjisi, yapının deprem etkisi altındaki davranışını belirler. Başka bir deyişle, depremin binaya uyguladığı enerji ile yapının kinetik enerjisi, geri dönen elastik şekil değiştirme enerjisi, sönüm enerjisi ve tüketilen enerji arasındaki denge, yapının sismik davranışını belirler. Eğer, yapının sönüm enerjisi, depremin yapıya uyguladığı enerjiden büyükse, binaya dışarıdan uygulamış olan deprem enerjisi sönümle dengelenmiş olur. Sönüm enerjisinin, depremin uygulamış olduğu enerjiden küçük olması halinde ise, sönüm enerjisi ile depremin uygulamış olduğu enerji arasındaki fark, histerik enerji ile dengelenir. Bu fark yapının sünekliğini tanımlar (Gioncu, 2002).

Çelik yapılar, genel olarak depreme dayanıklı ve sünek davranışa sahip olduklarından tercih edilen yapı türleridir. Fakat nasıl ki bir yapı malzemesi olarak çeliğin sünekliği içine konulan karbon miktarına bağlı ise, çelik bir yapının sünekliği de çelik malzemenin süneklik düzeyinin yanı sıra sistemin geometrisine de bağlıdır. Bu yapıların yapısal elemanlarının (kolon, kiriş) ve bu yapısal elemanların birleşim bölgelerinin yanal yükler altında yeterli sünekliğe sahip olmaları için taşıyıcı sistemin çevrimsel etki altında enerji tüketen bölgelerinin fazla olması gerekmektedir. Fakat, yapının plastik davranışı, plastik deformasyonun oluşmasından sonra yapıda plastikleşmeyen bölgelere yeniden dağıtıldığı varsayılan kesit tesirlerine bağlı olduğu için, tahmin edilen göçme yüküne erişilmesi, plastikleşen kesitlerdeki plastik mafsalların konumu ile ilgilidir. Bu nedenle, plastik mafsalın davranışı ve konumu süneklik miktarını ve dayanımı etkilemektedir(Gioncu 2002).

Plastik analizde istenen, dayanımda azalma olmaksızın büyük dönmelerin olmasıdır. Fakat elemanlarda gevrek kırılma, lokal burkulma ve eğilmeli-burulma gibi nedenlerle büyük plastik dönmelere ulaşılamaz. Ayrıca, çelik yapılar tasarlanırken değişik nedenlerden dolayı burulma düzensizliğine sahip olabileceği gibi çok düzenli ve hiçbir yapısal düzensizliğe sahip olmadan tasarlanan yapılar bile çeşitli uygulama hatalarından dolayı deprem anında burulmalı davranış sergileyebilmektedir(Gioncu 2002). Ayrıca, taşıyıcı sistem elemanlarında, burkulma veya ikinci mertebe etkiler yapıda stabilite kaybına neden olmaktadır. Depreme dayanıklı çelik taşıyıcı sistem tasarımında, yeterli yatay rijitliğin ve yüksek süneklik düzeyinin sağlanabilmesi bu nedenle çok önemlidir. Çelik yapılarda yatay rijitlik, çelik çapraz perdeli sistemler ile sağlanmaktadır(Gioncu 2002).

Dolayısıyla çelik yapıların yanal kuvvet olarak yapıya etkiyen deprem kuvvetlerine karşı yapısal tasarım esasları yapının yanal kuvvetlere karşı dayanımı temeline dayanmaktadır. Yapının deprem yüklerine karşı dayanıklı olmasını sağlayan pek çok yapısal uygulamaların başında çelik perde sistemleri gelmektedir. Çelik perde kullanımı hafiflik ve süneklik açısından yapı davranışı için avantaj sağlamaktadır. Çelik perde kullanımı durumunda dikkat edilmesi gereken husus, yapı davranışı için uygun çapraz sisteminin ve çelik profillerinin seçimidir. Çelik yapıları tasarlarken, yapıda kullanılacak perde sistemi yapının deprem yükleri altındaki davranışını büyük ölçüde değiştirmektedir. Bu değişim, yapının bu yüklere daha dayanıklı olması açısından olumlu etki göstermektedir. Bu nedenle, yapısal perde seçimi oldukça önemlidir.

Bu çalışmada geometrik düzensizliği olan yapının dairesel kesitli diagonal ve ters V merkezi çaprazı ile güçlendirilmesi ile sağlanan performans artışı incelenmiştir. Ayrıca çalışma kapsamından, merkezi çelik çaprazlı perdeleri, doğrusal olmayan yapı davranışını ve çözümlenmesini içermektedir. Merkezi çelik çaprazlı perde olarak, Deprem Bölgelerinde Yapılacak Binalar Hakkında Yönetmelik (DBYBHY) 2007’inde madde 4.5 te “Merkezi ve Dışmerkez Çelik Çaprazlı Perdeler” başlığı altında verilen merkezi çelik çapraz türleri ele alınmıştır.

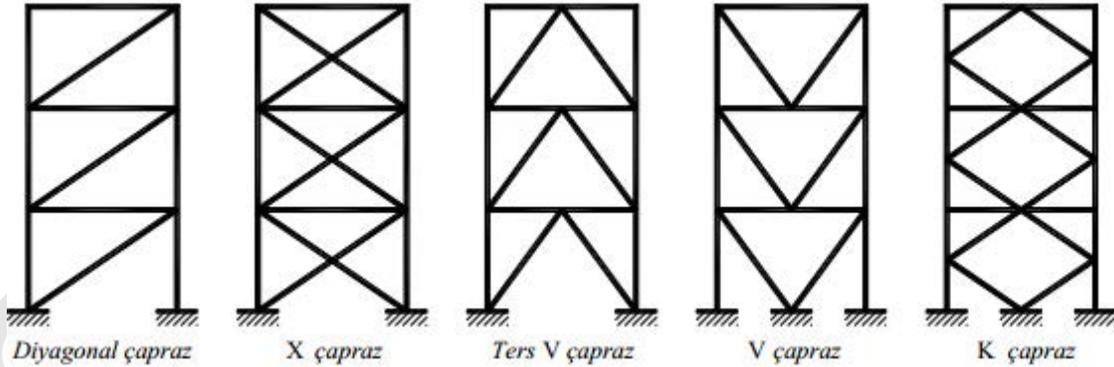
### Çelik Çaprazlı Perde Sistemler ve Türk Deprem Yönetmeliğinin Koşulları

Çelik çaprazlı perdeler, mafsallı birleşimli veya moment aktaran çerçeveler ile bunlara merkezi ve dışmerkez olarak bağlanan çaprazlardan oluşan yatay yük taşıyıcı sistemlerdir. Bu tür sistemlerin yatay yük taşıma kapasiteleri, eğilme dayanımlarının yanında, daha çok veya tümüyle elemanların eksenel kuvvet dayanımları ile sağlanmaktadır(DBYBHY, 2007).

Çelik çaprazlı perdeler, çaprazların düzenine bağlı olarak ikiye ayrılırlar:

- (a) Merkezi Çelik Çaprazlı Perdeler
- (b) Dışmerkez Çelik Çaprazlı Perdeler

Bu çalışmada merkezi çelik çaprazlar Şekil 1’de gösterilmiştir. Ayrıca çalışmada kapsam biraz daha küçültülmüş ve diagonal ve ters V merkezi çaprazlar üzerinde çalışılmıştır.

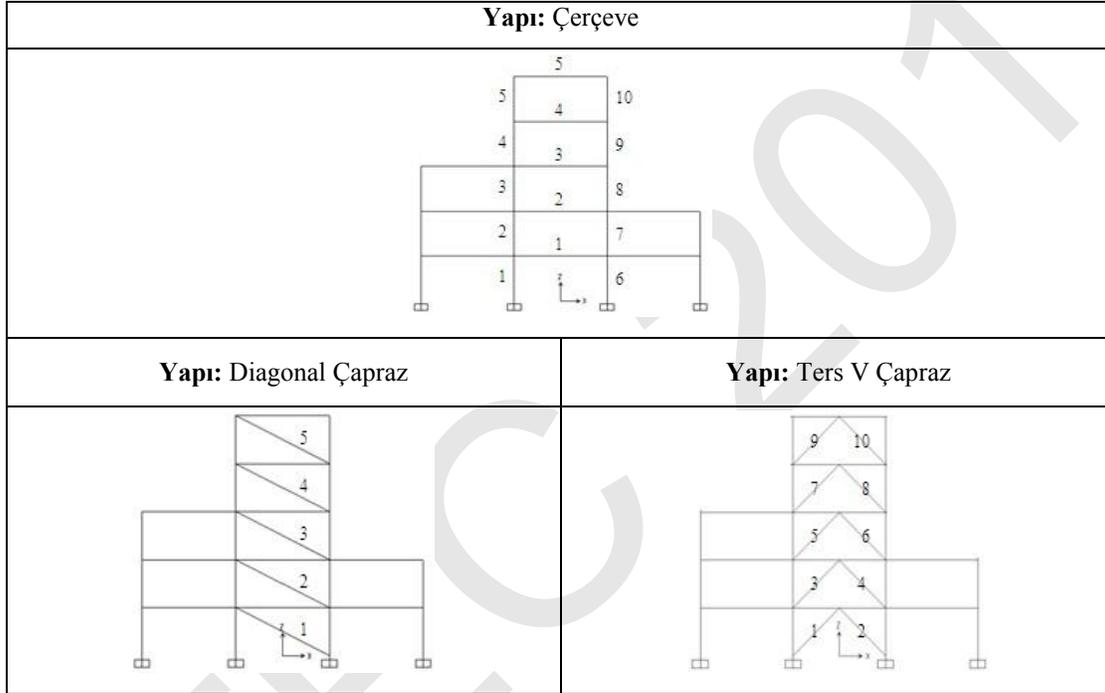


Şekil 1: Merkezi Çelik Çaprazlı Perdeler (DBYBHY 2007)

Çaprazların çerçeve düğüm noktalarına merkezi olarak bağlandığı Merkezi Çelik Çaprazlı Perdeler süneklik düzeyi yüksek veya süneklik düzeyi normal sistem olarak boyutlandırılabilirler. Süneklik düzeyi yüksek merkezi çelik çaprazlı perdeler, basınç elemanlarının bazılarının burkulması halinde dahi, sistemde önemli ölçüde dayanım kaybı meydana gelmeyecek şekilde boyutlandırılırlar. Bu sistemlerin boyutlandırılmasında uygulanacak kurallar DBYBHY-2007 Bölüm 4.6.’da verilmiştir(DBYBHY 2007).

## Çalışmanın Kapsamı

Analizler Sap2000 sonlu eleman programı kullanılarak yapılmıştır. Sap 2000 programı ile yapıların doğrusal olmayan davranışını temsil eden, yapı kapasite eğrisinin (pushover eğrisi) elde edilmesi bir takım kabuller ile mümkündür(SAP, 2009). Yatay yükler altında gerçek yapı davranışına yakın çözüm yapmak için yapı sistemlerinin çözümlenmesinde malzemenin gerçek davranışı ve yapı geometri değişimleri göz önüne alındığından doğrusal olmayan statik analiz kullanılmıştır. Çalışmada, simetrik olmayan düzlem bir çerçevede, yapının doğrusal olmayan davranışını olumlu etkileyecek daire enkesitine sahip merkezi çapraz perde türünün belirlenmesi hedeflenmektedir. Çalışma kapsamında Şekil 2’de görülen çerçeve tipi incelenmiştir. Bu çerçeve hem yatayda hem düşeyde simetrik olmayan düzensiz çerçeve tipidir.



Şekil 2: Çaprazlı ve çaprazsız düzlem çerçeveler

Düşey yükler etkisi altında yapıda mafsallaşma oluşmaması için kolonların kirişlerden daha rijit olması gerektiği için seçilen çerçeve sistemlerinde kolon kesitlerinin atalet momenti ve kesit alanı, kiriş kesitlerine oranla daha büyük alınmıştır. Açıklık mesafeleri x yönü 6 metre, z yönü 3 metredir. Kirişlerin üzerine 1 t/m’ lik çizgisel düşey yük tanımlanmıştır. Kolonlar için IPE300, kirişler için IPE240 profilleri seçilmiştir. Çelik malzeme akma dayanımı ise 2.40 t/cm<sup>2</sup>’ dir. Çerçeveye eklenen çelik perde sistemleri, DBYBHY 2007’de bahsi geçen Merkezi Çelik Çaprazlı Perdelerden seçilmiştir.

## Çelik Yapılarda Performans Kavramı ve Kabuller

Depreme dayanıklı yapı tasarlarken, depremin yapıdan isteyeceği maksimum kuvvet göre veya depremin yapıdan talep ettiği süneklığe göre tasarım yapmak mümkündür. Depremin yapıdan isteyeceği maksimum kuvvete göre tasarım olan dayanıma göre tasarımda, depremin istediği maksimum kuvvet esas alındığından, yapı maliyeti çok yüksek ve taşıyıcı kesitler büyük olmaktadır. Depremin istediği maksimum kuvvete göre değil, depremin yapıdan talep ettiği süneklığe göre tasarım ise süneklilik kabiliyeti yüksek çelik malzemeden yapılan bir yapı için daha avantajlı olacaktır. Deprem yüklerinin deprem yönetmeliklerinde yer alan taşıyıcı sistem davranış katsayısıyla azaltılması bu nedenle yapılır. Yapı için performans kavramı da bu nokta da başlar. DBYBHY 2007 ye göre bir binanın performansı doğrusal elastik yöntemler (eşdeğer deprem yükü yöntemi, mod birleştirme yöntemi) veya

doğrusal elastik olmayan yöntemler (artımsal eşdeğer deprem yükü yöntemi, artımsal mod birleştirme yöntemi ve zaman tanım alanında hesap yöntemi) ile hesaplanabilir(Kutaniş, 2011).

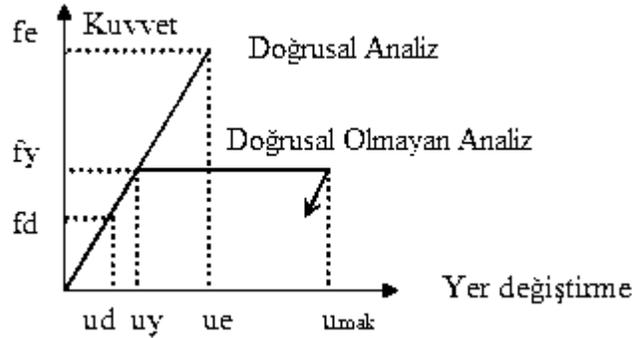
Doğrusal elastik olmayan hesap yöntemlerinin amacı, verilen bir deprem için sünek davranışa ilişkin plastik şekildeğiştirme istemleri ile gevrek davranışa ilişkin iç kuvvet istemlerinin hesaplanmasıdır. Daha sonra bu istem büyüklükleri, DBYBHY 2007 bölüm 7’de tanımlanmış bulunan şekildeğiştirme ve iç kuvvet kapasiteleri ile karşılaştırılarak, kesit ve bina düzeyinde yapısal performans değerlendirilmesi yapılacaktır(Kutaniş, 2011).

DBYBHY 2007 Bölüm 7.8 de, mevcut binaların değerlendirilmesinde ve güçlendirme tasarımında kullanılmak üzere üç deprem tehlikesi tanımlanmıştır: Tanımlanan birinci deprem düzeyi, yapıların servis ömürleri boyunca meydana gelebilmesi olasılığı fazla olan, göreceli olarak sık ancak şiddeti çok yüksek olmayan deprem yer hareketlerini ifade etmektedir. Bu depremin 50 yılda aşılma olasılığı %50, buna karşı gelen dönüş periyodu ise 72 yıldır. İkinci deprem düzeyi, yapıların servis ömürleri boyunca meydana gelebilmesi olasılığı çok fazla olmayan, seyrek ancak şiddetli deprem yer hareketlerini ifade etmektedir. Bu depremin 50 yılda aşılma olasılığı %10, buna karşı gelen dönüş periyodu ise 475 yıldır. Üçüncü deprem düzeyi, yapıların maruz kalabileceği en şiddetli deprem yer hareketini ifade etmektedir. Bu çok seyrek depremin 50 yılda aşılma olasılığı %2, buna karşı gelen dönüş periyodu ise 2475 yıldır(DBYBHY 2007).

Taşıyıcı elemanların kesitleri elastik gerilmeye ulaşsa bile genel olarak bir dayanım fazlalığına sahiptir. Bu dayanım fazlalığı, çeliğin uzayabilen bir malzeme olmasından kaynaklanmaktadır. Ayrıca bu dayanım fazlalığı, yapı sisteminin türüne ve yüke bağlı olarak değişir. Bir yapının gerçek davranışının belirlenmesi için bazı yakınsamalar ve bu yakınsamalar bazı kavramlar içerir bunlar aşağıda açıklanmıştır.

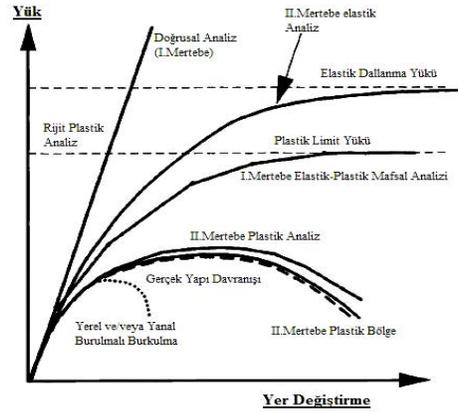
Sünek yapılarda elastik ötesi idealleştirme Şekil 3’ de gösterildiği gibidir. Şekilde yer alan  $f_e$ ; maksimum kuvvet,  $f_y$ ; dayanım kuvveti,  $f_d$ ; tasarım kuvvetini,  $u_d$ ; tasarım yer değiştirmeyi,  $u_y$ ; dayanım kuvvetine karşılık gelen yer değiştirmeyi,  $u_e$ ; elastik yer değiştirmeyi,  $u_{mak}$ ; yapının maksimum yapacağı yer değiştirmeyi simgelemektedir.

Süneklik;  $\mu = \frac{u_{mak}}{u_y}$ , dayanım fazlalığı;  $D = \frac{f_y}{f_d}$ , taşıyıcı sistem davranış katsayısı;  $R = \mu \cdot D$  bağıntılarıyla hesaplanırlar.



Şekil 3: Çelik yapıda elastik ötesi idealleştirilmiş davranış

Çelik yapılar, maruz kaldıkları yükler altında doğrusal olmayan davranış sergilerler. Bu davranışlarını ifade edebilmek için farklı çözüm yöntemleri kullanılmaktadır. Gerçeğe en yakın yapı davranışını saptayabilmek için ikinci mertebeli plastik çözümleme yapılması gerekmektedir. Çeşitli analizlerin gerçek yapı davranışına yakınsaklıkları Şekil 4 deki gibidir. Şekil 4’de kesikli çizgi, gerçek yapı davranışını temsil etmektedir.



Şekil 4: Çeşitli analiz yöntemleri ve gerçek yapı davranışı(Chan,200)

Plastik mafsall, doğrusal olmayan çözümlemede kesit modelinin davranışını temsil etmektedir. Davranışın tanımlanması için iki farklı kullanım yaklaşımı vardır;

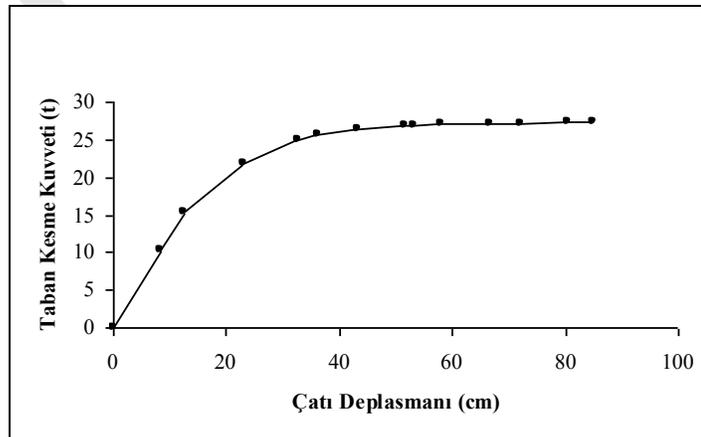
**Yayıllı plastik mafsall:** yapı sistemlerindeki taşıyıcı elemanların yüklere maruz kalması sonucu oluşan akmanın eleman boyunca gerçekleştiği varsayımı yapılır.

**Yoğunlaştırılmış plastik mafsall:** yapı sistemlerindeki taşıyıcı elemanların yüklere maruz kalması sonucu oluşan akmanın elemanın bir noktasında meydana geldiği varsayımı yapılır.

Yatay yükler altında yeteri kadar süneklik gösteren sistemlerde doğrusal olmayan şekil değiştirmelerin plastik mafsall adı verilen belirli kesitlerde toplandığı, bunun dışındaki bölgelerde sistemin doğrusal elastik olarak davrandığı kabul edilir. Bu hipoteze *plastik mafsall hipotezi* denir. Bu kabulün yapılabilmesi için plastik deformasyonların toplandığı bölge çok büyük olmamalıdır. Plastik analiz, ele alınan yapı sistemindeki yapısal elemanlara ait kesit zorlarının malzemenin gerilme-şekil değiştirme eğrisinde bulunan doğrusal bölge dışındaki kısmına yük taşıtılması durumunda yapılan çözümlemedir(Alıcıoğlu 2011).

## Sonlu Eleman Modellemeleri

Yapının doğrusal olmayan çözümlemesinde ilk önce düşey yüklerin analizi gerçekleşir ve bu analiz sonrasında şekil 5’de görülen yapı elemanlarına ait taban kesme kuvvet – çatı yer değiştirmesi değeri çiftleri bulunur. Yatay yük etkisindeki analiz ise, bu gerilmeli durumun sonrasında gerçekleştirilir. Yatay yük her adımda bir miktar artırılarak yapıda deformasyonlar oluşturulur. Bu çözümleme neticesinde Şekil 6’da gösterilen toplam taban kesme kuvvet – çatı yer değiştirmesi değeri çiftleri hesaplanır.



Şekil 5: Düzlem çerçevenin push-over eğrisi

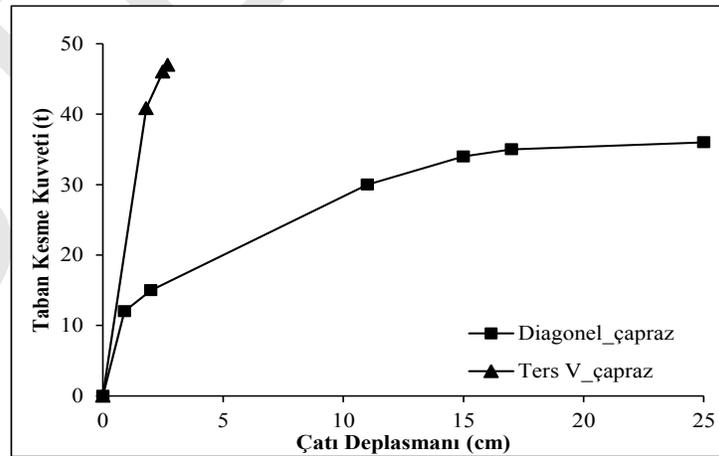
Tablo 1'de çapraz ilave edilmemiş çerçevenin her bir elemanında oluşan kuvvetler ve hasar parametreleri gösterilmiştir.

**Tablo1:** Düzlem çerçevenin mafsallaşma bilgileri

| Eleman        | P (ton) | Plastik $U_1$ (cm) | $M_3$ (tcm) | Plastik $R_3$ (rad) | Karakter P-M | Hasar (FEMA) |
|---------------|---------|--------------------|-------------|---------------------|--------------|--------------|
| Kolon 1 (Alt) | -18.36  | -0.0164            | 1919.89     | 0.0396              | Basınç-Çekme | $\geq$ GK    |
| Kolon 6 (Alt) | -32.97  | -0.0623            | 1749.86     | 0.0427              | Basınç-Çekme | $\geq$ GK    |
| Kiriş 1 (Sol) | ---     | ---                | 1039.35     | 0.0296              | Çekme        | AY - CG      |
| Kiriş 1 (Sağ) | ---     | ---                | -1091.33    | -0.0515             | Basınç       | AY - CG      |
| Kiriş 2 (Sol) | ---     | ---                | 1028.72     | 0.0288              | Çekme        | AY - CG      |
| Kiriş 2 (Sağ) | ---     | ---                | -1082.56    | -0.0478             | Basınç       | AY - CG      |
| Kiriş 3 (Sol) | ---     | ---                | 1051.31     | 0.0347              | Çekme        | AY - CG      |
| Kiriş 3 (Sağ) | ---     | ---                | -1107.49    | -0.0595             | Basınç       | AY - CG      |
| Kiriş 4 (Sol) | ---     | ---                | 1043.31     | 0.0313              | Çekme        | AY - CG      |
| Kiriş 4 (Sağ) | ---     | ---                | -1094.09    | -0.0526             | Basınç       | AY - CG      |
| Kiriş 5 (Sol) | ---     | ---                | 1014.24     | 0.0191              | Çekme        | AY - CG      |
| Kiriş 5 (Sağ) | ---     | ---                | -1064.01    | -0.0403             | Basınç       | AY - CG      |

Tablo 1'de yer alan hasar sütunu, FEMA' da bulunan hasar sınır değerlerini göstermektedir. Buradaki AY: Ani yüklemenin kısaltması olup, minimum hasar olduğunu işaret etmektedir. CG: Can güvenliğinin kısaltması olup, orta derecede hasar olduğunu işaret etmektedir. GK: Göçmenin korunması kısaltması olup, ileri derecede hasarı işaret etmektedir. FEMA 356' da bu hasar seviyeleri çekme karakteri için AY 0.25, CG 7, GK 9; basınç karakteri için AY -0.25, CG -4, GK -6 olarak tanımlanmıştır(FEMA,2000).

Çerçevelerin doğrusal olmayan statik analizinin gerçekleştirilebilmesi için bir yan yük şablonu tanımlanmalıdır. Bunun için modal analizden yararlanılmıştır. Yan yük şablonu olarak x yönü hâkim periyoduna karşı gelen yapı mod şekilleri çapraz yapılmış sistemde 0.224, diagonal çapraz yapılmış sistemde 0.086, ters V uygulanmış çerçevede periyot 0.064 olarak bulunmuştur



**Şekil 6:** Diagonalin ve Ters V çapraz türlerinin taban kesme kuvveti- çatı deplasman değerleri

Analizler sonucu elde edilen veriler ışığında, perde tertiplerinin ve kullanılan diyagonal en kesitlerinin yapı performansına etkileri karşılaştırılmıştır. Yapı performans eğrileri elde edilmiştir. Bu eğriler altında kalan alan

yapının sönümlediği enerji miktarını göstermektedir. Bu alan ne kadar büyük olursa yapı o kadar fazla enerji sönümlenmektedir. Şekil 6'da yapısal düzensizliği olan çerçeve, farklı perde türleri için kıyaslanmıştır. Tablo 2 ve Tablo 3'de çaprazlı sistemlerin çapraz ilave edilmiş çerçevenin her bir elemanında oluşan kuvvetler ve hasar parametreleri gösterilmiştir.

**Tablo 2:** Diagonal çaprazlı çerçevenin mafsallaşma bilgileri

| Eleman            | P (ton) | Plastik $U_1$ (cm) | $M_3$ (tcm) | Plastik $R_3$ (rad) | Karakter P-M | Hasar (FEMA) |
|-------------------|---------|--------------------|-------------|---------------------|--------------|--------------|
| Kolon 1 (Alt)     | -2.38   | 0.00               | 1805.90     | 0.0145              | Basınç-Çekme | AY - CG      |
| Kolon 3 (Üst)     | 2.93    | 0.0009             | -1652.66    | -0.0002             | Çekme-Basınç | $\leq$ AY    |
| Kolon 6 (Alt)     | -44.41  | -0.03              | 1705.72     | 0.0158              | Basınç-Çekme | $\geq$ GK    |
| Kiriş 1 (Sol)     | ---     | ---                | 963.96      | 0.0005              | Çekme        | $\leq$ AY    |
| Kiriş 1 (Sağ)     | ---     | ---                | -1026.94    | -0.0244             | Basınç       | AY - CG      |
| Kiriş 2 (Sol)     | ---     | ---                | 966.84      | 0.0000              | Çekme        | $\leq$ AY    |
| Kiriş 2 (Sağ)     | ---     | ---                | -1021.58    | -0.0224             | Basınç       | AY - CG      |
| Kiriş 3 (Sağ)     | ---     | ---                | -993.32     | -0.0141             | Basınç       | AY - CG      |
| Diyagonal 1 (Üst) | -7.48   | -3.12              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 1 (Alt) | -7.54   | -3.10              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 2 (Üst) | -6.76   | -3.67              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 2 (Alt) | -6.83   | -3.65              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 3 (Üst) | -7.08   | -3.12              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 3 (Alt) | -7.15   | -3.10              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 4 (Üst) | -9.42   | -1.63              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 4 (Alt) | -9.48   | -1.62              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 5 (Üst) | -11.27  | -0.20              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 5 (Alt) | -11.34  | -0.20              | ---         | ---                 | Basınç       | $\geq$ GK    |

Sonlu eleman ile yapılan çözümlemede çerçeve geometrileri oluşturulmuş ve düşey yüklemeler tanımlanmıştır. Yapı elemanları için plastik kesit tanımlamaları yapılmıştır. bu tanımlamada kirişlerin eğilme momenti ( $M_3$ ) etkisinde, kolonların aksel yük ve eğilme momenti (P- $M_3$ ) etkisinde, perde elemanların ise aksel yük (P) etkisinde mafsallaşacağı ön görülmüştür.

**Tablo 3:** Ters V çaprazlı çerçevenin mafsallaşma bilgileri

| Eleman            | P (ton) | Plastik $U_1$ (cm) | $M_3$ (tcm) | Plastik $R_3$ (rad) | Karakter P-M | Hasar (FEMA) |
|-------------------|---------|--------------------|-------------|---------------------|--------------|--------------|
| Diyagonal 2 (Üst) | -28.39  | -0.17              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 2 (Alt) | -28.46  | -0.17              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 4 (Üst) | -28.75  | -0.10              | ---         | ---                 | Basınç       | $\geq$ GK    |
| Diyagonal 4 (Alt) | -28.82  | -0.10              | ---         | ---                 | Basınç       | $\geq$ GK    |

## Sonuçlar

Çelik yapılarda yapı davranışını olumlu yönde iyileştirmek ve yan yükler altında performansını arttırmak amacı ile çelik perde kullanımı oldukça önemlidir. Çelik perde tertibi ve perdede kullanılacak kesit geometrisi yapı davranışını önemli ölçüde değiştirmektedir. Bu nedenle yapıyı oluşturan çerçeveler göz önüne alınarak hem perde tertibi hem de perde profil kesiti seçimi önem taşımaktadır.

Analizler sonucu elde edilen veriler ışığında, kullanılan dairesel en kesit ile oluşturulan diagonal ve ters V perde türlerinin yapı performansına etkileri karşılaştırılmıştır. Bu eğriler altında kalan alan yapının sönümlediği enerji miktarını göstermektedir. Bu alan ne kadar büyük olursa yapı o kadar fazla enerji sönümlemektedir. Aynı enkesite sahip farklı perde türleri bu kriter de göz önüne alınarak kıyaslanmıştır.

Elastik sınır durumundaki maksimum deplasman kıstas alındığında;

- Perde teşkili daire kesitli diyagonal seçilmesi durumunda elastik sınır 0.90 cm olarak hesaplanmıştır.
- Perde teşkili daire kesitli ters V seçilmesi durumunda elastik sınır 1.88 cm olarak hesaplanmıştır.
- Perde teşkili dairesel kesitli diagonal seçilmesi durumunda çerçeve en esnek davranışa sahip olmaktadır.
- Perde teşkili dairesel kesitli ters V seçilmesi durumunda çerçeve rijit davranışa sahip olmaktadır.

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# DYNAMIC FEEDBACK LINEARIZATION STRATEGY BASED LUNBERGER OBSERVER FOR A 6 DOF QUADROTOR HELICOPTER IN VERTICAL FLIGHT

ZEGHLACHE Samir <sup>(1)</sup>, SAIGAA Djamel <sup>(1)</sup>, KARA Kamel <sup>(2)</sup>, BOUGUERRA Abderrahmen (1)

<sup>(1)</sup> Department of Electronics, Faculty of Technology, University of Msila BP 166 Ichbilia 28000 Algeria

<sup>(2)</sup> Department of Electronics, Faculty of Engineering Sciences, University of Blida, Algeria

zeglache\_samir@yahoo.fr, saigaa\_dj@yahoo.fr

**Abstract-** In this work, we propose a multi-input multi-output feedback linearization based controller for a quadrotor helicopter. Contrary to the proposed controllers in the literature, where feedback linearization is applied to the Quadrotor in SISO form to deal with each one of its subsystems, the proposed controller considers the problem as a MIMO control design. Since the control matrix is singular, dynamic feedback linearization is used to compute the control laws. Furthermore, to alleviate the constraint of states measurement, in this work, only the outputs are considered available for measurable. Stability of the closed loop is guaranteed along with achieving excellent performance which is shown by simulation.

**Keywords**— feedback linearization, quadrotor, Dynamic modelling

## 1 Introduction

Autonomous Unmanned Air vehicles (UAV) are increasingly popular platforms, due to their use in military applications, traffic surveillance, environment exploration, structure inspection, mapping and aerial cinematography, in which risks to pilots are often high. Rotorcraft has an evident advantage over fixed-wing aircraft for various applications because of their vertical landing/take-off capability and payload. Among the rotorcraft, quadrotor helicopters can usually afford a larger payload than conventional helicopters due to four rotors. Moreover, small quadrotor helicopters possess a great maneuverability and are potentially simpler to manufacture. For these advantages, quadrotor helicopters have received much interest in UAV research [1].

The quadrotor is an underactuated system with six outputs and four inputs, and the states are highly coupled. Many efforts have been made to control quadrotor helicopter and some strategies have been developed to solve the path following problems for this type of systems. In [2], the quadrotor has been controlled in 3 DOF by classical independent PD controllers. In [3] the authors developed a PID controller in order to stabilize altitude and in [4] a PID controller and a LQ controller were proposed to stabilize the attitude. The PID controller showed the ability to control the attitude in the presence of minor perturbation and the LQ controller provided average results. In [5], the authors proposed a combination of the backstepping technique and a nonlinear robust PI controller. The integral action gain is nonlinear and based on a switching function that ensures a robust behaviour for the overall control law. In [6], a Backstepping Fuzzy Logic controller and Backstepping Least Mean Square controller as new approaches to control the attitude stabilization of Quadrotor were presented.

Many backstepping based and feedback linearization based controllers have been developed to control the quadrotor in 6 DOF. In [7, 8] a full-state backstepping technique based on the Lyapunov stability is presented. In [9] presented the Backstepping Approach for Controlling a quadrotor Using Lagrange Form Dynamics In addition, two neural networks are introduced to estimate the aerodynamic components, one for aerodynamic forces and the other for aerodynamic moments. In [10] a mixed robust feedback linearization with linear  $GH^\infty$  controller is proposed. In [11] the control strategy included feedback linearization coupled with a PD controller for the translational subsystem and a backstepping-based PID nonlinear controller for the rotational subsystem of the quadrotor. A robust adaptive-fuzzy control is proposed in [12]. This controller showed good performance against sinusoidal wind disturbance. In [13] an integral predictive and nonlinear  $H^\infty$  control strategy to solve the path following problem for a quadrotor helicopter is presented.

Contrary to the controllers of the Quadrotor proposed in the literature, where multiple SISO feedback linearization based controllers were developed, in this work, we present a MIMO feedback linearization controller. Since control matrix is singular, dynamic feedback linearization controller is derived. Furthermore, to alleviate the constraint of states measurement, in this work, only the outputs of the Quadrotor are considered available for measurement. This paper is structured as follows: In Section 2, the operating principle of the Quadrotor and its dynamic equations are presented. In Section 3, a feedback linearization controller is designed. Section 4 presents an observer design to estimate unmeasured states. Simulation results are given in Section 5, and Section 6 concludes paper.

## 2 Quadrotors Dynamics Modeling

In this section we will describe the dynamical model for the quadrotor mini aircraft using the Euler-Lagrange approach, a sketch of the quadrotor rotorcraft system studied in this study is shown in Fig. 1, where the Euler angles and the cartesian coordinate frame are shown. The equations of motion are given in (1) and the values of some variables seen are tabulated in Table. 1 [14]

Let  $E(O, X, Y, Z)$  denote an inertial frame, and  $B(O', x, y, z)$  denote a frame rigidly attached to the quadrotor

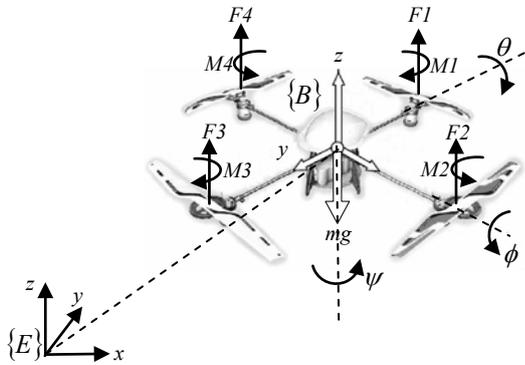


Fig 1 General view of the quadrotor

We will make the following assumptions:

- The quadrotor structure is rigid and symmetrical.
- The center of mass and 'o' coincides.
- The propellers are rigid.
- Thrust and drag are proportional to the square of the propellers speed.

$$\begin{cases} m \ddot{x} = -u \sin(\theta) \\ m \ddot{y} = -u \sin(\theta) \sin(\phi) \\ m \ddot{z} = -u \cos(\theta) \cos(\phi) - mg \end{cases} \quad (1)$$

$$\tau = J\ddot{\eta} + \dot{J}\dot{\eta} + J\dot{\eta} \times J\dot{\eta} \quad (2)$$

Where

$$\eta^T = (\psi \ \theta \ \phi) \quad (3)$$

$$\tau = [\tau_\phi \ \tau_\theta \ \tau_\psi]^T \quad (4)$$

If we apply the properties of vector of product to (2) we obtain

$$\tau = J\ddot{\eta} + \dot{J}\dot{\eta} \quad (5)$$

Where

$$J = I W \quad (6)$$

$$J = \begin{bmatrix} I_{xx} & 0 & 0 \\ 0 & I_{yy} & 0 \\ 0 & 0 & I_{zz} \end{bmatrix} \begin{bmatrix} 0 & -\sin(\psi) & \cos(\psi)\cos(\theta) \\ 0 & \cos(\psi) & \sin(\psi)\cos(\theta) \\ 1 & 0 & -\sin(\theta) \end{bmatrix} \quad (7)$$

For simplicity we consider the matrix  $I$  in (7) as unit matrix, i.e.

$$I = \text{diag}(1,1,1) \quad (8)$$

Where

$$I_{xx} = I_{yy} = I_{zz} = 1 \text{ kg } m^2 \quad (9)$$

From (5), we have

$$\ddot{\eta} = J^{-1}(\tau - \dot{J}\dot{\eta}) \quad (10)$$

We can regroup the three dynamics in (7) and (10) as:

$$\begin{cases} \ddot{\psi} = \dot{\theta} \operatorname{tg}(\theta) + \dot{\varphi} \frac{1}{\cos(\theta)} + \tau_{\varphi} \operatorname{tg}(\theta) \sin(\psi) + \tau_{\theta} \operatorname{tg}(\theta) \sin(\psi) + \tau_{\psi} \\ \ddot{\theta} = -\dot{\varphi} \cos(\theta) - \tau_{\varphi} \sin(\psi) + \tau_{\theta} \cos(\psi) \\ \ddot{\varphi} = -\dot{\theta} \frac{1}{\cos(\theta)} + \dot{\psi} \operatorname{tg}(\theta) + \tau_{\varphi} \frac{\cos(\psi)}{\cos(\theta)} + \tau_{\theta} \frac{\sin(\psi)}{\cos(\theta)} \end{cases} \quad (11)$$

$$f_i = k_i \omega_i^2 \quad \forall i = 1, 2, 3 \quad (12)$$

$f_i$  is the thrust generated by the  $i$ -th motor,  $k_i > 0$  is a constant and  $\omega_i$  is the angular speed of motor  $i$ .

|       |   |              |
|-------|---|--------------|
| $m_i$ | Motor weight                                  | 0.08 kg      |
| $m_b$ | Battery weight                                | 0.20 kg      |
| $m$   | Total weight of the quadrotor                 | 0.52 kg      |
| $l$   | Distance from motors to the centre of gravity | 0.205 kg     |
| $g$   | Gravitational acceleration                    | 9.81 $m/s^2$ |

**Table 1** Physical parameters of the quadrotor

Then the equations represented in (1) can be rewritten in vector form as (13)

$$\ddot{X} = D(X) + E(X)U \quad (13)$$

With  $X = [x, y, z, \varphi, \theta, \psi]^T$  and  $U = [u, \tilde{\tau}_{\varphi}, \tilde{\tau}_{\theta}, \tilde{\tau}_{\psi}]^T$

$$\ddot{X} = \begin{bmatrix} 0 \\ 0 \\ -g \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} -\frac{1}{m} \sin(\theta) & 0 & 0 & 0 \\ \frac{1}{m} \cos(\theta) \sin(\varphi) & 0 & 0 & 0 \\ \frac{1}{m} \cos(\theta) \cos(\varphi) & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} U \quad (14)$$

### 3 Feedback Linearization Control Strategy

The objective of this section is to review the techniques that can be applied to develop a nonlinear controller for the quadrotor system. The technique is based on the construction of a nonlinear inverse dynamic controller described in [15], for a system of the form:

$$\dot{X} = f(X) + g(X)U \quad (15)$$

$$Y = H(X) \quad (16)$$

Where  $f(X)$  and  $g(X)$  are vector fields in  $R^n$ ,  $U$  is the input and  $Y$  is the output.

The control design process is to find an integer  $\rho$  and a state feedback

$$U = \alpha(X) + \beta(X)V \quad (17)$$

Where  $V$  is a new control variable,  $\alpha$  and  $\beta$  are smooth functions defined in a neighborhood of some point  $x_0 \in R^n$  and  $\beta(x_0) \neq 0$  such that the closed loop system (15), (16) and (17)

$$\dot{X} = f(X) + g(X)(\alpha(X) + \beta(X)V) \quad (18)$$

has the property that the  $\rho$ -th-order derivative of the output is given by:

$$y^{\rho} = V, \quad t \in \Gamma \quad (19)$$

Where  $\Gamma$  is an open interval containing  $t=0$ . This problem is termed as (local) input-output feedback linearization. The point  $x_0$  around which the linearization is performed is called the analysis point. The above idea can be implemented by successively differentiating the output  $Y = H(X)$  as

$$Y^0 = H(X) \quad (20)$$

$$Y^{(1)} = L_f H(X) \quad (21)$$

$$\begin{aligned} & \vdots \\ Y^{\rho-1} &= L_f^{\rho-1} H(X) \end{aligned} \quad (22)$$

$$Y^{\rho-1} = L_f^{\rho} H(X) + L_g L_f^{\rho-1} H(X) U \quad (23)$$

Where  $L_f^k H(X)$  is called the Lie derivative of  $L_f^{k-1} H(X)$  along the vector field  $f$ . Note that by choosing the control  $U$  in (23) as

$$U = \frac{V - L_f^{\rho} H(X)}{L_g L_f^{\rho-1} H(X)} \quad (24)$$

and provided that the integer  $\rho$  exists and  $L_g L_f^{\rho-1} H(X)$  in the neighborhood of  $x_0$  equation (19) can easily obtained. In this case the system has a relative degree in the neighborhood of  $x_0$ . The functions  $\alpha(x)$  and  $\beta(x)$  of equation (17) can be obtained directly from equation (24) as

$$\alpha(x) = -\frac{L_f^{\rho} H(X)}{L_g L_f^{\rho-1} H(X)} \quad (25)$$

$$\beta(x) = -\frac{1}{L_g L_f^{\rho-1} H(X)} \quad (26)$$

From equation (19), we see that the inversion-based control law (24) has the capability in shaping the output response by simply designing the new control  $V$  to get the desired output. However, since the inversion-based control law is only based on the system's input-output dynamics, it may fail to result in a stable closed-loop system. This can happen if the controlled system is non-minimum phase. The quadrotor output dynamic can placed in state space as equation (17). Note that the matrix multiplying the control  $U = [u, \tilde{\tau}_{\phi}, \tilde{\tau}_{\theta}, \tilde{\tau}_{\psi}]^T$  is singular which implies that there is no static state feedback that will linearize (14). In this case we must use dynamic inversion and this can be achieved by dynamic extension or simply by placing two integrator before  $u$  input. Thus differentiating equation (1) two more times we obtain the following output dynamics for the quadrotor:

$$\begin{bmatrix} \ddot{x}^{(4)} \\ \ddot{y}^{(4)} \\ \ddot{z}^{(4)} \\ \ddot{\psi} \end{bmatrix} = \begin{bmatrix} \left(\frac{1}{m}\right) 2\dot{u}\dot{\theta}\cos\theta - \left(\frac{1}{m}\right) u\dot{\theta}^2\sin\theta \\ -\left(\frac{1}{m}\right) \dot{u}\dot{\theta}\sin\theta\sin\phi - \left(\frac{1}{m}\right) \dot{u}\dot{\theta}\sin\theta\cos\phi + \left(\frac{1}{m}\right) 2\dot{u}\dot{\phi}\cos\theta\cos\phi - \left(\frac{1}{m}\right) u\dot{\phi}^2\sin\phi\cos\theta \\ -\left(\frac{1}{m}\right) 2\dot{u}\dot{\theta}\sin\theta\cos\phi - \left(\frac{1}{m}\right) 2\dot{u}\dot{\phi}\cos\theta\sin\phi + \left(\frac{1}{m}\right) 2u\dot{\phi}\dot{\theta}\sin\theta\sin\phi - \left(\frac{1}{m}\right) u(\dot{\theta}^2 + \dot{\phi}^2)\cos\theta\cos\phi \\ 0 \end{bmatrix} +$$

$$\begin{bmatrix} \left(\frac{1}{m}\right) \sin\theta & \left(\frac{1}{m}\right) u \cos\theta & 0 & 0 \\ -\left(\frac{1}{m}\right) \cos\theta\sin\phi & 0 & \left(\frac{1}{m}\right) u \cos\phi\cos\theta & 0 \\ \left(\frac{1}{m}\right) \cos\theta\cos\phi & \left(\frac{1}{m}\right) u \sin\theta\cos\phi & \left(\frac{1}{m}\right) u \cos\theta\sin\phi & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^{-1} \begin{bmatrix} \ddot{u} \\ \tilde{\tau}_{\phi} \\ \tilde{\tau}_{\theta} \\ \tilde{\tau}_{\psi} \end{bmatrix} \quad (27)$$

$$\begin{bmatrix} \ddot{u} \\ \tilde{\tau}_{\phi} \\ \tilde{\tau}_{\theta} \\ \tilde{\tau}_{\psi} \end{bmatrix} = \begin{bmatrix} -\left(\frac{1}{m}\right) \sin\theta & -\left(\frac{1}{m}\right) u \cos\theta & 0 & 0 \\ -\left(\frac{1}{m}\right) \cos\theta\sin\phi & 0 & -\left(\frac{1}{m}\right) u \cos\phi\cos\theta & 0 \\ \left(\frac{1}{m}\right) \cos\theta\cos\phi & -\left(\frac{1}{m}\right) u \sin\theta\cos\phi & -\left(\frac{1}{m}\right) u \cos\theta\sin\phi & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^{-1}$$

$$\begin{bmatrix} \left(\frac{1}{m}\right) (2\dot{u}\dot{\theta}\cos\theta - u\dot{\theta}^2\sin\theta) + V_1 \\ \left(\frac{1}{m}\right) (-\dot{u}\dot{\theta}\sin\theta\sin\phi - \dot{u}\dot{\theta}\sin\theta\cos\phi + 2\dot{u}\dot{\phi}\cos\theta\cos\phi - u\dot{\phi}^2\sin\phi\cos\theta) + V_2 \\ \left(\frac{1}{m}\right) (-2\dot{u}\dot{\theta}\sin\theta\cos\phi - 2\dot{u}\dot{\phi}\cos\theta\sin\phi + 2u\dot{\phi}\dot{\theta}\sin\theta\sin\phi - u(\dot{\theta}^2 + \dot{\phi}^2)\cos\theta\cos\phi) + V_3 \\ 0 \end{bmatrix} \quad (28)$$

We define an extended system which includes an additional input  $\ddot{u}$ , then the control inputs generated by the  $x - y - z$  controller are  $[\ddot{u}, \tilde{\tau}_{\phi}, \tilde{\tau}_{\theta}]^T$ . The control inputs are defined as (28) using pseudo inputs  $[v_1, v_2, v_3]$ . Setting the pseudo input terms as:

$$v_1 = x_d^{(4)} - k_{x1} e_x^{(3)} - k_{x2} \ddot{e}_x - k_{x3} \dot{e}_x - k_{x4} e_x \quad (29)$$

$$v_2 = y_d^{(4)} - k_{y1} e_y^{(3)} - k_{y2} \ddot{e}_y - k_{y3} \dot{e}_y - k_{y4} e_y \quad (30)$$

$$v_3 = z_d^{(4)} - k_{z1} e_z^{(3)} - k_{z2} \ddot{e}_z - k_{z3} \dot{e}_z - k_{z4} e_z \quad (31)$$

Where  $e_x = x - x_d$ ,  $e_y = y - y_d$ ,  $e_z = z - z_d$  We can choose gains  $[k_{x1}, \dots, k_{x4}]$ ,  $[k_{y1}, \dots, k_{y4}]$ ,  $[k_{z1}, \dots, k_{z4}]$  to obtain stable error dynamics for the simplified system. And the  $\psi$  controller is a PD controller:

$$\tilde{\tau}_\psi = \psi_d + k_{\psi 1} (\ddot{\psi}_d - \ddot{\psi}) + k_{\psi 2} (\dot{\psi}_d - \dot{\psi}) \quad (32)$$

Where  $k_{\psi 1}$  and  $k_{\psi 2}$  are derivative and proportional gains, respectively.

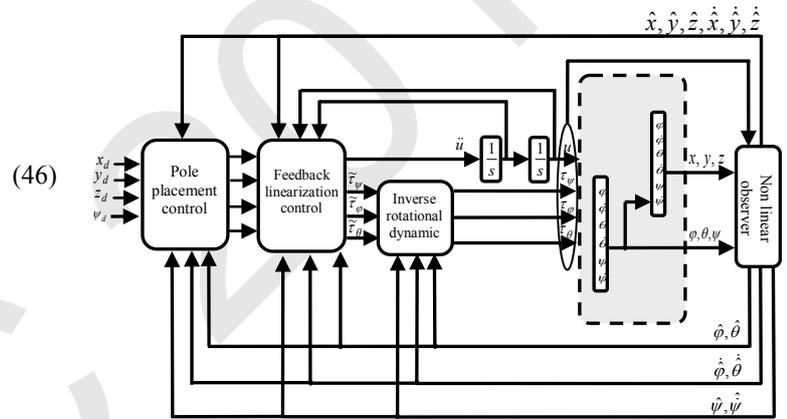
#### 4 Observer Design

The computation of the control input requires the knowledge of the angular velocities  $[\dot{\psi}, \dot{\theta}, \dot{\phi}]$  and linear velocities  $[\dot{x}, \dot{y}, \dot{z}]$ . The angular and linear velocities will be estimated using a non linear observer, consider the model system (34) and denote the  $\hat{X}$  estimate of the state vector (33) and the considered output of our system are:

$$Y = [x_1, x_3, x_7, x_9, x_{11}] \quad (45)$$

The observer model is a copy of the original system, which has corrector gains functions of estimation errors; so:

$$(46) \quad \begin{cases} \dot{\hat{x}}_1 = \hat{x}_2 + k_{11}(x_1 - \hat{x}_1) \\ \dot{\hat{x}}_2 = -\frac{1}{m} \sin x_9 + k_{12}(x_1 - \hat{x}_1) \\ \dot{\hat{x}}_3 = x_4 + k_{21}(x_3 - \hat{x}_3) \\ \dot{\hat{x}}_4 = \frac{1}{m} \cos x_9 \sin x_{11} + k_{22}(x_3 - \hat{x}_3) \\ \dot{\hat{x}}_5 = x_6 + k_{31}(x_5 - \hat{x}_5) \\ \dot{\hat{x}}_6 = \frac{1}{m} \cos x_9 \cos x_{11} - g + k_{32}(x_5 - \hat{x}_5) \\ \dot{\hat{x}}_7 = x_8 + k_{41}(x_7 - \hat{x}_7) \\ \dot{\hat{x}}_8 = \tau_\psi + k_{42}(x_7 - \hat{x}_7) \\ \dot{\hat{x}}_9 = x_{10} + k_{52}(x_9 - \hat{x}_9) \\ \dot{\hat{x}}_{10} = \tau_\theta + k_{53}(x_9 - \hat{x}_9) \\ \dot{\hat{x}}_{11} = x_{12} + k_{61}(x_{11} - \hat{x}_{11}) \\ \dot{\hat{x}}_{12} = \tau_\phi + k_{62}(x_{11} - \hat{x}_{11}) \end{cases}$$



From (26) and (46) the following representation for the estimation error is defined as  $e = X - \hat{X}$  follows:

$$\dot{e} = A e \quad (47)$$

Where

$$A = \begin{bmatrix} -k_{11} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -k_{12} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -k_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -k_{22} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -k_{31} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -k_{32} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -k_{41} & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -k_{42} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -k_{52} & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -k_{53} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -k_{61} & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -k_{62} & 0 \end{bmatrix}$$

$$e = [e_1 \ e_2 \ e_3 \ e_4 \ e_5 \ e_6 \ e_8 \ e_9 \ e_{10} \ e_{11} \ e_{12}]$$

$$e = [x_1 - \hat{x}_1 \ x_2 - \hat{x}_2 \ x_3 - \hat{x}_3 \ x_4 - \hat{x}_4 \ x_5 - \hat{x}_5 \ x_6 - \hat{x}_6 \ x_7 - \hat{x}_7 \ x_8 - \hat{x}_8 \ x_9 - \hat{x}_9 \ x_{10} - \hat{x}_{10} \ x_{11} - \hat{x}_{11} \ x_{12} - \hat{x}_{12}] \quad (48)$$

The characteristic polynomial of the matrix  $A$  is

$$\det(SI - A) = (k_{12} + k_{11}s + s^2)(k_{22} + k_{21}s + s^2)(k_{32} + k_{31}s + s^2) (k_{42} + k_{41}s + s^2)(k_{53} + k_{52}s + s^2)(k_{62} + k_{61}s + s^2) \quad (49)$$

The positive values  $k_{ij} > 0$ , for  $i, j = 1, 2, 3, 4, 5, 6$  are chosen such that  $e \rightarrow 0$  exponentially. There is a trade-off in the choice of the observer parameters  $k_{ij}$  between convergence speed of the estimation error  $e$  to zero and robustness with respect to disturbances.

The framework of the quadrotor control system with the proposed feedback linearization is presented in Fig.7.

Fig.2 Quadrotor helicopter control structure.

## 5 Simulation results

To show the performance of the proposed approach, the corresponding algorithm is implemented in simulation for the position and attitude dynamic of the quadrotor UAV. The results obtained for the attitude and position stabilization of the mini aircraft are given in the Fig.3 to Fig.8. One can see that, the controller based non linear observer ensures a good convergence and good estimation of the unmeasured states in infinite time.

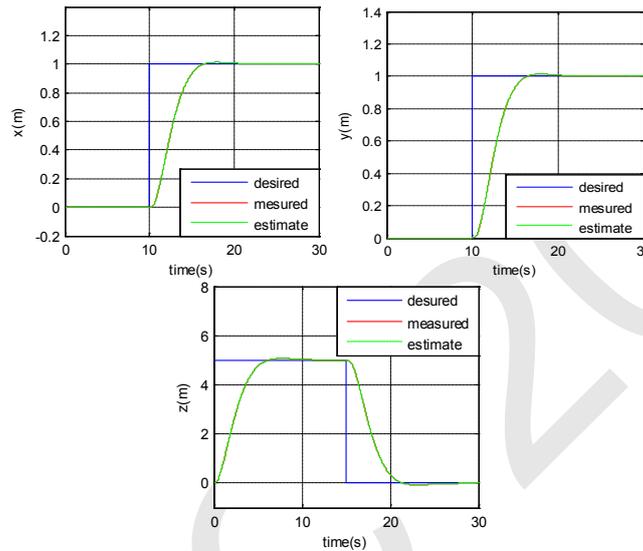


Fig 3 Tracking simulation results of desired trajectories along (X,Y,Z) axis

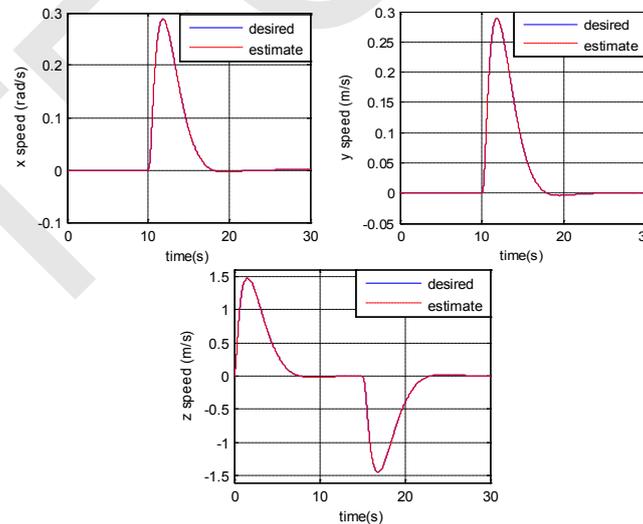
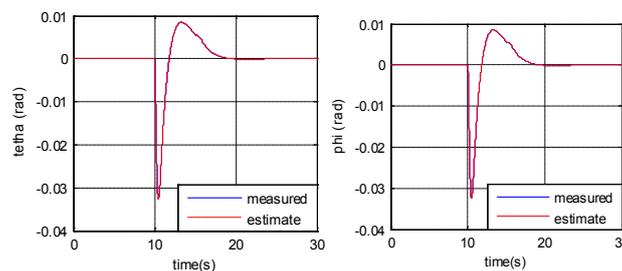
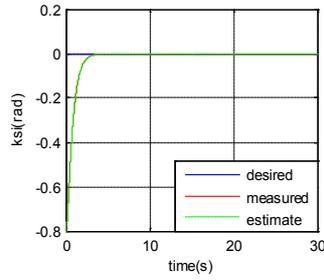
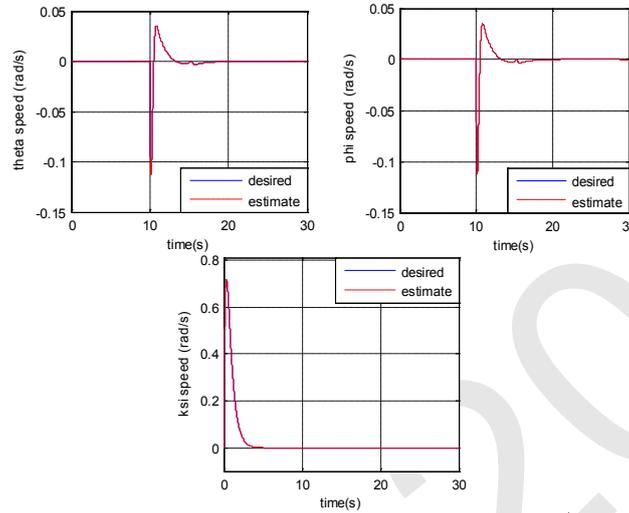


Fig 4 Tracking simulation results of linear velocities  $(\dot{x}, \dot{y}, \dot{z})$

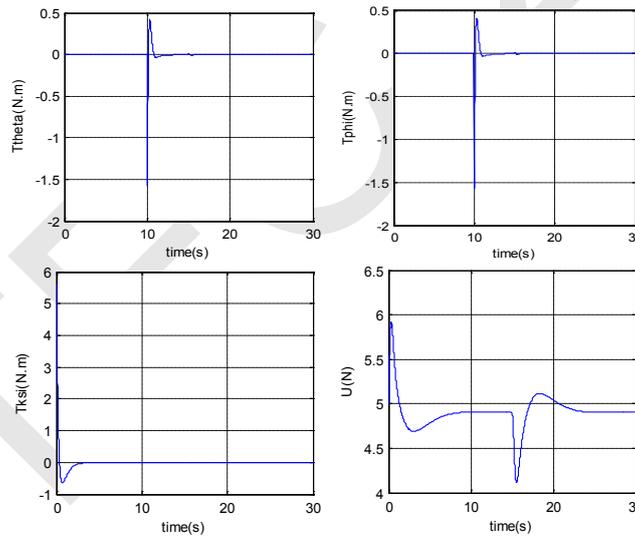




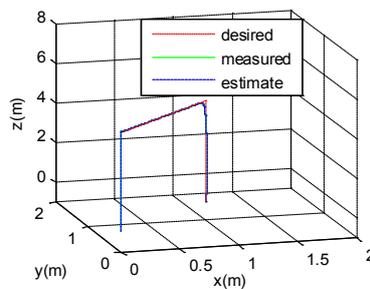
**Fig 5** Tracking simulation results of desired trajectories along axis  $(\theta, \phi, \psi)$



**Fig 6** Tracking simulation results of angular velocities  $(\dot{\theta}, \dot{\phi}, \dot{\psi})$



**Fig 7** Control response of a quadrotor helicopter



**Fig 8** Global trajectory of the quadrotor

## 6 Conclusion

In this paper, we presented stabilizing control laws synthesis by dynamic feedback linearization. Firstly, we start by the development of the dynamic model of the quadrotor taking into account the different physics phenomena imposed to the system motions; this says these control laws allowed the tracking of the various desired trajectories expressed in term of the center of mass coordinates of the system in spite of the complexity of the proposed model. After we are interested to the development of a nonlinear observer in order to be able to estimate unmeasured states. As prospects we hope to develop other control techniques and other kinds of nonlinear observer in order to improve the performances and to ensure good navigation of such systems in evolutionary and constrained environment.

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# ECONOMIC GROWTH, ENERGY CONSUMPTION, AND CARBON EMISSION IN UNITED ARAB EMIRATES

Aydin Basarir<sup>1</sup> & Hasan Arman<sup>2</sup>

<sup>1</sup>United Arab Emirates University, College of Food and Agriculture, Department of Agribusiness

<sup>2</sup>United Arab Emirates University, College of Science, Department of Geology

**Abstract:** The relationships between economic growth, energy consumption, and environmental pollution have received increasing attention in recent energy, economics and CO<sub>2</sub> emission literature. The United Arab Emirates (UAE) has the world's fifth largest proven reserves of crude oil, and fourth largest reserves of natural gas. The federal economy depends for one third of its Gross Domestic Product (GDP) on petroleum and gas mining downed from 74% in 1980s. The UAE is an oil exporting country and the second largest source of its revenue is re-exports which is roughly one third of total merchandise exports. The manufacturing sector in the country is large and dynamic, largely based on activities in Jebel Ali free zones located in Dubai. The main sources of energy consumed both in industry and personally are petroleum and natural gas. That is why, per capita CO<sub>2</sub> of the country is relatively higher than most of the countries in the world. The main objective of this study is to investigate the existence and direction of Granger causality between economic growth, energy consumption, and CO<sub>2</sub> emissions in the UAE. A dynamic time series model was utilized by using data for 1975-2008 periods. According to results there were unidirectional causal relationships running from energy consumption per capita to CO<sub>2</sub> emission per capita. Evidence shows that there were no cointegration relationships in GDP versus CO<sub>2</sub> and GDP versus Energy. Therefore, the UAE government can pursue environmental and energy conservation policies in the long run without impeding economic growth.

Keywords: GDP, CO<sub>2</sub> Emission, Energy Consumption, Granger Causality, Cointegration.

## Introduction

Energy consumption and environmental pollution are considered two main factors cause global warming and climate change. But on the other hand, there seems to be a strong relationship between energy consumption, environmental pollution and Gross Domestic Product (GDP). Such relationships have attracted many researchers in the recent decades. As living standards increase the energy consumption is expected to increase which causes environmental degradation.

The causal relationship between energy use and economic growth; environmental pollution and economic growth have been considerable research topics in the literature. The researchers generally used the causality test to analyze such relationships both in single country base (Chang, 2010; Hatzigeorgiou, Polatidis, & Haralambopoulos, 2011; Ozturk & Acaravci, 2010; Zhang & Cheng, 2009) and multiple countries bases (Chontanawat, Hunt, & Pierse, 2008; Coondoo & Dinda, 2002).

In addition to the relationship between GDP and energy consumption the researcher such as Shafik & Bandyopadhyay (1992), Panayotou (1993), and Grossman & Krueger (1994) realized a relationship between GDP and environmental pollution and called it Environmental Kuznets Curve (EKG). According to the EKG there is an inverted U-shape relationship between GDP and environmental pollution. Such relationship can be different depending on different levels of economic development and different regions of the world. By using EKG concept the researchers have found different kind of relationship between GDP and environmental pollutions. While some of them found a valid EKG (inverted U-shape) between GDP and environmental pollutions (Esteve & Tamarit, 2011; He & Richard, 2010; Jalil & Mahmud, 2009), some found U-shape (Akboostanci, Turut-Asik, & Tunc, 2009; Friedl & Getzner, 2003) and some others such as Lantz and Feng (2006) found no evidence to support the EKG hypothesis.

Greenhouse gas emission (GHG), mainly CO<sub>2</sub>, pollute environment and are considered to be the main causes of global warming. All economic activities such as production, value adding, distribution, retailing, and etc. need energy consumption and as a result of that GHG occurs and pollute environment. Energy is one of the most important contributors to economic growth but at the same time causes GHG. Several countries signed the Kyoto Protocol and promised to decrease their emission levels. Some researchers (Esteve & Tamarit, 2011; He & Richard,

2010; Jalil & Mahmud, 2009) have proved that initially as per capita income increases environmental degradation intensifies, but at the later levels of economic growth it tends to subside (Kuznet Curve = Inverted U-Shape). They have also shown that the sustainable development can be achieved via efficient energy use (energy conservation) and greener production (decreasing of environmental pollution).

The UAE has the world's fifth largest proven reserves of crude oil, and fourth largest reserves of natural gas reserves. The federal economy depends for one third of its GDP on petroleum and gas mining downed from 74% in 1980s. The UAE is an oil exporting country and the second largest source of its revenue is re-exports which is roughly one third of total merchandise exports. The manufacturing sector in the country is large and dynamic, largely based on activities in Jebel Ali free zones located in Dubai. The main sources of energy consumed both in industry and personally are petroleum and natural gas. That is why, per capita CO<sub>2</sub> of the country is relatively higher than most of the countries in the world (WorldBank, 2012).

Having high values of GDP, energy consumption, and CO<sub>2</sub> emission per capita in the UAE make us to ask the question: *Is it possible to have economic growth while implementing environmental and energy conservation policies in the UAE?*

The authors have found two article in the literature one of which conducted by Al-Iriani (2006) and analyzed the relationship between energy and GDP for GCC countries by using panel causality. According to his results there was a unidirectional causal effect of GDP on energy consumption in GCC countries. The second article was written by Al-Mulali (2012). The factors affecting CO<sub>2</sub> emission were analyzed in 12 Middle Eastern countries by using panel data as well. According to the results of Al-Mulali's study the total primary energy consumption, foreign direct investment net inflows, GDP, and total trade were important factors increasing CO<sub>2</sub> emission. The researchers are not aware of such studies focused on the UAE. As for this study, the relationships between energy consumption and GDP; CO<sub>2</sub> emission and GDP; CO<sub>2</sub> and energy are analyzed by using time series data.

The main objective of this study is to investigate the existence and direction of Granger Causality between economic growth, energy consumption, and carbon emissions in UAE. The Specific objectives are to

- check stationary of time series data,
- analyze cointegration between variables,
- analyze causal relationship in GDP versus CO<sub>2</sub>, GDP versus Energy, and CO<sub>2</sub> versus Energy- emission and to determine the direction of it,
- line up some recommendations to decision makers.

## Materials and Method

Annual time series data for the UAE from 1975 to 2008 was taken from world development indicator database, the World Bank (2012). The real GDP in US dollars according to year 2000 constant prices was converted to the per capita real GDP. The per capita real GDP is used a proxy for economic growth. The proxy of environmental pollution was CO<sub>2</sub> and calculated as metric tons per capita. Per capita energy consumption was measured as kilogram of oil equivalent.

After organizing the data two statistical procedures were followed before conducting Granger Causality test. The first procedure was Stationary and/or Unit Root Test. As defined by Hill et al., "a time series  $y_t$  is stationary if its mean and variance are constant over time, and if the covariance between two values from the series depends only on the length of time separating the two values, and not on the actual times at which the variables are observed" (Hill, Griffiths, Lim, & Adkins, 2008). There are many different tests to check whether a series is stationary or nonstationary. The Phillips-Perron unit root test is one of well-known and used extensively in literature. In this test nonparametric statistical method is used to take care of serial correlations in error terms without adding lagged difference terms (Gujarati, 2003).

$$\text{No constant no trend} \quad \Delta y_{it} = \gamma_i y_{it-1} + v_{it} \quad (1)$$

$$\text{With constant but no trend} \quad \Delta y_{it} = \alpha_i + \gamma_i y_{it-1} + v_{it} \quad (2)$$

$$\text{With constant and with trend} \quad \Delta y_{it} = \alpha_i + \gamma_i y_{it-1} + \lambda_{it} + v_{it} \quad (3)$$

$$H_0: \gamma = 0 \text{ and } H_1: \gamma < 0$$

Where  $y$  stands for GDP per capita ( $i=1$ ) or CO<sub>2</sub> emission per capita ( $i=2$ ) or energy consumption per capita ( $i=3$ ) Phillips-Perron unit root tests were conducted to check if the data are stationary or nonstationary.

Once the time series variables checked for their stationary one can easily conduct cointegration test. As indicated by Hill et al., (2008) because of spurious problem nonstationary time-series variables should not be used in regression analysis. The exception to this rule is cointegration. According to Engle and Granger (1987) any linear combination or difference of nonstationary variables can be stationary and if such case exists the variables are said to be cointegrated. Following Hill et al. one variable is regressed on the other one as indicated in the following equation.

$$y_t = \beta_1 + \beta_2 x_t + e_t \quad (4)$$

The  $y_t$  and  $x_t$  can be tested for cointegration through the stationary test of their residuals via equation 5 by using a Dickey-Fuller test.

$$e_t = y_t - \beta_1 - \beta_2 x_t \quad (5)$$

The test for cointegration is basically testing the stationary of residuals from equation 6.

$$e_t = y_t - \beta_1 - \beta_2 x_t \quad (6)$$

The test for cointegration is basically testing the stationary of residuals

$$\Delta \hat{e}_t = \gamma \hat{e}_{t-1} + v_t \quad (7)$$

Where  $\Delta \hat{e}_t = \hat{e}_t - \hat{e}_{t-1}$ . The t (or tau) statistics is examined for estimated slope coefficient.

Once the cointegration relationship between the variables is confirmed then the Granger Causality test can be conducted. In order to test the causality running from independent variable ( $x$ ) to dependent variable ( $y$ ) equation 8 is used.

$$y_t = \mu_1 + \sum_{i=1}^m \beta_i y_{t-i} + \sum_{j=1}^n \lambda_j x_{t-j} + u_t \quad (8)$$

$$H_0: \lambda_1 = \lambda_2 = \dots = \lambda_n = 0$$

F-test is conducted from the OLS estimation of equations 8 and 9:

$$y_t = c_t + \sum_{i=1}^n \gamma_i y_{t-i} + e_t \quad (9)$$

Their respective sum of squared residuals are compared ( $RSS_1 = \sum_{t=1}^T \hat{u}_t^2$  and  $RSS_0 = \sum_{t=1}^T \hat{e}_t^2$ ) via F or  $\chi^2$  test.

$$S_1 = \frac{(RSS_0 - RSS_1)/p}{RSS_1/(T-2p-1)} \sim F_{p, T-2p-1} \quad (10)$$

If the test statistic is greater than the specified critical value, then reject the null hypothesis that  $y$  does not Granger-cause  $x$ .

It is worth noting that with lagged dependent variables, as in Granger-causality regressions, the test is valid only asymptotically. An asymptotically equivalent test is given by

$$S_1 = \frac{T(RSS_0 - RSS_1)}{RSS_1} \sim \chi^2(p) \quad (11)$$

Granger-causality tests are very sensitive to the choice of lag length and to the methods employed in dealing with any non-stationarity of the time series.

## Results and Discussion

The descriptive statistics of the variables are given in Table 1. As can be seen from the Table GDP per capita is ranged from \$25574 to \$61375 with an average value of \$39698. The proxy of environmental pollution was CO<sub>2</sub> and calculated as metric tons per capita. The value of CO<sub>2</sub> emission per capita is ranged from 16 to 64 with an average value of 33. Per capita energy consumption was measured as kilogram of oil equivalent and ranged from 3631 to 12608 with an average of 9868.

The logarithmic values of gross domestic product per capita (GDPPC), energy consumption per capita (ENERGYPC), and CO<sub>2</sub> emission per capita (CO2PC) are plotted in Figures 1a, 1b and 1c, respectively.

Table 1. Descriptive Statistics of Variables (1975 – 2008).

| Variables               | Minimum  | Maximum  | Mean     | Std. Deviation | Skewness | Kurtosis |
|-------------------------|----------|----------|----------|----------------|----------|----------|
| GDP Per Capita          | 25574.00 | 61375.00 | 39697.65 | 10247.57       | 0.94     | -0.57    |
| CO2 emission Per Capita | 15.95    | 63.50    | 33.31    | 10.25          | 1.44     | 2.50     |
| ENERGY Use Per Capita   | 3631.00  | 12608.00 | 9868.47  | 2489.31        | -1.19    | 0.43     |

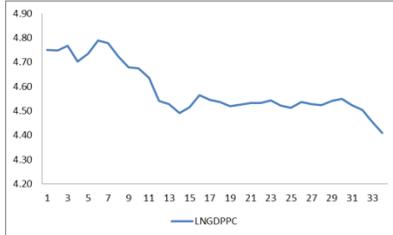


Figure 1a. GDP Per Capita.

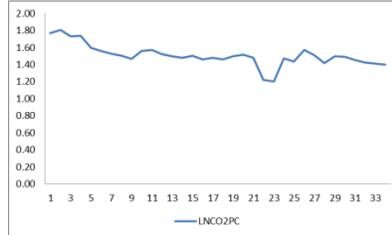
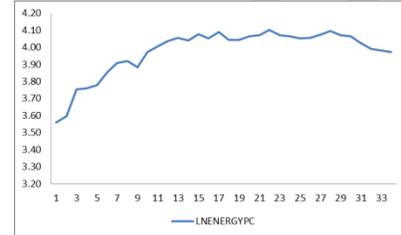

 Figure 1b. CO<sub>2</sub> Emission Per Capita.


Figure 1c. Energy Consumption Per Capita.

The results of Phillips-Perron unit root tests on each of the variables are given in Table 2. In order to check the stationary of variables, random walk model without drift, random walk model with drift, and random walk model with drift and slope were used. According to results only energy consumption per capita variables are stationary when random walk with drift equation is used. The all other series are non-stationary at their level but stationary at their first differences irrespective of using the three models. Since the variables are becoming stationary after the first difference one can say the time series variables are integrated of order 1 (I(1)). As indicated above, the stationary of variables are a pre-requisite for both Augmented Dickey-Fuller and Phillips-Ouliaris cointegration and then the Granger Causality tests.

Table 2. Phillips-Perron Unit Root Test.

| Variables                           | Level    |          |          | Difference |          |          |
|-------------------------------------|----------|----------|----------|------------|----------|----------|
|                                     | $\tau_0$ | $\tau_D$ | $\tau_T$ | $\tau_0$   | $\tau_D$ | $\tau_T$ |
| GDP Per Capita                      | -1.7094  | -0.8460  | -1.7999  | -4.1664*   | -4.4817* | -4.4027* |
| Energy Consumption Per Capita       | 1.5149   | -4.8920* | -2.3442  | -4.6390*   | -4.8925* | -7.2344* |
| CO <sub>2</sub> Emission Per Capita | -0.9909  | -2.5878  | -3.0092  | -5.9962*   | -6.0434* | -6.0624* |

\* Indicates that unit root in the first differences are rejected at 0.01 level.

-  $\tau_0$ ,  $\tau_D$ , and  $\tau_T$  indicate tau-statistics of random walk without drift and without slope, with drift, and with slope, respectively

- Critical values are -1.94 (5%), -2.56 (1%) without drift and without slope; -2.86 (5%), and -3.43 (1%) with drift; -3.41 (5%), and -3.96 (1%) with slope (Russell & MacKinnon, 1993)

The first differences of the variables are given in Figures 2a, 2b, and 2c as well. By looking to the level and first differences of variables plotted for each case one can see how the data became stationary.

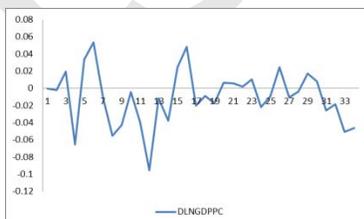


Figure 2a. Difference in GDP Per Capita.

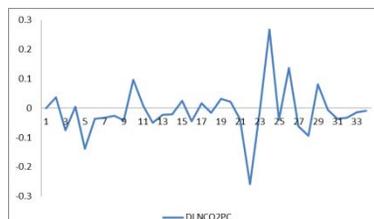
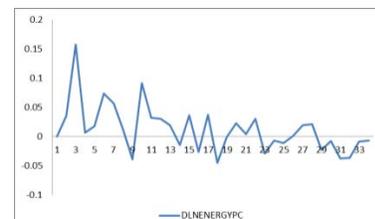

 Figure 2b. Difference in CO<sub>2</sub> Emission Per Capita.


Figure 2c. Difference in Energy Consumption Per Capita.

Since the variables are non-stationary and share common integration properties, long-run relationship between the selected variables were analyzed. Three different bi-variate models were conducted as follows:

- Growth in GDP versus CO<sub>2</sub> emission,
- Growth in GDP versus energy consumption, and
- Energy consumption versus CO<sub>2</sub> emission.

Augmented Dickey-Fuller and Phillips-Ouliaris cointegration tests were conducted and the results are given in Table 3. The corresponding Figures (3a, 3b, and 3c) are given after Table 3, respectively. According to cointegration tests there was no cointegration in GDP versus CO<sub>2</sub> and GDP versus energy. There was cointegration only between energy consumption per capita and CO<sub>2</sub> per capita.

**Table 3.** Results of Cointegration Test.

| Models                                 | Augmented Dickey- Fuller Tau | Phillips-Ouliaris Tau | Decision         |
|--|------------------------------|-----------------------|------------------|
| GDP versus Energy Consumption          | -1.60                        | -1.51                 | No Cointegration |
| GDP versus CO <sub>2</sub> Emission    | -2.12                        | -2.08                 | No Cointegration |
| Energy versus CO <sub>2</sub> Emission | -3.59*                       | -3.58*                | Cointegrated     |

\* Indicates cointegration at 0.05 level.

- Critical values are -3.96 (1%), -3.37 (5%) and -3.07 (10%) taken from J. Hamilton (1994)

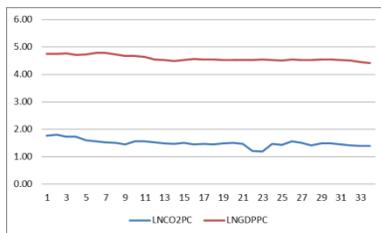


Figure 3a. GDP versus CO<sub>2</sub>

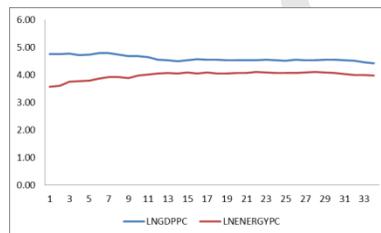


Figure 3b. GDP versus Energy.

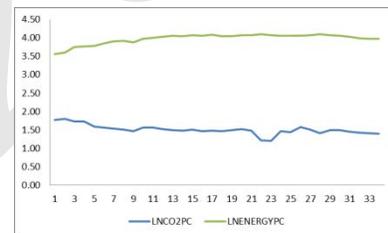


Figure 3c. CO<sub>2</sub> versus Energy.

In order to see the relationship between GDP and CO<sub>2</sub>; GDP and energy; CO<sub>2</sub> and energy the variables are plotted in the Figures 4a, 4b, and 4c, respectively.

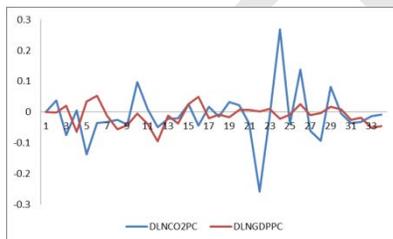


Figure 4a. Differences of GDP and CO<sub>2</sub>.

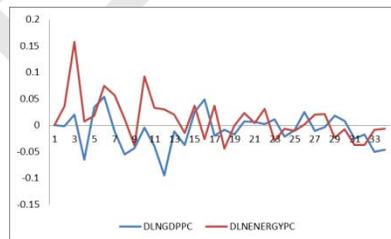


Figure 4b. Differences of GDP and Energy.

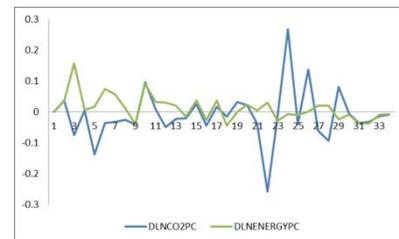


Figure 4c. Differences of CO<sub>2</sub> and Energy.

Having no cointegration relationship between GDP and energy; GDP and CO<sub>2</sub> seems that implementing energy conservation policies and decreasing the environmental pollution does not affect the growth of the UAE economy. There was cointegration between CO<sub>2</sub> and energy consumption. Having such relationship between CO<sub>2</sub> and energy make us think an indication of causal relationship between their time series variables. Since there were no cointegration between GDP and energy; GDP and CO<sub>2</sub>, the Granger Causality test was conducted only between energy consumption and CO<sub>2</sub> emission. The results of the causality test are given in Table 4. According to the results there is a unidirectional causal relationship running from energy consumption to CO<sub>2</sub> emission.

**Table 4.** Results of Causality Test.

| Dependent Variables | Sort of Causation (Independent Variables) |        | Sort of Causation (Independent Variables) |        |
|---------------------|---|--------|---|--------|
|                     | CO <sub>2</sub>                           | Energy | CO <sub>2</sub>                           | Energy |
|                     | F-statistics                              |        | $\chi^2$ -statistics                      |        |
| CO <sub>2</sub>     | -   | 2.82** | -   | 6.62*  |
| Energy              | 0.31                                      | -      | 0.74                                      | -      |

\* indicates significance at 0.05 level

\*\* indicates significance at 0.10 level

The results of this study are somehow similar to the results gathered by Al-Iriani (2006) and Al-Mulali (2012). According to the results of this study, it seems that the energy conservation policies, suggested by Al-Iriani as well, will not hurt GDP in the UAE. Having unidirectional causal effect of energy on CO<sub>2</sub> emission is similar to the study conducted by Al-Mulali who found a positive effect of energy consumption on increase in CO<sub>2</sub> emission. Given such results we can suggest energy conservation policies to decrease the CO<sub>2</sub> emission without hurting GDP growth in the UAE.

## Conclusions

In order to encourage environmental protection and energy conservation policies, the relationships between GDP, energy consumption, and CO<sub>2</sub> emission have been extensively studied in literature. Some researchers did not find positive impacts of energy consumption and CO<sub>2</sub> emission on economic growth. According to results of this study, there were no cointegration relationship in GDP versus CO<sub>2</sub> and GDP versus energy. But on the other hand, there was cointegration and a unidirectional causal relationship running from energy to CO<sub>2</sub> emission. It seems that one of the main reasons of having high CO<sub>2</sub> per capita is due to the consumption of energy. Therefore, reducing environmental pollution and implementing energy conservation policies will not cause a decrease in GDP per capita in the UAE. Beside efficient use of current energy, contribution of more renewable energy sources to economy can make the country to have a cleaner environment.

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# EFFECT OF WAVE IMPEDING BARRIER DEPTH ON BURIED PIPELINE

Fatih Göktepe<sup>1</sup>, H. Serdar Küyük<sup>2</sup> ve Erkan Çelebi<sup>1</sup>

<sup>1</sup>Sakarya University

Engineering Faculty, Department of Civil Engineering,

<sup>2</sup>UC Berkeley

Berkeley Seismological Laboratory

fgoktepe@sakarya.edu.tr, skuyuk@seismo.berkeley.edu, ecelebi@sakarya.edu.tr

**Abstract:** Pipelines are one of most important component of lifeline engineering. For instance, the Southern Caucasus- Eastern Turkey energy corridors are formed by several key pipelines carrying crude oil and natural gas from Azerbaijan, via Georgia, to world markets through Mediterranean Sea. Many project accomplished recently and construction of new corridors are still going on. They should be protected from earthquake disaster especially when they pass through high seismicity zones. The wave impeding barrier (WIB) based on the cut-off frequency of a soil layer over bedrock can be used to reduce the earthquake excitation of this vulnerable the infrastructures. In this paper, efficiency of WIB with the application of various depths underneath of pipeline is investigated. The proposed model is analyzed as numerical simulation using 2D finite element analysis. A parametric study carried out for various depths of embankment of WIB. The soil is defined as semi-infinite medium by using absorbent boundaries and Mohr-Coulomb material model is chosen in the analysis. Results showed that artificial bedrock can be very promising as an isolator to protect pipelines when they buried for a certain depth.

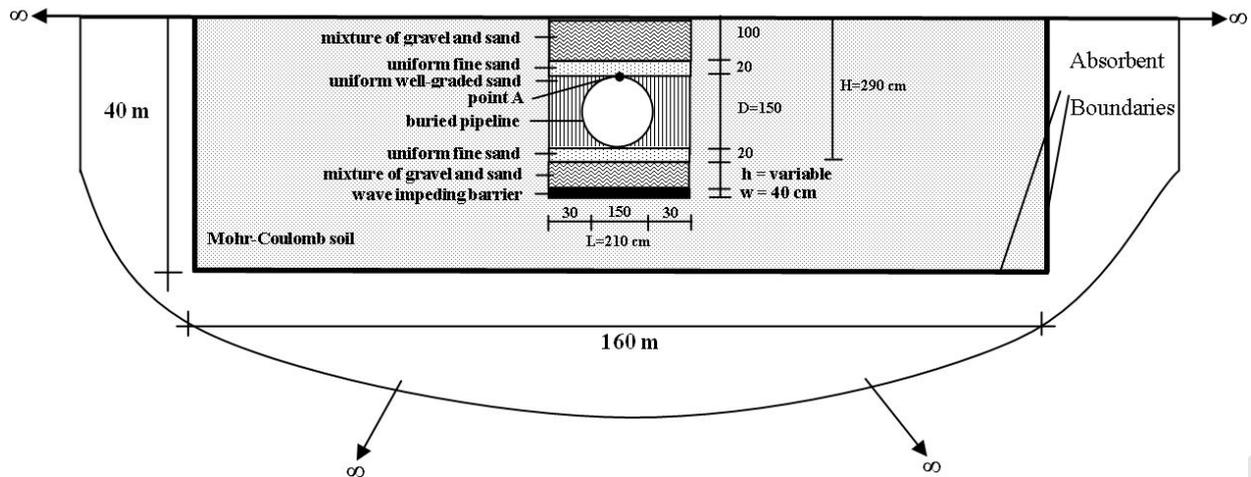
**Key words:** Wave impeding barrier, Dynamic FE analysis, infrastructures, earthquake motion, passive isolation, absorbent boundaries

## Introduction

Excessive dynamic loading during strong ground motion causes in enormous stress and deformation on underground structures in active tectonic regions. Last decade, shallowly buried pipelines are utilized for a wide range of key applications, such as natural gas/oil transmission, telecommunication and water supply. Damages to small pipelines were observed in some earthquakes such as 1964 Niigata and Alaska earthquakes however fewer damages were generally reported to large underground structures compared to surface structures. On the other hand, real performance of recent project of new energy corridors such as Southern Caucasus- Eastern Turkey natural gas pipelines still unknown under strong ground motion. These vital underground structures will affect the environment extensively and the countries that depend on them. Sustainability, durability and security of these pipelines are very critical for all earth habitants. Thus, recently, earthquake induced damages followed by severe earthquakes and earthquake corresponding resistance design have received considerable attention by the authors (Hall and O'Rourke, 1991, Liu and Song, 2005) in many countries.

There can be two way for reducing the response of pipeline as: I) by modifying the wave dissipation characteristics of the soil deposit underneath of pipeline, and b) by partially interrupting the spreading of waves into the understructure or by providing the structure more damping by means of installation certain devices such as additional base isolation systems which can be very costly. It is also possible to modify the dynamic transmitting behavior of local sub-soil through a complex mechanism of wave reflection and mode alteration around the vibration source by constructing a suitable wave barrier at the bottom of pipeline (Göktepe et al., 2010). Various numerical techniques for analyzing the influences of soil heterogeneity and layering on the vibration screening by means of trench and wave impeding barriers are investigated by the authors (Beskos et al., 1986, Leung et al., 1991, Klein et al., 1997, Takemiya, 1998a,b, Chouw and Schmid, 1999, Adam and Chouw, 2001, Pflanz et al., 2002, Adam and Estorff, 2005, Çelebi et al., 2006, Çelebi and Göktepe, 2012) to compare with the few experimental studies which are carried out full scale tests on site and laboratory model investigations only for particular cases (Woods, 1968, Haupt, 1981, Ahmad and Al-Hussaini, 1991, Forchap and Verbic, 1994).

In this paper a WIB, which behaves as artificial bedrock (concrete in this study), is tested as an isolator to reduce responses of buried pipelines under earthquake strong ground motion. 2D numerical finite element method is used for investigations. It is buried horizontally underneath of trench below the pipelines to be protected in various depths as seen in Fig. 1. A parametric study carried out for optimum depth.



**Figure 1:** Schematic diagram of the considered soil-structure model with wave impeding barrier

## Numerical Model

Soil-structure interaction, wave propagation, defining realistic material properties of the local soil condition and adequate software for the numerical analysis have fundamental influence on soil related finite element analysis.

In order to analyze the wave propagation of surface vibrations in the soil, and to predict the mitigation of buried pipelines responses produced by an earthquake excitation the proposed model and its computational work as numerical simulation with wave propagation in the soil are performed using finite element analysis by the computer program (Brinkgreve et al., 2002).

Special boundary conditions named as absorbent boundaries, which can absorb the energy waves, were specified to both the vertical and horizontal model boundaries to avoid spurious reflection of waves back into the soil medium. The mechanical behavior of the underlying soil medium considered in the model is simulated by an elasto-plastic Mohr Coulomb model under plane-strain conditions. 1990 Upland Earthquake acceleration record is considered as input motion.

Wave-impeding barrier buried in various depth are considered as reduction measure to reveal the optimal geometrical properties. The FE discretization of the soil-structure system with a WIB is shown in Fig. 1. The observation point (A) chosen for investigation is on the top of the buried pipeline as shown in the same figure. The essential material parameters considered in FE model for the underlying and filling soil together with steel pipeline are summarized in Tables 1-3.

**Table 1:** Properties of soil for undrained FE Mohr-Coulomb model (Gamber, 2004)

| Parameter                               | Symbol   | Unit                 | Magnitude |
|---|----------|----------------------|-----------|
| Total unit weight                       | $\gamma$ | (kN/m <sup>3</sup> ) | 16.67     |
| Mass density                            | $\rho$   | (Mg/m <sup>3</sup> ) | 1.70      |
| Young's modulus                         | E        | (kPa)                | 34500.00  |
| Shear modulus                           | G        | (kPa)                | 13270.00  |
| Poisson's ratio                         | $\nu$    | -                    | 0.30      |
| Constrained modulus                     | M        | (kPa)                | 46440.00  |
| Compression wave velocity               | $V_p$    | m/s                  | 165.200   |
| Shear wave velocity                     | $V_s$    | m/s                  | 88.300    |
| Rayleigh damping with alpha coefficient | $\alpha$ | -                    | 0.001     |
| Rayleigh damping with beta coefficient  | $\beta$  | -                    | 0.01      |
| Void ratio                              | e        | -                    | 0.50      |
| Cohesion                                | c        | (kPa)                | 0.00      |
| Friction angle                          | $\phi$   | (°)                  | 33.00     |
| Dilatancy angle                         | $\psi$   | (°)                  | 3.00      |

|                                     |             |   |      |
|-------------------------------------|-------------|---|------|
| Interface strength reduction factor | $R_{inter}$ | - | 0.67 |
|-------------------------------------|-------------|---|------|

**Table 2:** Properties of filling soil of buried pipeline for undrained FE Mohr-Coulomb model (Zaneta, 2006)

| Parameter         | Symbol          | Unit                 | Magnitude         |
|-------------------|-----------------|----------------------|-------------------|
| Total unit weight | $\gamma$        | (kN/m <sup>3</sup> ) | 77.00             |
| Mass density      | $\rho$          | (Mg/m <sup>3</sup> ) | 7.85              |
| Young's modulus   | E               | (kPa)                | 2x10 <sup>8</sup> |
| Damping factors   | $\alpha, \beta$ | -                    | 0.05              |
| Poisson's ratio   | $\nu$           | -                    | 0.30              |

**Table 3:** Properties of steel pipeline for FE elastic plate-element

| Soil type                         | Mixture of gravel and sand | Uniform fine sand | Uniform well-graded sand |
|-----------------------------------|----------------------------|-------------------|--------------------------|
| Mass Density (Mg/m <sup>3</sup> ) | 2.00                       | 1.60              | 1.80                     |
| Young's Modulus(kPa)              | 15000                      | 15000             | 20000                    |
| Poisson's Ratio (-)               | 0.25                       | 0.25              | 0.25                     |
| Friction Angle (°)                | 38.00                      | 32.00             | 33.00                    |
| Cohesion (kPa)                    | 3.00                       | 0.00              | 0.00                     |

## Results

In order to obtain the influence of a wave impeding block as an isolator when constructed underneath of pipeline in various depths, a parametric investigation has been performed for reducing adverse effects of earthquake vibrations. Göktepe et al. (2011) proposed a WIB, investigated various thicknesses from 10 cm to 100 cm and a 40 cm thickness was chosen for given best performance. In the current study depths of embankment 20, 40, 80, 160 and 200 cm are examined. Selected material properties of the concrete block are given in Table 4.

**Table 4:** Properties of concrete wave impeding block (WIB) for FE elastic model

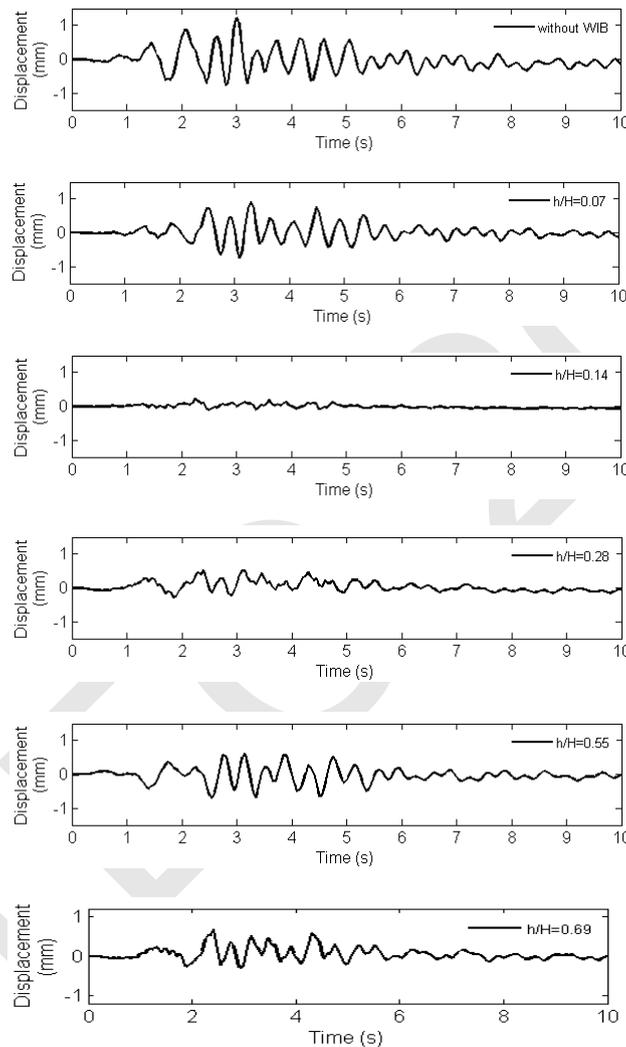
| Parameter         | Symbol          | Unit                 | Magnitude           |
|-------------------|-----------------|----------------------|---------------------|
| Total unit weight | $\gamma$        | (kN/m <sup>3</sup> ) | 22.00               |
| Mass density      | $\rho$          | (Mg/m <sup>3</sup> ) | 2.24                |
| Young's modulus   | E               | (kPa)                | 3.7x10 <sup>7</sup> |
| Damping factors   | $\alpha, \beta$ | -                    | 0.01                |
| Poisson's ratio   | $\nu$           | -                    | 0.25                |

Mixture of gravel and sand filling soil is used for the depth of embankment. A dimensionless parameter which is obtained from the ratio of depth of embankment (h) to height of trench (H) is derived and proposed for the optimum thickness. The height of trench which is equal to 290 cm is assumed as summation of the radius of pipeline and filling

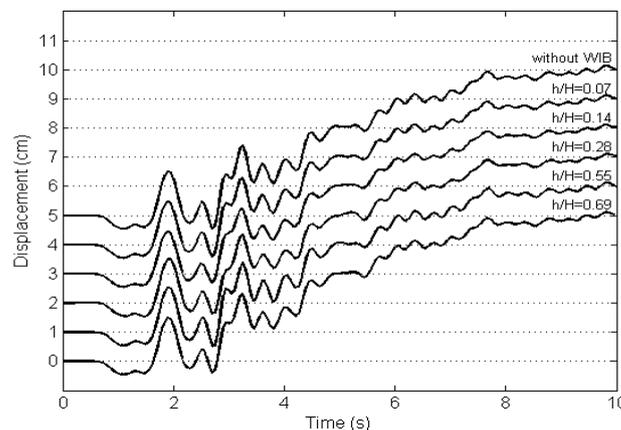
upside down of the pipeline as 20 cm uniform fine sand and 100 cm mixture of gravel and sand is shown Fig. 1. Therefore  $h/H$  ratios for 20, 40, 80, 160 and 200 cm depth of embankment are 0.07, 0.14, 0.28, 0.55 and 0.69 respectively.

Vertical displacements recorded after dynamic analysis without WIB and for various  $h/H$  ratios are shown in Fig. 2. The ratio with 0.14 results in the best attenuation considering peak ground displacement (PGD). Any depth of embankment seems effective compared without WIB. It is seen that 40 cm is the most effective depth where 92% reduction is achieved on the pipeline.

On the other hand, there is no change at all on horizontal displacements. Displacements are plotted and showed as one centimeter shifted for better visualization (Fig. 3). About 5 cm total displacements are seen in each case which means, the WIB has no effect in horizontal displacement.

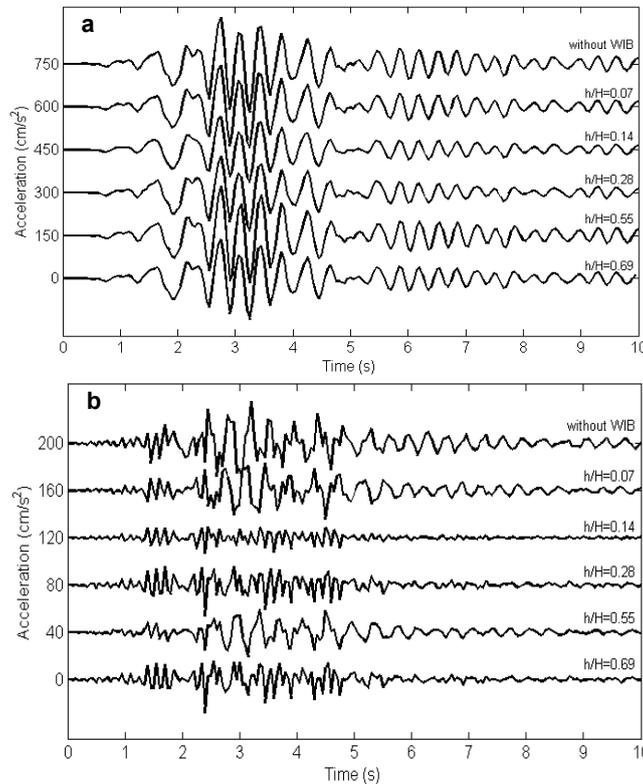


**Figure 2:** Records of vertical displacements depending on various  $h/H$  ratios at point A



**Figure 3:** Records of horizontal displacements depending on various h/H ratios at point A (records are shifted 1 cm)

The horizontal acceleration records are plotted in Fig. 4a. Similar tendency is seen for all ratios. The vertical accelerations are also shown in Fig. 4b. Top waveform shows acceleration without WIB where the waveforms underneath demonstrates with different depth of embankment. According to peak ground acceleration (PGA), best result is acquired from the WIB for 0.14 of h/H ratio.



**Figure 4:** Records of horizontal acceleration (a) and of vertical acceleration (b) depending on various h/H ratios at point A (records are shifted 150 cm/s<sup>2</sup> and 40 cm/s<sup>2</sup> respectively)

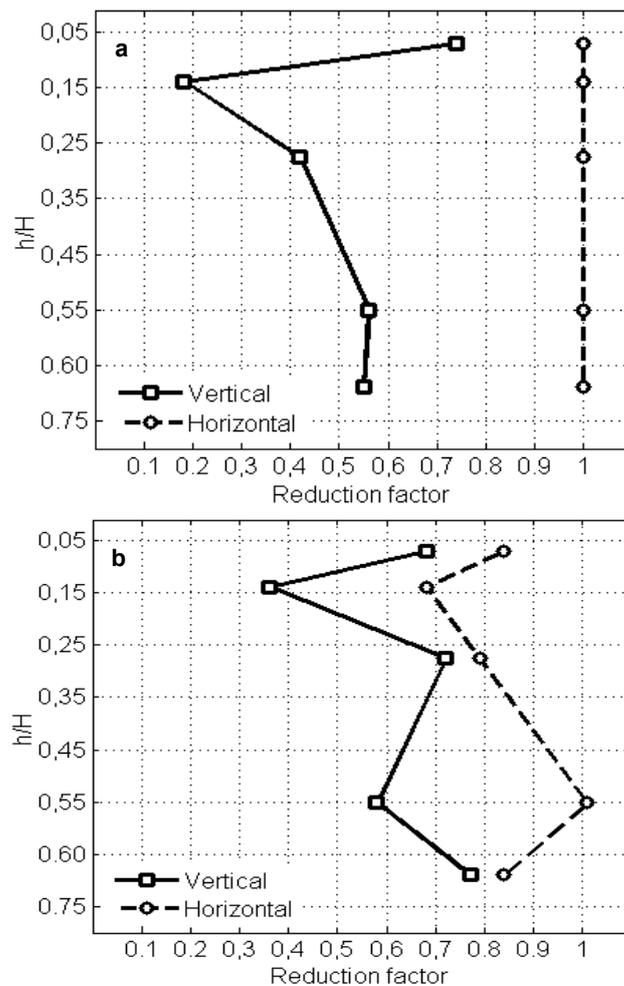
We introduce a reduction factor which is defined with following equation;

$$R_{t,c} = \frac{a_{t,c}}{a_c}, \quad R_{d,t,c} = \frac{d_{t,c}}{d_c} \quad (1)$$

where indexes t is for various h/H ratios and c is stands for without WIB. Relations of reduction factors (RF) with h/H ratios for acceleration and displacement results are shown in Fig. 5a,b.

Ratio of 0.14 gave the smallest RF for PGD and PGA in the analyses. For the former, a very promising reduction is achieved with 92% and the latter is succeeded 64% reduction in vertical acceleration. Interestingly, only h/H=0.55 is bigger than 1.00 in horizontal acceleration which means wave barrier is amplified around 1% for this depth of embankment as seen Fig. 5.

As for horizontal acceleration, 40 cm embankment made best isolation with 32%. Göktepe et al. (2011) previously found that 20 cm WIB is better than the 40 cm according to horizontal and vertical PGA (not in PGD). We showed that if the 40 cm WIB applied to 40 cm depth, the reduction is better compared with the performance of 20 cm WIB.



**Figure 5:** Reduction factors depending on various  $h/H$  ratios at the point A. Vertical and horizontal (a) displacements (b) acceleration (RF are dimensionless)

Analyzing the all cases, a general tendency is inferred that employment of wave impeding barrier for buried pipelines is a very effective application to reduce the vibration. However a special care should be taken for amplification cases before application.

## Conclusion

Earthquakes have caused colossal casualties and severe damages to engineering structures and especially leading to substantial economic loss to the underground structures and/or infrastructures. Security, sustainability, and durability of these pipelines are very vital for many reasons. The response of lifeline engineering under earthquake excitation which present a risk for population and environment is influenced by deformability of the buried pipelines such as used in natural gas transmission, especially in case of very soft ground conditions. A parametric investigation has been executed to obtain the influence of a wave impeding block as an isolator when constructed below pipeline for reducing adverse effects of earthquake vibrations. Various depth of embankment for the artificial bedrock (concrete block) are investigated by using 2D finite element method. It is found that even 40 cm depth of embankment with 40 cm thickness of the block can reduce the peak ground acceleration and displacement. It is concluded that wave impeding barrier can be used in practice in the field.

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# EFFECTS OF BALL-TO-MASS RATIO DURING MECHANICAL ACTIVATION ON THE STRUCTURE AND THERMAL BEHAVIOR OF TURKISH LATERITIC NICKEL ORE

Tuğba Tunç & Kenan Yıldız  
Metallurgy and Materials Engineering, Engineering Faculty  
Sakarya University  
Turkey  
ttunc@sakarya.edu.tr, kenyil@sakarya.edu.tr

**Abstract:** In this study, lateritic nickel ore was activated mechanically in a planetary mill for different ball-to-mass ratios and the changes in the ore structure and thermal behavior of the ore were investigated by means of X-ray diffraction (XRD), scanning electron microscopy (SEM), particle size analysis and thermal analysis (TG-DTA). The results showed that particle size decreased and amorphization in the ore structure was occurred with increment of the ball-to-mass ratio. The transformation of goethite to hematite in thermal behavior of laterite started to occur during mechanical activation.

**Key words:** Lateritic nickel ore, mechanical activation, thermal behavior.

## Introduction

Nickel oxides (laterites) and nickel sulphides comprise the two types of ores used in industrial practice for nickel production. Today world nickel supply is covered predominantly by sulphide ores (60% against 40% by laterites. By taking into consideration that any additional nickel demand is expected to be mainly satisfied by mining of laterite deposits, the optimization of the metallurgical laterite processing methods constitutes a great challenge for the nickel industry and there is an increasing focus on the processing of the huge reserves of nickel-rich laterite ores due to declining global reserves of nickel sulphides (Zevgolits et al., 2000; King, 2005; Tunç et al., 2012a).

The mechanical activation of minerals makes it possible to reduce their decomposition temperature or causes such a degree of disordering that the thermal activation may be omitted entirely. In this process, the complex influence of surface and bulk properties occurs. The mineral activation leads to a positive influence on the reaction kinetics, an increase in surface area and further phenomena. Mechanical activation by high energy milling is an innovative procedure that improves the efficiency of mineral processing because of several factors, most importantly the formation of new surfaces and the creation of lattice defects. High energy ball milling can induce, at room temperature, some chemical reactions that normally occur at very high temperatures (Balaz, 2008; Tromans et al., 2001; Apaydin et al., 2011).

In this study, the effects of ball-to-mass ratio during mechanical activation on the structure and thermal behavior of a Turkish lateritic nickel ore were investigated with X-ray diffraction (XRD), particle size analysis, scanning electron microscopy (SEM) and thermal analysis (TG/DTA).

## Materials and Method

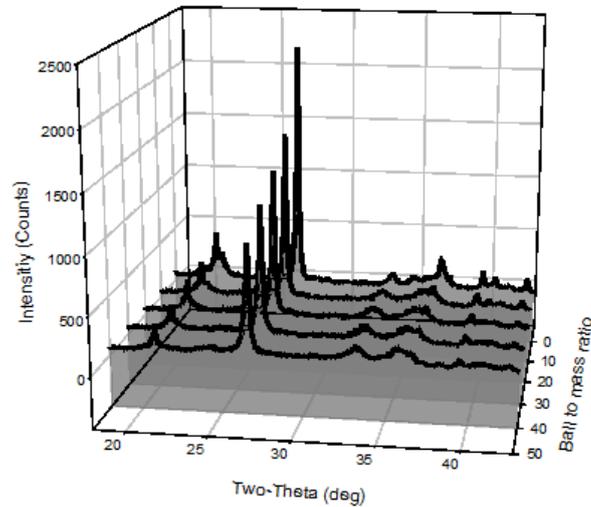
The mechanical activation of lateritic nickel ore from Manisa-Gördes (Turkey) was performed in a Planetary Mono Mill Pulverisette 6 under the following conditions: the weight and diameter of tungsten carbide (WC) balls were 200 g and 10 mm respectively; the grinding bowl was 250 mL WC; the grinding times was 30 min; the speed of the main disk was 600 rev.min<sup>-1</sup>; the grinding process was dry. Ball-to-mass ratios during mechanical activation were 10, 20, 30 and 40.

X-ray diffraction analysis was performed using a Rigaku Ultima X-ray diffractometer and Cu K $\alpha$  radiation. A JEOL 6060 LV scanning electron microscope (SEM) was used for morphological analysis of the non-activated and activated samples. DTA was performed using TA Instruments SDTQ 600 at heating rate of 10°C.min<sup>-1</sup> under atmospheric conditions and Mikrotrac S3500 was used for particle size distribution analysis.

## Results and Discussion

X-ray diffraction patterns of non-activated laterite and activated with different ball-to-mass ratios are given in Figure 1. Quartz and goethite are the major phases while hematite presents as minor phase. When laterite was subjected to mechanical activation for different ball-to-mass ratios during milling, peak broadening and decreasing of intensity

occurred. This fact is the result of crystal lattice imperfections and disorderings. Crystalline size becomes smaller than about one micron by mechanical activation. During high-energy milling, the size of crystals decreased to some critical values. Further energy supply to these crystals of limiting size causes further deformation of crystals, energy accumulation in the volume or at the surface of crystals and subsequently amorphization. There is not only one effect occurring during the milling process. Because of the contact between powder – ball and attrition between powder-ball-bowl, local temperatures may be increase for higher rev (Tunç et al., 2012a; Balaz, 2000; Tunç et al., 2012b).

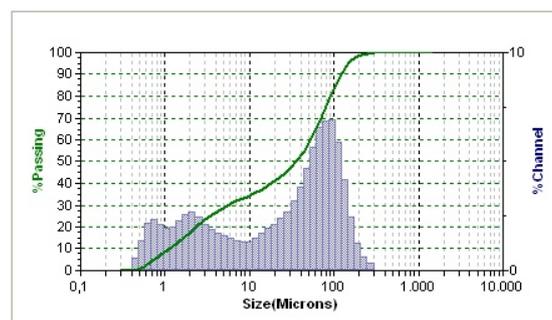
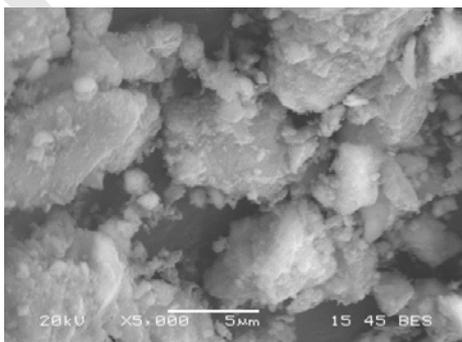


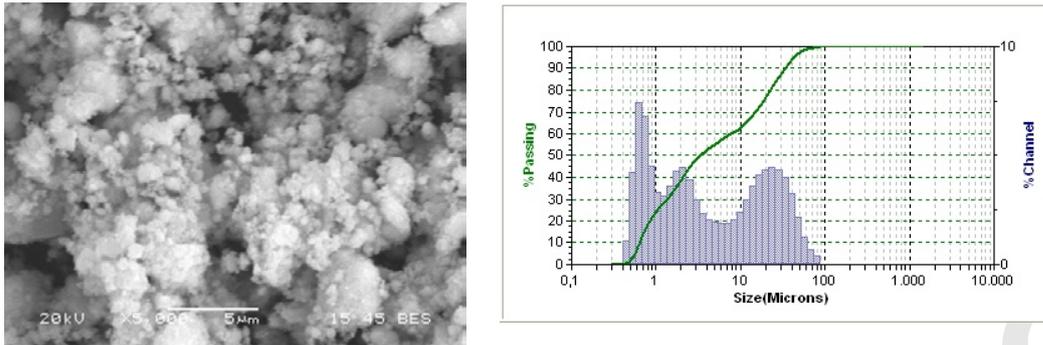
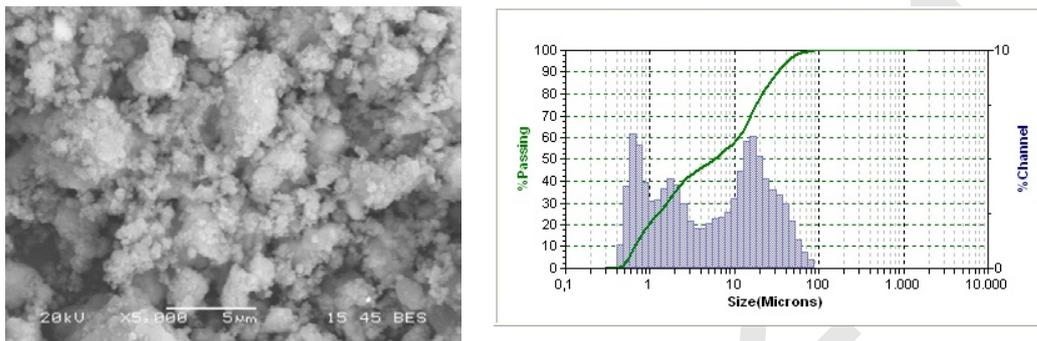
**Figure 1.** X-ray diffraction patterns of non-activated and activated laterite ore with different ball-to-mass ratios

Scanning electron micrographs (SEM) and particles size analysis of the samples were given in Figure 2-4. It was clear that the particle size decreased during mechanical activation. SEM analysis is in good agreement with particle size distribution data, given in Table 1. Defining of particle size distribution by using three percentiles is common practice. These are the cumulative distributions of particle size correspond to 10%, 50%, 90% and specified as  $d_{10}$ ,  $d_{50}$ ,  $d_{90}$ . They are taken directly from mass-based cumulative particle size distribution (German, 2007). Mechanical activation results in smaller particle than the non-activated one when focused on  $d_{90}$  cumulative distribution, but when  $d_{50}$  column is taken into account, the particles become larger. Increases in the particle size with mechanical activation may be due to the agglomeration of the particles. When the particle is milled, its surface area increased because of the crushing and forming new surfaces become more reactive.

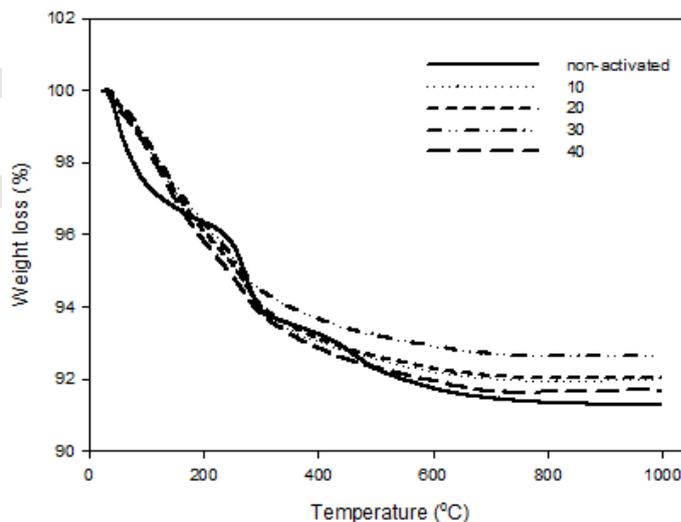
**Table 1.** Particle size analysis of non-activated and activated laterite samples

| Ball-to-mass ratio | $d_{10}$ ( $\mu\text{m}$ ) | $d_{50}$ ( $\mu\text{m}$ ) | $d_{90}$ ( $\mu\text{m}$ ) |
|--------------------|----------------------------|----------------------------|----------------------------|
| Non-activated      | 1,103                      | 35,65                      | 120,20                     |
| 10                 | 0,635                      | 2,711                      | 36,67                      |
| 20                 | 0,646                      | 3,320                      | 33,49                      |
| 30                 | 0,644                      | 3,600                      | 30,80                      |
| 40                 | 0,668                      | 5,781                      | 32,68                      |



**Figure 2.** SEM micrograph and particle size analysis of non-activated ore

**Figure 3.** SEM micrograph and particle size analysis of activated ore (ball-to-mass ratio: 20)

**Figure 4.** SEM micrograph and particle size analysis of activated (ball-to-mass ratio: 40)

Thermal analysis (TG/DTA) of the non-activated and activated laterite with different ball-to-mass ratios are given in Figure 5 and 6. For the non-activated lateritic nickel ore, the weight losses in two steps exist at 120°C and 280°C, belonging to evaporation of humidity and dehydroxylation of goethite into hematite respectively. The temperature of dehydroxylation for pure goethite varied between 274 and 305°C, depending on particle size and crystallinity. O'Connor et al.(2006) stated that the transformation of goethite to hematite occurred between 210 and 370°C in limonitic laterite. Pickles (2004) also stated that the goethite – hematite transformation occurred after 250°C in limonitic laterite. Mechanical activation resulted in disappearing the second endothermic peak corresponding to transformation. From these results it can be said that goethite transformation into hematite needs lower energy than the original one for activated samples because of the accumulated energy from mechanical activation and there is a probability for transformation which occur during milling.


**Figure 5.** Thermogravimetric analysis (TG) of the samples

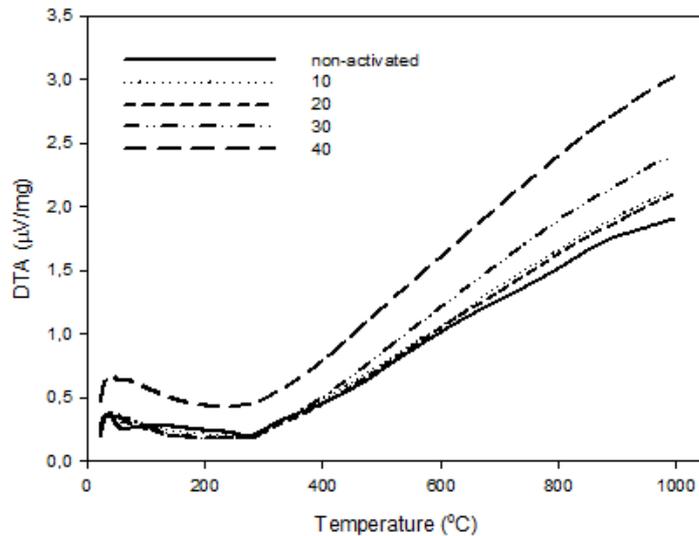


Figure 6. Differential thermal analysis (DTA) of the samples

## Conclusions

Increasing in ball-to-mass ratio during mechanical activation caused amorphization and structural disordering in laterite. Particle size of the ore was decreased. Dehydroxylation reaction, which is transformation of goethite to hematite, occurred during milling and the peak of dehydroxylation in thermal analysis (DTA) disappeared, due to the structural disordering in laterite.

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# EFFECTS OF CONTROLLER ON SYSTEM CHARACTERISTICS AND AN APPLICATION ON SHIP PROPULSION SYSTEM

Muhammet Su, Fatih Cüneyd Korkmaz, Fuat Alarçin

**Abstract:** System characteristics give information about an applied system which is controlled by a controller. So it is important to select an accurate controller and adjust its parameters. In this study, the effect of controller on system characteristics has been investigated. Three different controller considered and compared; namely, the conventional PID (Proportional-Integral-Derivative), Fuzzy PID and hybrid PID. The classical PID and the Fuzzy PID controller have been combined by directly at hybrid PID controller. A sample process and a real ship propulsion system simulated, and it has seen that using the hybrid PID controller provides better system characteristics when compared to the conventional PID or the Fuzzy PID controller applications.

**Key words:** System characteristics, hybrid controller, Fuzzy PID controller, ship propulsion system

## Introduction

PID controllers have been used in feedback applications for a long time as a result of effective and flexible work. Furthermore, its basic structure provides easier using quite all systems also in future. However, PID controllers have not given desired result in system characteristics at some applications and not effective in non-linear systems. Different controllers designed one of which is Fuzzy controller. This controllers that occur knowledge based non-linear characteristics have generally used in non-linear systems. In order to avoid the negative effects the two controllers have been combined; namely, hybridization.

Various structures of hybrid controller exist in literature. Brehm, T. and Rattan, K.S. (1993) investigated two fuzzy logic PID controllers (Fuzzy logic PD and PI) that use simplified design schemes. Fuzzy hybrid control using simplified indirect inference method was presented in Otsubo et al. (1998). Oh et al. (2004) designed hybrid fuzzy controllers based on genetic algorithms and estimation techniques. Erenoglu et al. (2006) combined the classical PID and fuzzy controller by a blending mechanism.

Vibration can be occurred because of axial run-out and unstable working at ship propulsion systems. There are some studies on this vibration to control in literature. Alarçin F. (2005) studied a containership yaw and roll autopilots based on Fuzzy Logic controllers. He demonstrated that the autopilots using Fuzzy Logic controllers can provide significant performance advantages when compared to the conventional autopilots through the simulation results obtained. Shu et al. (2006) expressed torsional and axial vibrations of the engine crankshaft with Rayleigh differential method. The engine crankshaft was modeled as a mass spring system to obtain easily natural frequency of torsional and axial vibrations. Calculated results were compared with measured results and it is recognized that torsional vibration has an enormous effect on axial vibration that causes noise and vibration in engine. Dylejko et al. (2006) investigated optimization of a resonance changer to minimize the vibration. An optimization scheme involving a genetic and a general nonlinear constrained algorithm was used to minimize two fitness functions associated with the vibration transmission to the hull over a low-frequency range transmission in marine vessels. Grzadziela (2008) carried out a study by using Matlab-Simulink, in which a propeller shaft system has four-degrees of freedom. Model was established by using the Finite Element Method (FEM), the propeller shaft speed ranges in different frequency values were determined according to different forms of support. Simulation results showed a maximum 10% error with the measured values converges. Korkmaz F. C. and Alarçin F. (2012) controlled a ship shaft torsional vibration via PID controller which was performed to propeller shaft system, and compared with uncontrolled system.

The purpose of this study is to investigate the effects of controllers on system characteristics. Then, on a real application about ship propulsion systems were simulated and analyzed through the conventional, Fuzzy and Hybrid PID controllers.

## Conventional PID Controller

As shown in Fig. 1 system characteristics that consist of overshoot, settling time, rise time and steady-state error have critical information about system.

Overshoot is the maximum peak value of the response curve measured from the desired response of the system. Settling time is the time required for the response curve to reach and stay within a range of certain percentage (usually 5% or 2%) of the final value. On the other hand, rise time is the time for a curve to go from 10% to 90% of its reference value. Beside, steady-state error is the difference between the input and output of a system in the limit as time goes to infinity (Ogata, K., 1990).

The parameters of PID controller cause different influences on system characteristics. The proportional block provides an overall control action, and the integral block reduces steady-state errors. On the other hand, the derivative

block improves transient response. Table 1 also shows the effects of increasing a parameter independently (Jinghua, Z., 2006). The closed loop system with conventional PID controller is shown in Fig.2.

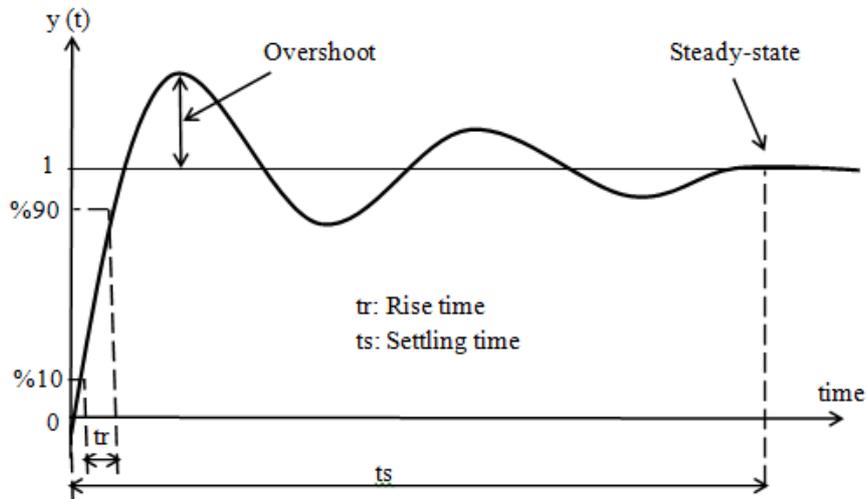


Figure 1: System characteristics

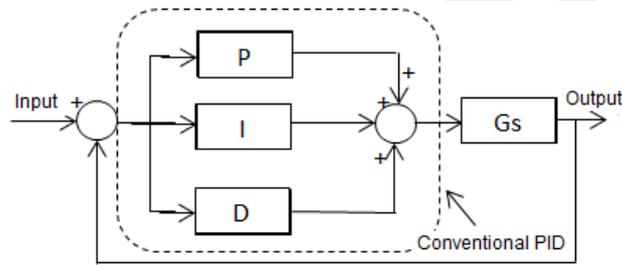


Figure 2: Closed loop system with conventional PID controller (Ogata, K., 1990)

Generally, transfer function of classical PID controller is given below:

$$G_c(s) = K_p \left[ 1 + \frac{1}{s} + K_d s \right] \quad (1)$$

The Laplace transform of PID controller given in (1) becomes:

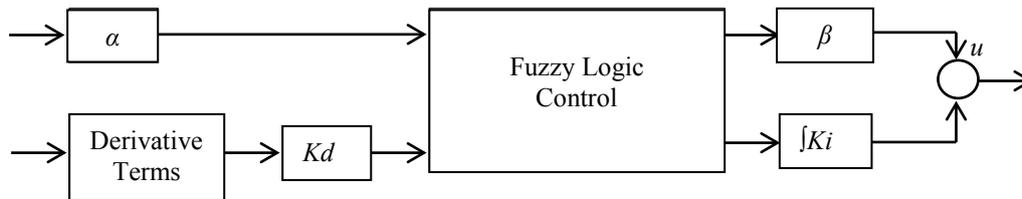
$$G_c(s) = K_p \left[ \frac{s^2 + K_d s + 1}{s} \right] \quad (2)$$

Table 1: Effects of increasing a parameter independently (Jinghua, Z., 2006)

| Parameter              | Overshoot | Settling time | Rise time    | Steady-state error |
|------------------------|-----------|---------------|--------------|--------------------|
| Proportional ( $K_p$ ) | Increase  | Minor Change  | Decrease     | Decrease           |
| Integral ( $K_i$ )     | Increase  | Increase      | Decrease     | Eliminate          |
| Derivative ( $K_d$ )   | Decrease  | Decrease      | Minor Change | Minor Change       |

## Fuzzy PID Controller

Fuzzy PID controllers in literature can be classified into three major categories as direct action type, Fuzzy gain scheduling type, and hybrid type Fuzzy PID controllers (Erenoglu et al. 2006). The block diagram of Fuzzy PID controller is shown in Fig. 3.

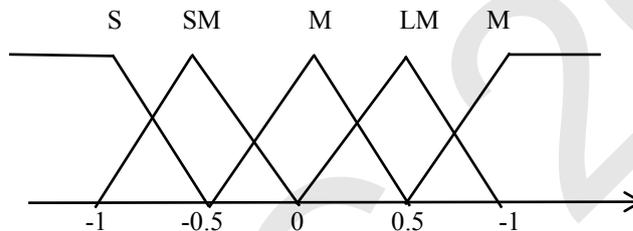


**Figure 3:** The Fuzzy PID Controller structure (Guzelkaya, M. et al., 2003)

$Kd$  and  $Ki$  are constant that affect directly derivative and integral blocks of Fuzzy structure, respectively.  $\alpha$  and  $\beta$  are also constant that affect the actuated error.

The selected Fuzzy logic controller is Sugeno type, and uses the product-sum inference mechanism and weighted average defuzzification method. The structure of the Fuzzy PID controller, which has two inputs, an output and one rule base. The inputs are the error  $e$  and the change of error  $de$ . As shown in Fig. 4 uniformly distributed triangular membership functions were used for input variables. The linguistic levels assigned to the input variables  $e$  and  $de$  that is given as follows;

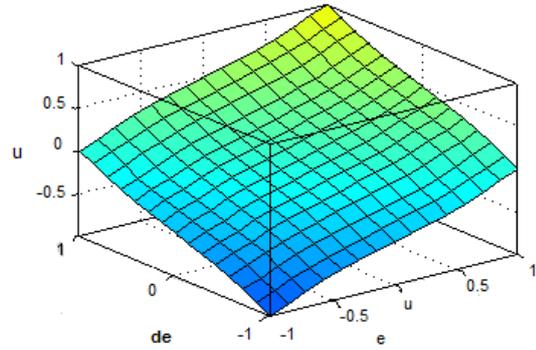
L: large; LM: large medium; M: medium; SM: small medium; S: small. For the output variable  $u$ , singleton membership functions were defined. The Fuzzy PID controller rule base composed of 25 (5x5) rules as shown in Table 2 which Qiao and Mizumoto (1996) has given the symmetrical rule base. The control surface of the Fuzzy PID controller is also given in Fig. 5.



**Figure 4:** The membership functions of  $e$  and  $de$

**Table 2:** Fuzzy Control Rules (Qiao and Mizumoto,

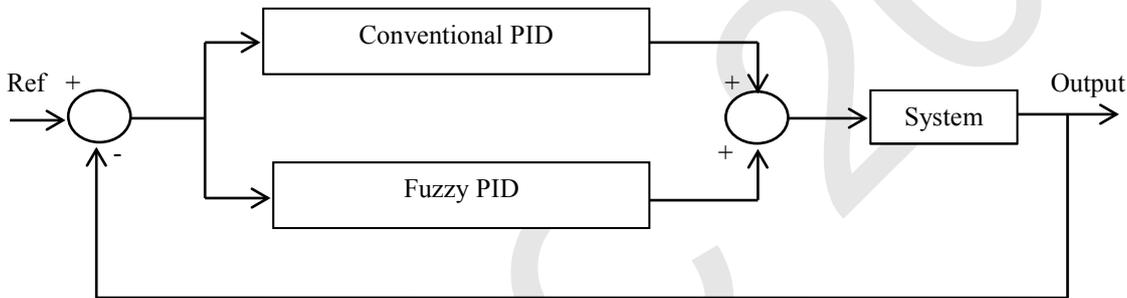
| <i>e/de</i> | S    | SM   | M    | LM   | L   |
|-------------|------|------|------|------|-----|
| S           | -1   | -0.7 | -0.5 | -0.3 | 0   |
| SM          | -0.7 | -0.4 | -0.2 | 0    | 0.3 |
| M           | -0.5 | -0.2 | 0    | 0.2  | 0.5 |
| LM          | -0.3 | 0    | 0.2  | 0.4  | 0.7 |
| L           | 0    | 0.3  | 0.5  | 0.7  | 1   |



1996)

**Figure 5:** The control surface of the Fuzzy PID controller

In hybrid PID controller the conventional PID controller and Fuzzy PID controller have been combined directly as shown in Fig. 6. So as to make a fair comparison, the control rules of hybrid PID controller have taken the same rules as Fuzzy PID controllers.


**Figure 6:** Block diagram of closed loop system with hybrid type Fuzzy PID controller (Oh et al. 2004)

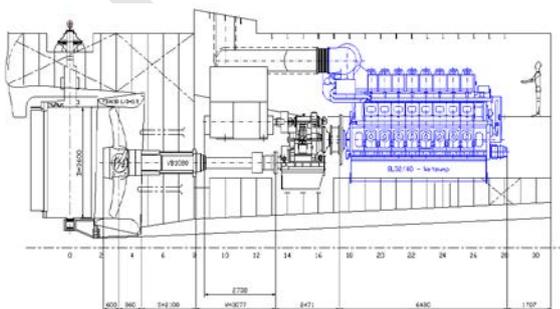
## Ship Propulsion System

The entire propulsion power plant of ship, as from main engine through propeller, all drivelines cause vibrations more than one axis. The most influential vibration is torsional vibration. The considered ship propulsion plant which is shown in Figure 7, have been performed via controllers.

The multi-degree of freedom system can be solved by Energy Methods, one of which is Lagrange equations;

$$\frac{d}{dt} \frac{\partial T}{\partial \dot{q}_i} - \frac{\partial T}{\partial q_i} + \frac{\partial U}{\partial q_i} + \frac{\partial D}{\partial \dot{q}_i} = Q_i \quad (3)$$

$T$ ,  $U$ ,  $D$  and  $Q_i$  are total kinetic energy of a system, change of potential energy of a system with respect to its potential energy in the static-equilibrium position, total damping energy and generalized non-potential moments, respectively. Analyzing of equations of motion with Lagrange, the transfer functions can be determined as numbered (4) and (5).


**Table 3:** Main engine properties

| MAN 8 L 32/40       | Values  |
|---------------------|---------|
| Piston Stroke       | 40 cm   |
| Cylinder bore       | 32 cm   |
| Number of cylinders | 8       |
| Power               | 4000 KW |
| Speed               | 750 rpm |

**Figure 7:** Main engine and power plant (MAN, 2006)

$$\square\square = \frac{2.85\square7\square + 4.878\square8}{1.582\square8\square^4 + 2.692\square8\square^3 + 1.666\square10\square^2 + 1.188\square9\square + 2.034\square10} \quad (4)$$

$$\square\square = \frac{2.891\square8\square^2 + 2.85\square7\square + 4.178\square8}{1.582\square8\square^4 + 2.692\square8\square^3 + 1.666\square10\square^2 + 1.188\square9\square + 2.034\square10} \quad (5)$$

## Simulations and Analysis

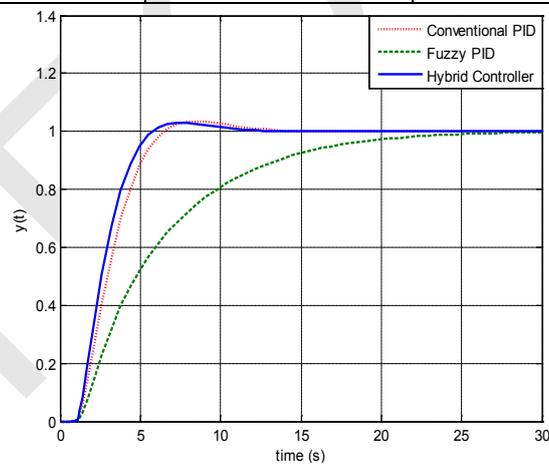
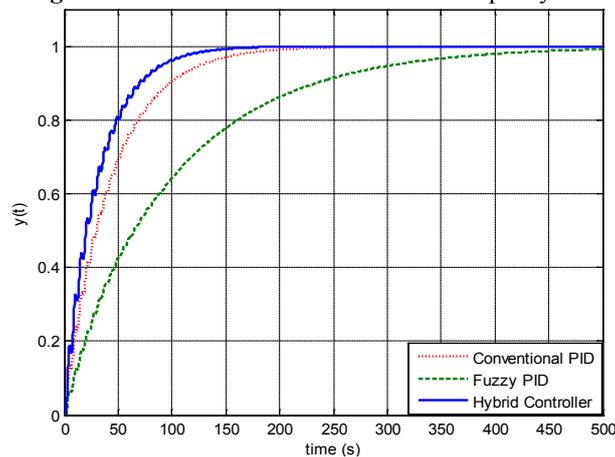
In order to recognize the effects of parameter of controllers a second order stable system  $G_s$  was assumed.

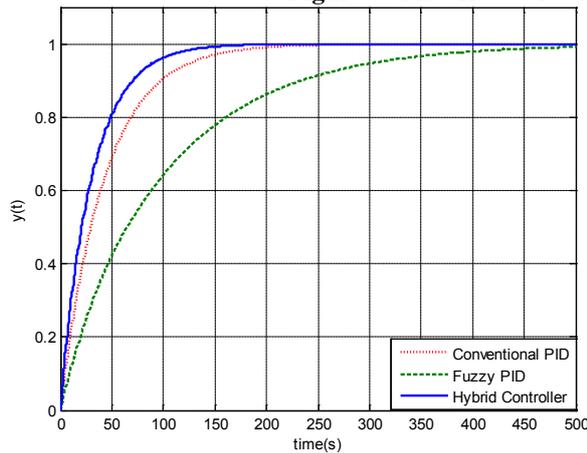
$$\square\square = \frac{1}{(\square + 1)(\square + 2)} \quad (6)$$

The effects of controllers are shown in Fig. 8. Next, the propeller and the shaft systems have been applied through controllers as shown in Fig. 9 and Fig. 10, respectively.

**Table 4:** System characteristics of the sample system

| The sample system | Overshoot       | Settling time (s) | Rise time(s) | Steady-state error |
|-------------------|-----------------|-------------------|--------------|--------------------|
| Conventional PID  | 1.035 [8.50(s)] | 3.4               | 15.1         | 0                  |
| Fuzzy PID         | 0               | 11.4              | >30          | 0.0023             |
| Hybrid Controller | 1.03 [7.30(s)]  | 2.8               | 13.9         | 0                  |


**Figure 8:** The effects of controllers on sample system


**Figure 9:** The effects of controllers on ship propeller system

**Figure 10:** The effects of controllers on ship shaft system

It is obviously seen in Table 4 that even though hybrid controller causes overshoot, it has the best solution each system characteristics except overshoot. Although Fuzzy PID controller does not produce an overshoot, it does not response as well as hybrid controller. Table 5 indicates that controllers have the same influences on system characteristics in ship propulsion system.

**Table 5:** System characteristics of the ship propeller system

| The Ship Propeller System | Overshoot |       | Settling time(s) |       | Rise time(s) |       | Steady-state error |        |
|---------------------------|-----------|-------|------------------|-------|--------------|-------|--------------------|--------|
|                           | Propeller | Shaft | Propeller        | Shaft | Propeller    | Shaft | Propeller          | Shaft  |
| Conventional PID          | 0         | 0     | 95.47            | 94.3  | 280.7        | 347.1 | 0                  | 0      |
| Fuzzy PID                 | 0         | 0     | 223.88           | 225.2 | >500         | >500  | 0.0023             | 0.0082 |
| Hybrid Controller         | 0         | 0     | 66.82            | 67.46 | 186.1        | 268.7 | 0                  | 0      |

**Table 6:** The effects of controller on system characteristics

| Influence | Overshoot | Settling time(s) | Rise time(s) | Steady-state error   |
|-----------|-----------|------------------|--------------|----------------------|
| Positive  | Each      | Hybrid           | Hybrid       | Conventional+ Hybrid |
| Negative  | None      | Fuzzy            | Fuzzy        | Fuzzy                |

## Conclusions

In this study, effects of controller on system characteristics were investigated, and an application on ship propulsion system was applied. System characteristics that have important information about system are determined or adjusted via controllers. The most commonly used controller is PID controllers which are not adequate last decades. So intelligent controller as Fuzzy PID has been started to use instead of or with the conventional PID controller. Thus, in this paper the conventional PID and Fuzzy PID controllers were combined directly which named hybrid controller. The simulations done on a sample and ship propulsion systems using the hybrid PID controller have provided better system responses in terms of system characteristics. As shown in Table 6, hybrid PID controller is compared to the conventional PID or the Fuzzy controller applications. Consequently, the simulation results have shown that the hybrid structure has provided a good and effective performance on system characteristics.

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## EFFECTS OF N-BUTANOL AND ISOPROPHYL ALCOHOL (IPA) – DIESEL FUEL FUELS IN A DIESEL ENGINE

Hanbey Hazar

Department of Automotive Engineering, Technology Faculty, Firat University, Turkey  
hanbeyhazar@hotmail.com

**Abstract:** An experimental study is conducted to evaluate the effects of using blends of diesel fuel with either n-butanol in proportions of 2%, 8%, 12% and 16% or isoprophyl alcohol (IPA) in 1% (by vol.). The effect of additive materials on diesel engine was examined experimentally in a three cylinder, direct injection diesel engine running at a constant speed 1500 rpm at different loads. In order to prevent phase separation 1% dodecanol was added into the mixture. From the results, it was seen that the CO, HC and smoke density emission decreased, NOx emission increased with the increase in n-butanol amount.

**Key words:** Diesel engine; n-butanol; isoprophyl alcohol; exhaust emissions

**Özet:** Bu deneysel çalışmada, hacimsel olarak %1 isopropil alkol içeren %2, %8, %12 ve %16 n-butanol dizel yakıt karışımlarının etkileri araştırılmıştır. Katkı maddelerinin etkileri üç silindirli, direkt enjeksiyonlu dizel bir motorda sabit 1500 devir ve farklı motor yüklerinde test edilmiştir. Yakıt içerisindeki faz ayrışmalarını önlemek için %1 dodekanol ilavesi yapılmıştır. Sonuçlarda CO, HC emisyonlarının azaldığı, NOx, HC emisyonlarının arttığı tespit edilmiştir.

**Anahtar kelimeler:** Dizel motor; n-butanol; isopropil alkol; egzoz emisyonu

### Giriş

İçten yanmalı motorlar, icadından sonra çok hızlı bir gelişme göstererek endüstride çok önemli bir yere sahip olmuşlardır. Bu motorlarda yakıt olarak petrol ürünleri kullanılmaktadır. Çok yakın bir gelecekte petrolün tükeneceğinin ortaya çıkması bu yakıtların yerini alabilecek alternatif yakıt arama çalışmaları hızlandırmıştır. Önceden beri var olan alternatif yakıt kullanma çalışmaları hız kazanmış ve kriz dönemleri sonrasında önemli ölçüde yavaşlama göstermiştir. İçten yanmalı motorlarda alternatif yakıt olarak gaz veya sıvı yakıtlar kullanılabilir. Gaz yakıt olarak LPG (Sıvılaştırılmış Petrol Gazı) ve doğal gaz, sıvı yakıt olarak etanol, metanol ve çeşitli bitkisel yağların (BY) motorlarda kullanımı ile ilgili bir çok araştırma yapılmaktadır. Buji ateşlemeli motorlarda LPG ve doğal gaz kullanımı yaygınlaşmakta, etanol ve metanolun ise yalnız başına yada benzin ile çeşitli oranlarda karıştırılarak kullanımı ile ilgili çalışmalarda yürütülmektedir. Dizel motorlarında ise gaz yakıt olarak doğal gaz pilot yakıt ile birlikte kullanılırken, BY'lar ve bunlardan elde edilen etil ve metil esterler ise yalnız başına yada çeşitli oranlarda dizel yakıt ile karıştırılarak test edilmektedir. Türkiye'de petrol üretimi, tüketime göre oldukça azdır. Ülkemizde tüketilen enerji kaynaklarına bakıldığında en fazla miktar petrolde görülmektedir. Mevcut petrol havzalarımızdan üretilen petrol miktarı sınırlı olduğundan ancak yeni petrol havzaları bulunması gerekir. Bunlara ilave olarak petrolün belirli bir rezerve dayalı sonlu kaynak olması, mevcut motor teknolojisinde fazla bir değişiklik yapmadan petrole alternatif olacak yeni yakıtların ve petrol rezervlerinden motorlar için kullanılabilir yeni yakıt karışımlarının araştırılarak kullanılmasını zorunlu hale getirmiştir (Hazar, 2008).

Bu çalışmada, bir dizel motorda dizel yakıtının içerisine hacimsel olarak belirli oranlarda n-butanol katkısı ilave edilmiş ve dizel yakıt karışımlarının etkileri araştırılmıştır.

## Yöntem ve Metod

Deneyel çalışmalara başlamadan test motorunun genel bakımları yapılmıştır. Motorun yakıt enjektörleri sökülerek kontrolleri yapılmıştır. Tüm yakıt testleri motorda herhangi bir modifikasyon yapılmadan gerçekleştirilmiştir. Motor standart dizel yakıt ile bir süre yüksüz çalıştırılmış ve sonra motor optimum çalışma sıcaklığına geldikten sonra motora 2,5MW (%20) – 5MW (%40) – 7,5MW (%60) – 10MW (%80) değerdeki 4 ayrı kademedeki yük uygulanmıştır. Bu işlem iki defa tekrar edilmiş ve ölçülen değerlerin ortalaması hesaplanmıştır. Bir yakıt türü için ölçümler tamamlandıktan sonra motor durdurulup, bir süre beklendikten sonra diğer yakıt türü ile çalışmaya geçilmiştir. Deneyel çalışmada yukarıda belirtilen değişken yük değerlerinde Özgül Yakıt Tüketimi (gr/kw.h), HC (ppm), CO (%), NOx (ppm) ve Duman yoğunluğu (is) değerleri ölçülmüştür.

### Kullanılan test ölçüm cihazları:

#### 1. Egzoz Emisyon Ölçüm Cihazı

Deneylerde egzoz gazlarının analizi için CAPELEC CAP 3200 gaz analiz cihazı kullanılmıştır. Bu cihaz hacimsel olarak HC ve NOx 'i ppm cinsinden CO, CO<sub>2</sub> ve O<sub>2</sub> 'yi % cinsinden tespit etmektedir. Tablo 1' de hassasiyet özellikleri verilmiştir.

**Tablo 1:** Egzoz emisyon ölçüm cihazının ölçüm aralığı ve hassasiyet değerleri

| Parametre       | Ölçme aralığı | Hassasiyet |
|-----------------|---------------|------------|
| HC              | 0 – 20000 ppm | 1ppm       |
| CO              | 0 – 15 %      | 0,001 %    |
| CO <sub>2</sub> | 0 – 20 % .    | 0,1 %      |
| O <sub>2</sub>  | 0 – 21,7 %    | 0.01 %     |
| LAMBDA          | 0,6– 1,2      | 0.001      |
| NOx             | 0 – 5000 ppm  | 1 ppm      |

#### 2. Duman Ölçüm Cihazı:

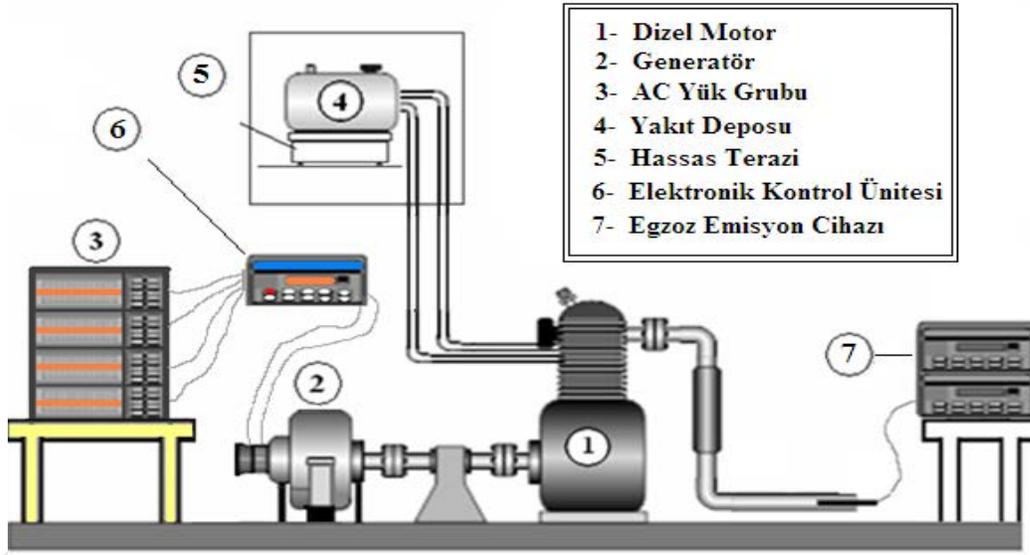
Duman ölçümü için CAP 3200 D dizel duman ölçer kullanılmıştır. LCD grafik ekranlıdır. Bu cihaz egzoz gazlarındaki duman yoğunluğunu hem (%) hem (m-1) cinsinden ölçebilmektedir. Cihazın ölçüm aralığı ve hassasiyeti Tablo 2' de verilmiştir.

**Tablo 2:** Duman ölçüm cihazı ölçüm aralığı ve hassasiyet değerleri

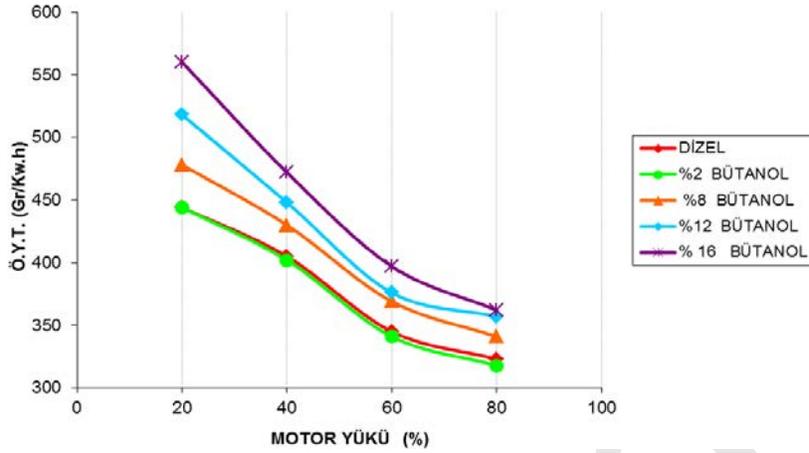
| Parametre | Ölçme aralığı   | Hassasiyet |
|-----------|-----------------|------------|
| N         | 0 – 100 %       | 0.1 %      |
| K         | 0.00 – 9,99 m-1 | 0.01 m-1   |

**Tablo 3:** Deneylerde kullanılan motorun teknik özellikler

|                   |                            |
|-------------------|----------------------------|
| <b>MARKASI</b>    | <b>GENPOWER (GNT 13)</b>   |
| Tipi              | Senkron-Fırçasız           |
| Aktif Gücü        | 12,5 KW                    |
| Akım Dağılımı     | L1 - L2 -L3                |
| Gerilimi          | 231/400 V                  |
| Gerilim Toleransı | 0,5                        |
| Dayanımı          | 2U+1000V Minimum 1800 Volt |


**Şekil 1:** Deneysel çalışmada kullanılan motorun şematik resmi.

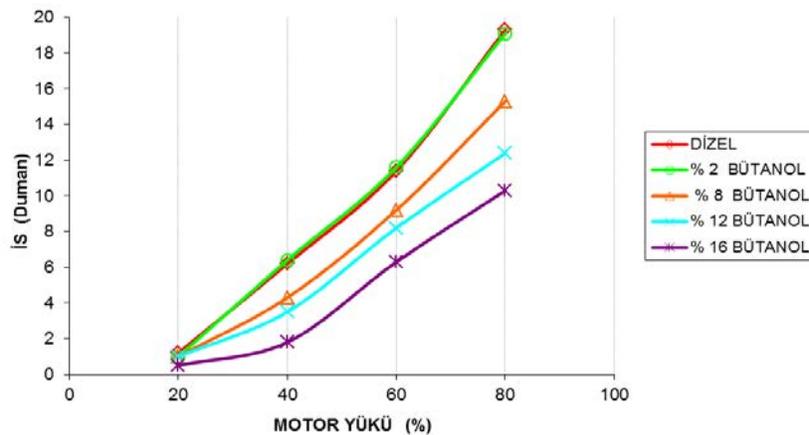
## Sonuçlar ve tartışma



Şekil 2: Özgül yakıt tüketiminin motor yüküne göre değişimi.

Şekil 2' de sabit devir, değişken motor yüküne göre özgül yakıt tüketimi değişimi görülmektedir. İçten yanmalı motorlarda özgül yakıt tüketimi üzerinde, yakıtın fiziksel ve kimyasal özellikleri ve yanma verimi önemli bir etkiye sahiptir. Şekilde görüldüğü gibi test yakıtları içerisinde n-butanol oranının artmasıyla beraber özgül yakıt tüketiminin arttığı görülmektedir. N-butanol ve isopropil alkolün ısı değerinin standart dizel yakıtına göre düşük olması, n-butanol katkılarında özgül yakıt tüketiminin yüksek çıkmasına neden olduğu düşünülmektedir. Yapılan diğer bu görüşü desteklemektedir (Özer, 2010 ).

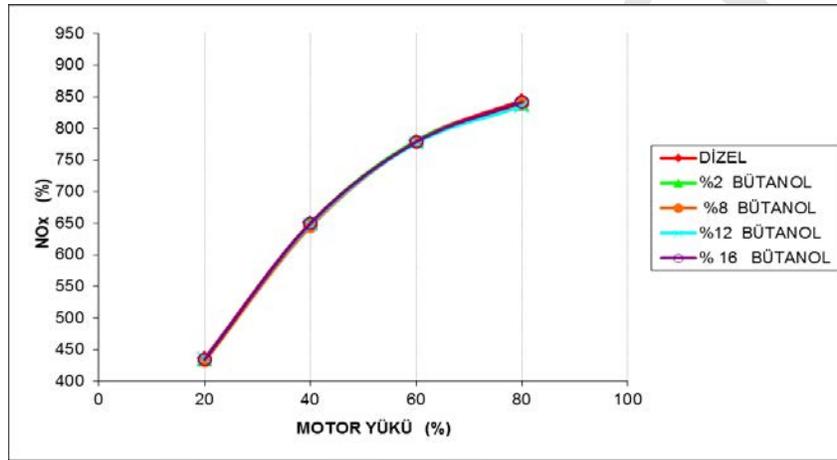
Test yakıtları incelendiğinde, %2 n-butanol yakıtının % 0.79 azalma gösterdiği, ancak diğer test yakıtlarının ise artan n-butanol oranıyla özgül yakıt tüketiminin arttığı tespit edilmiştir. En büyük artış, %16 n-butanol test yakıtında %18 olarak tespit edilmiştir. Aynı şekilde n-butanol yoğunluğunun dizel yakıtına göre düşük olması aynı çıkış gücünü elde edilmesi için silindirler içerisine daha fazla yakıt gönderilmesine neden olduğu düşünülmektedir.



Şekil 3: Duman yoğunluğunun motor yüküne göre değişimi.

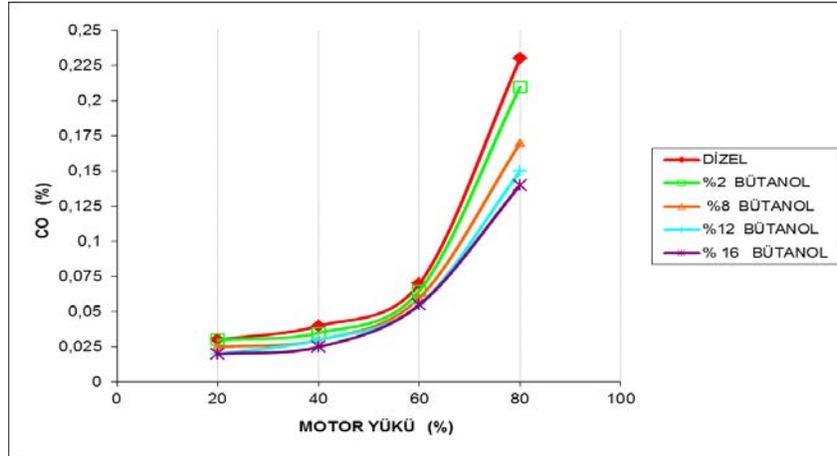
Özellikle dizel motorlarının egzoz emisyonlarında yüksek oranda görülen is, bir eksik yanma ürünüdür. Duman yoğunluğunun yapısı, alevdeki yerine göre fiziksel ve kimyasal olarak farklılık göstermektedir (Boran, 2001; Tree, 2007).

Şekil 3' de duman yoğunluğunun sabit motor devri, değişken yüke göre değişimi görülmektedir. Alçak motor yüklerinde bütün test yakıtları için duman yoğunluğunun düşük çıktığı görülmektedir. Bu durum, düşük motor yüklerinde yanma odasındaki hava hareketliliğinin ve yanma odası sıcaklığının düşük olmasıyla izah edilebilir. Yüksek motor yüklerinde ise bütün test yakıtları için duman yoğunluğunun arttığı görülmektedir. Artan motor yüküyle beraber yetersiz süre, düşük yanma verimi ve zengin karışım oluşum, duman yoğunluğunun arttırdığı düşünülmektedir. Test yakıtları içerisindeki n-butanol oranının artmasıyla beraber, standart dizel yakıtına göre is oluşumunun azalması, dizel yakıtına göre C/H oranının düşük olmasıyla izah edilebilir. Standart dizel yakıtına göre en fazla azalma %16 n-butanol yakıtında %50.39 olarak tespit edilmiştir.



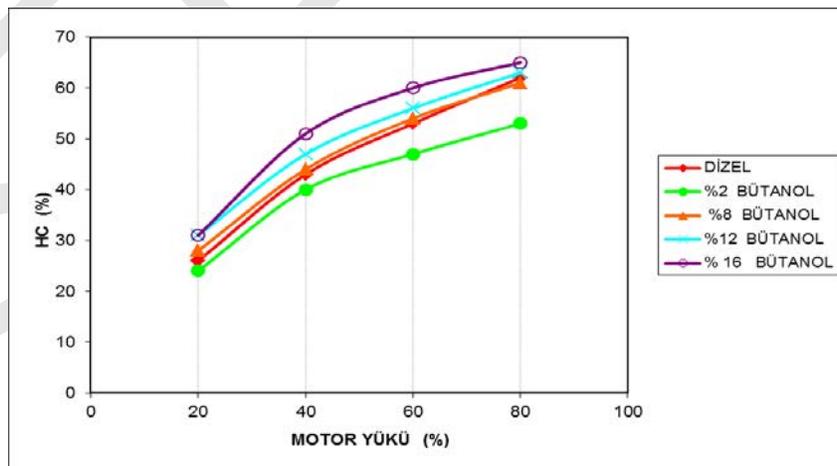
**Şekil 4:** NOx emisyonunun motor yüküne göre değişimi.

NOx oluşumunun temel sebebi, yanma esnasındaki azotun oksitlenmesidir. Nitrik oksit (NO) ve nitrojen dioksit (NO<sub>2</sub>), NOx emisyonu olarak gruplandırılan NO, motor silindiri içerisinde üretilen nitrojen baskın oksitidir. NOx emisyonu genellikle 1800 °K' nin üzerindeki sıcaklıklarda meydana gelir. Özellikle O<sub>2</sub>'nin bulunduğu bölgelerdeki sıcaklığın yüksekliği ve bu sıcaklıkta kalma süresi oldukça etkilidir (Heywood, 1988). Şekil 4'e bakıldığında standart dizel yakıtına ilave edilen n-butanol oranının artmasıyla beraber NOx emisyonunda çok azda olsa bir azalma görülmektedir. Bu düşüşün başlıca sebebi, n-butanol ve isopropil alkolün standart dizel yakıtına göre enerji içeriğinin düşük olmasından dolayı yanma sonu sıcaklığını düşürmesidir. N- butanol karışımlarının standart dizel yakıtına göre NOx oluşumunun düşük çıkmasının diğer bir sebebi de artan karışım oranı ile orantılı olarak n-butanolün buharlaşma ısısının yüksek olmasından dolayı silindirlere içerisinde daha çok ısı çekerek yanma sonu sıcaklığı ve bununla birlikte basıncının düşürmesidir. Yapılan diğer çalışmalar bu sonucu desteklemektedir (Özer, 2010; Rakopoulos, 2013). Elde edilen sonuçlarda, standart dizel yakıtına göre en fazla düşüş, %8 n- butanol test yakıtında, % 0.7 olarak tespit edilmiştir.



**Şekil 5:** CO emisyonun motor yüküne göre değişimi.

CO oluşumu yakıtın eksik yanmasından kaynaklanmaktadır. Yanma odası içerisindeki yakıtın tam yanması durumunda karbon bileşiminin tamamı  $CO_2$ 'ye dönüşür. Yanma odasında karbon monoksit (CO) emisyonu genellikle yakıt/hava oranıyla kontrol edilmektedir (Heywood, 1988). Dizel motorlarında yanma olayını etkileyen ve yanmayı devam ettiren; yanma bölgesindeki sıcaklık, basınç, karışım oranı ve oksijen miktarını belirleyen yerel koşullardır (Morel, 1986; Hazar, 2011). Şekil 5' de standart dizel yakıtının içerisindeki n-butanol oranının artmasıyla beraber CO emisyonunun azaldığı görülmektedir. Bu oluşumun başlıca sebebi, n-butanol katkısının içerisindeki karbon (C) miktarı standart dizel yakıtına göre daha düşük olmasıyla izah edilebilir. Ayrıca n-butanol katkısının içerisindeki oksijen yoğunluğu standart dizel yakıtına göre fazla olması, yanma odası içerisindeki kimyasal tepkimedeki CO oluşumunu azalttığı düşünülmektedir. Test sonuçlarında, standart dizel yakıtına göre en fazla CO emisyonu düşüşü, %16 n-butanol test yakıtında, % 35 olarak tespit edilmiştir.



**Şekil 6:** HC emisyonun motor yüküne göre değişimi.

HC emisyonu oluşumunun esas sebebi, yanma odası içerisindeki yakıtın kısmen veya büyük bir kısmının yanmamasıdır. Şekil 6' da görüldüğü gibi, standart dizel yakıtına göre %2 n-butanol yakıtı hariç diğer test yakıtları için HC emisyonunun arttığı görülmektedir. Test yakıtları içerisindeki n-butanol katkısının artmasıyla beraber HC emisyonunun artmasının esas sebebi, n-butanolün setan sayısının, viskozitesinin ve yoğunluğunun düşük olduğu düşünülmektedir. Test sonuçlarında, standart dizel yakıtına göre en fazla HC emisyonu artışı, %16 n- butanol test yakıtında,% 12.5 olarak tespit edilmiştir.

## Sonuçlar

Deney sonuçlarına göre; test yakıtları incelendiğinde, %2 n-butanol yakıtının % 0.79 azalma gösterdiği, ancak diğer test yakıtlarının ise artan n-butanol oranıyla özgül yakıt tüketiminin arttığı, test yakıtları içerisindeki n-butanol oranının artmasıyla beraber, standart dizel yakıtına göre is, NOx, CO emisyonunun azaldığı, HC emisyonunun arttığı tespit edilmiştir.

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# EĞİTİM PAYDAŞLARININ DÜŞÜNCELERİNE GÖRE OKULLARIN ETKİLİ OKUL ÖZELLİKLERİNE SAHİP OLMA DÜZEYLERİ

Yrd. Doç. Dr. Celal GÜLŞEN

Fatih Üniversitesi Eğitim Fakültesi Eğitim Bilimleri Bölümü  
Eğitim Yönetimi Teftişi Planlaması ve Ekonomisi Anabilim Dalı Başkanı  
İstanbul/Türkiye  
[celalgulsen@gmail.com](mailto:celalgulsen@gmail.com)

Aysel ATEŞ

Fatih Üniversitesi Sosyal Bilimler Enstitüsü  
Eğitim Yönetimi Teftişi Planlaması ve Ekonomisi Anabilim Dalı Yüksek Lisans Öğrencisi-İstanbul/Türkiye  
[ates.aysel@yahoo.com](mailto:ates.aysel@yahoo.com)

Emine Gürer BAHADIR

Fatih Üniversitesi Sosyal Bilimler Enstitüsü  
Eğitim Yönetimi Teftişi Planlaması ve Ekonomisi Anabilim Dalı Yüksek Lisans Öğrencisi-İstanbul/Türkiye  
[egurer@hotmail.com](mailto:egurer@hotmail.com)

**Özet:**Bu araştırma, ilkokul ve ortaokul düzeyindeki okulların, etkili okul özelliklerine sahip olma düzeylerini eğitim paydaşlarından yönetici, öğretmen, öğrenci ve velilerin görüşleri doğrultusunda belirlemek amacıyla yapılmıştır. Okulların etkililiği, okulun hedeflerine ulaşma derecesiyle ve paydaşlarının ihtiyaçlarının karşılanma düzeyiyle ölçüldüğü için, böyle bir araştırma yapılmasına ihtiyaç duyulmuştur. Araştırma verilerine dayalı olarak etkili okullarla ilgili çıkarımlar yapılması hedeflenen araştırma, tarama modelinde desenlenmiştir. Verilerin toplanmasında ise, Mortimore'un (1995) etkili okul faktörlerine ilişkin sınıflaması esas alınarak, araştırmacılar tarafından 2012 yılında geliştirilen "Etkili Okul Özellikleri Anketi" kullanılmıştır. Araştırmada etkili okulun "öğrenci", "okul çevresi ve veli", "okul yönetimi" ve "öğretmen" boyutları ele alınarak değerlendirilmiştir. Araştırma sonuçlarına göre, en etkili okul boyutunun genel aritmetik ortalamalara ( $\bar{X}$ ) göre "2.53" düzeyiyle "öğretmen" boyutu olduğu görülmüştür. En az etkili bulunan etkili okul boyutu ise, "2.35" düzeyiyle "okul çevresi ve veli" boyutu olarak belirtilmiştir. Bu sonuçlara dayalı olarak okullarımızda okul-çevre-veli ilişkilerinin geliştirilmesi gerektiği önerilmektedir.

**Anahtar Kelimeler:** Etkili Okul, Yönetici, Öğretmen, Veli, Eğitim, Paydaş.

## Giriş

1930'larda Barnard etkililiği örgütün hedeflerine ulaşma derecesi olarak tanımlarken, etkinliği ise örgüt paydaşlarının ihtiyaçlarının karşılanma düzeyi olarak tanımlamıştır. Schreens ise etkinliği en az maliyetle en iyiye ulaşma düzeyi olarak tanımlamıştır. Etkililiğin farklı bakış açılarına göre pek çok tanımı olmakla birlikte kuramsal çerçevelere uyan net bir tanımlanamamıştır. Ancak çok boyutlu bir kavram olduğu konusunda görüşbirliği sağlanmıştır. Etkililiğin kuramsal çerçevelere uyan bir tanımının yapılamamış olması etkili okulu tanımlamayı da zorlaştırmıştır. Klopff ve diğerlerine göre (1982), etkili okul; öğrencilerin bilişsel, duyuşsal, psikomotor ve estetik alanda gelişmelerinin sağlanabilmesi için düzenlenmiş optimum öğrenme ortamına sahip olan okul olarak tanımlanmıştır. Brookover (1985) ise etkili okulun temelinde fırsat eşitliği olduğu görüşünden yola çıkarak, etkili okulu sadece seçilmiş öğrencilerin değil de tüm öğrencilerin temel becerileri kazanabildiği okul olarak tanımlamıştır (Balci, 2011). Bu araştırmada ise etkili okul yaratan faktörlerin Yakuplu Kemal Arıkan İlkokul ve ortaokulu'nda bulunup bulunmadığının değerlendirmesi Mortimore'un (1995) belirlemiş olduğu faktörler açısından değerlendirilecektir. Mortimore'un etkili okul faktörlerinden biri olan mesleki liderlik; yöneticinin açık ve net hedefler belirlemesine, bu hedefleri belirlerken de eğitim paydaşlarının fikirlerini almasını ve kısmen onları da yönetime katmasını öngörür (Çelik, 2012). Bu da bize yönetim kavramını hatırlatmaktadır. Yönetim ise yönetimin, iletişimin ve etkileşimin birleşiminden oluşmaktadır. Yöneticinin okuldaki personelle kurduğu açık iletişim beraberinde etkileşimi getireceğinden; yönetimin ihtiyaç duyduğu doğal bir ortam oluşacaktır. Yönetimin sağladığı doğal ortam sayesinde ortak hedefler oluşur; bu hedefler ise bütün paydaşların etrafında birleşeceği ortak bir vizyona çerçeve

çizmiş olur.(Şişman,2011). Belirlenen çerçeveye göre misyon tanımlanıp harekete geçilir.Paydaşlar tarafından kabul edilmiş misyona ulaşma çabası olumlu bir okul iklimini oluşturur. Olumlu okul iklimi ise meslektaş ilişkisini ve işbirlikçi çalışmayı beraberinde getirir(Aydın,2012). Böyle bir ortam ise sadece öğrencilerin değil bütün personelin öğreneceği ve sürekli kendini geliştirebileceği süreci başlatacaktır. Başlayan bu süreçte ise tüm eğitim paydaşları öğrenmeye yoğunlaşacağından öğrenme zamanının maksimizasyonu kendiliğinden sağlanmış olacaktır. Bu ise başarı odaklı bir okul kültürünü beraberinde getirecektir. Oluşan başarı odaklı kültürde hedefler açık olacağından iyi yapılandırılmış sınıf içi süreçler sayesinde hedeflere ulaşılabilecektir (Çelik,2012). Başarı odaklı okul kültürünün var olduğu okullarda belirlenen hedeflere ulaşmak için eğitim paydaşlarının birbirlerinden yüksek beklenti içerisinde olmaları temel göstergedir. Paydaşlar karşılıklı olarak bu beklentilerin farkındadırlar (Aydoğan ve Helvacı,2011,s 41-60). Bu farkındalık ise açık ve adil disiplin ve geri besleme ile pekiştirilir. Pekiştirmenin yönü pozitif olduğundan bunu olumlu pekiştirme olarak adlandırmak mümkündür. Olumlu pekiştirme ile öğrenci performansı artırılırken , diğer yandan da öğrencinin süreç içindeki gelişim performansı yönetilmiş olur. Öğrenci performansı değerlendirmeleri ise okul performansına dönüt olmaktadır. Öğrenci performansının yönetimi öğrencinin sorumluluk almasını gerektirmektedir(Şişman,2011). Gelişim yönetimine göre öğrenciye verilen sorumluluklar öğrencinin kendine güvenini artırarak otokontrolünü sağlamaktadır.Yukarıda söz konusu edilen faktörler gerçekleştirildiğinde okul tüm personeliyle öğrenen bir örgüt olacaktır. Okul denilen eğitim örgütlerinin öğrenen örgüt olarak etkililiği, okul paydaşlarının okulun amaçlarını optimum seviyede gerçekleştirip en uygun öğrenme ortamlarını oluşturması ile mümkün olacaktır (Kaplan, 2008: 4).Bu ise okula dayalı personel geliştirmenin önünü açacaktır(Aslan ve Beycioğlu,2010,s153-173).

### **Metod**

Yakuplu Kemal Arıkan İlkokul'unun ve Ortaokulu'nun Peter Mortimore'un (1995) etkili okul faktörlerine (Balci,2012: s.25) göre değerlendirilmesi amaçlanan bu çalışmada, eğitim paydaşlarının (yönetici, öğretmen, öğrenci ve veli) okulu öğrenci boyutuna, okul çevresi ve veli boyutuna, okul yönetimi boyutuna ve öğretmen boyutuna göre değerlendirmelerine bakarak okulun etkililiği hakkında bir yargıya ulaşmaktır. Ayrıca bu yargıya veri toplamak için okul memuresi, okul aile birliği başkanı, okul hizmetlileri ve güvenlik görevlisi ile görüşülmüştür.

Eğitim paydaşlarının düşüncelerine göre Yakuplu Kemal Arıkan İlkokulu'nun ve Ortaokulu'nun etkili okul özelliklerine ne derece sahip olduğu betimlenmek istenmektedir. Araştırma varolan bir durumu ortaya koymak için yapılmış bir çalışmadır.

Yakuplu Kemal Arıkan İlkokulu'nun ve Ortaokulu'nun tüm öğretmenleri ve idarecileri çalışma grubuna dahil edilmiştir. Bir okul müdürü ve iki okul müdürü yardımcısı ile toplam otuzbeş öğretmen araştırmanın çalışma grubunu oluşturmuştur.

Bu öğretmenlerin onyedisi ilköğretim bölümünden, onsekiz tanesi ortaokul bölümünden dir.

Ayrıca çalışma grubundaki öğrencilerin tespiti için, okul idaresinden ilköğretim ve ortaokul öğrencilerinin isim listesi alınmış ve bu listeden her dokuzuncu öğrenci tespit edilerek çalışma grubuna dahil edilmiştir.İlkokul bölümündeki toplam öğrenci sayısı beşyüzonsekiz ve ortaokul bölümündeki öğrenci sayısı ise üçyüzdokuzdur. İlkokul bölümünden yirmi öğrenci ,ortaokul bölümünden otuzüç öğrenci çalışma grubuna dahil edilmiştir. Araştırma verilerinin tarafsız olması için listeden bu yolla seçim yapılmıştır.

Çalışma grubuna dahil edilecek velilerin tespiti için, çalışma grubuna dahil edilen öğrencilerin velileri olmaması için, öğrenci isim listesinden her onuncu öğrencinin velisi gruba dahil edilmiştir. İlkokul bölümündeki toplam veli sayısı beşyüzonsekiz ve ortaokul bölümündeki veli sayısı ise üçyüzdokuzdur. İlkokul bölümünden yirmi veli ,ortaokul bölümünden otuzüç veli çalışma grubuna dahil edilmiştir. Araştırma verilerinin tarafsız olması için listeden bu yolla seçim yapılmıştır.

Araştırmada beş bölümden oluşan ve her bölümün içinde beş soru bulunan anket; yönetici, öğretmen, öğrenci ve velilere uygulanmıştır. Bu ankete eğitim paydaşlarının okulu beş kategoride değerlendirmeleri istenmektedir. Bunlar; öğrenci boyutu, okul çevresi ve veli boyutu, okul yönetimi boyutu ve öğretmen boyutudur. Destek personeli, okul aile birliği başkanı, güvenlik görevlisi ve okul memuresine anket uygulanmamıştır. Görüşme yoluyla . destek personeli, okul aile birliği başkanı, güvenlik görevlisi ve okul memuresinden fikirleri alınmıştır.

Verilerin yorumlanmasında her bir maddeye ilişkin olarak hesaplanan ortalama, o maddenin gerçekleşme düzeyinin göstergesi olarak alınmıştır. Bilgi toplamak amacıyla uygulanan anket etkili okulun öğrenci, okul çevresi ve veli, okul yönetimi ve öğretmen olmak üzere dört boyutundan meydana gelmektedir. Anket formunda her boyut için beş madde bulunmaktadır. Bunlar karşısında deneklerin verebileceği tepkilerde üç kategoride toplanmış olup, bu kategoriler “katılıyorum”, “ az katılıyorum” ve “katılmıyorum” şeklinde düzenlenmiştir. Seçenekler “katılıyorum” için 3, “az katılıyorum” için 2 ve “ katılmıyorum” için 1 biçiminde puanlandırılmıştır.

Ankette kişisel değişkenlere yer verilmemiştir. Uygulanan anket örneği aşağıdaki gibidir.

#### Etkili Okul’un “Öğrenci” Boyutuna İlişkin Değerlendirmesi

|   | Genel olarak bu okuldaki öğrenciler;....   | Katılıyorum | Az katılıyorum | Katılmıyorum |
|---|--|-------------|----------------|--------------|
| 1 | Başarılı olabileceklerine inanırlar ve başarı ile ilgili beklentileri yüksektir. |             |                |              |
| 2 | Birlikte ve işbirliği içinde çalışma yapmaya yatkındırlar.                       |             |                |              |
| 3 | Görev ve sorumlulukları konusunda bilinçlidirler.                                |             |                |              |
| 4 | Haklarında verilen kararlarda söz hakları olduğunu bilirler.                     |             |                |              |
| 5 | Okul ortamında öğretilenlerin çoğunu öğrenebilirler.                             |             |                |              |

#### Etkili Okul’un “Okul çevresi ve Veli” Boyutuna İlişkin Değerlendirmesi

|   | Genel olarak bu Okulun çevresi ve velileri;.....  | Katılıyorum | Az katılıyorum | Katılmıyorum |
|---|---|-------------|----------------|--------------|
| 1 | Veliler okul ve eğitim-öğretimle ilgili kararlarda söz sahibidirler.                      |             |                |              |
| 2 | Veliler, okulla ilgili şikayet , öneri ve fikirlerini okula çekince duymadan bildirirler. |             |                |              |
| 3 | Veliler okula maddi ve manevi katkıda bulunmayı isterler.                                 |             |                |              |
| 4 | Öğrenci disiplini konusunda aileler okula desteklidir.                                    |             |                |              |
| 5 | Okul ve öğretmenler veliler tarafından sıkça ziyaret edilir.                              |             |                |              |

#### Etkili Okul’un “Okul Yönetimi” Boyutuna İlişkin Değerlendirmesi

|   | Genel olarak bu okulun yönetimi;.....                            | Katılıyorum | Az katılıyorum | Katılmıyorum |
|---|--|-------------|----------------|--------------|
| 1 | Okuldaki eğitim ve öğretim sürecini denetler ve değerlendirir.   |             |                |              |
| 2 | Her türlü başarıyı ödüllendirir.                                 |             |                |              |
| 3 | Sınıf ziyaretleri yapar ve okullun her biriminde sık görülür.    |             |                |              |
| 4 | Okuldaki çalışma ortamlarının iyileştirilmesinde çaba sarf eder. |             |                |              |
| 5 | Çevre ve velilerin olanaklarını uygun şekilde değerlendirir.     |             |                |              |

#### Etkili Okul’un “Öğretmen ” Boyutuna İlişkin Değerlendirmesi

|   | Genel olarak bu okulun öğretmenleri;.....  | Katılıyorum | Az katılıyorum | Katılmıyorum |
|---|--|-------------|----------------|--------------|
| 1 | Eğitim öğretimle ilgili konularda işbirliği içindedirler.  |             |                |              |
| 2 | Her türlü başarıyı artıracabileceklerine inanırlar ve öğrencilerin başarılı olmasını beklerler . |             |                |              |
| 3 | Sorumluluk duyguları yüksektir.  |             |                |              |

|   |   |  |  |  |
|---|---|--|--|--|
| 4 | Öğrenciler için örnek davranışlar sergilerler.  |  |  |  |
| 5 | Dersleri ile ilgili yeni yöntem ve teknikleri takip eder ve sınıf ortamında uygularlar. |  |  |  |

## Sonuçlar

### Eğitim Paydaşlarının Etkili Okul'un "Okul Yönetimi" Boyutuna İlişkin Değerlendirmesi

|   |   | Yönetici  | Öğretmen  | Öğrenci   | Veli        |
|---|---|-----------|-----------|-----------|-------------|
|   |   | $\bar{X}$ | $\bar{X}$ | $\bar{X}$ | $(\bar{X})$ |
| 1 | Sınıfları ziyaret edip öğretmenlere rehberlik yapar.                                | 2,5       | 1,76      | 2,25      | 2           |
| 2 | Başarı değerlidir ve ödüle layıktır..   | 3         | 2,61      | 2,65      | 2,8         |
| 3 | Çalışanların okula bağlılığını sağlayarak, bütüleştirici kültür oluşturmaya çalışır | 2,5       | 2,15      | 2,45      | 2,4         |
| 4 | Öğretmenlerle olduğu kadar öğrenci ve velilerle de iletişim içindedir.              | 3         | 2,38      | 2,65      | 2,35        |
| 5 | Eğitim ve öğretime ilişkin öğretmen ve öğrencilerden beklentileri yüksektir.        | 3         | 2,46      | 2,65      | 2,8         |

Öğretmenler hariç diğer paydaşlar ,yöneticilerin sınıfları sık ziyaret edip,öğretmenlere rehberlik ettiği görüşüne katıldıklarını belirtmiştir ve ortalamaları iki veya ikinin üzerinde çıkmıştır.Ancak öğretmenler, bu maddeye 1,76'lık cevap ortalamasıyla çok fazla katılmadıklarını belirtmişlerdir.

Başarı değerlidir ve ödüle layıktır maddesine paydaşların hepsinin katıldıklarını ikinin üstünde olan cevap ortalamalarından anlamaktayız.İdareciler bu maddeye en çok katılan paydaşlardır.İdarecilerin bu madde için cevap ortalaması 3'tür.

Eğitim paydaşları, okul idaresinin çalışanların okula bağlılığını sağlayarak bütüleştirici bir kültür oluşturmaya çalıştığını düşünmektedir.Tüm paydaşların konuyla ilgili maddeye verdikleri cevapların ortalaması 2'nin üzerindedir.

Okul yönetiminin öğretmenlerle olduğu kadar öğrenci ve velilerle de iletişim içinde olduğu görüşüne tüm paydaşlar katılmıştır.Öğretmen,öğrenci ve velilerin cevaplarının ortalaması 2'nin üzerindedir.Yöneticilerin cevaplarının ortalaması ise 3'tür.Yani yöneticiler bu maddeye tamamen katıldıklarını belirtmişlerdir.

Eğitimin tüm paydaşları,okul yönetiminin öğrenci ve öğretmenlerden beklentisinin yüksek olduğu görüşüne katılmıştır.Yöneticiler hariç tüm paydaşların cevapları ortalaması 2'nin üzerindedir.Yöneticilerin cevaplarının ortalaması ise 3 olup,yöneticiler bu maddeye tamamen katıldıklarını belirtmiştir.

Okul aile birliği başkanı da bu bölümdeki maddeler hakkında olumlu görüş bildirmiştir.Yönetimin personelin okula bağlılığını arttırmak için zaman zaman programlar düzenlediğini belirtmiştir.Bu programlara örnek olarak ;birlikte okulda yemek yeme veya her sene öğretmenler günü için hazırlanan sürpriz ikramları göstermiştir.Ayrıca her sene öğretmenler gününde öğretmenler okul kapısından girerken kendilerine çiçek verilmesini de örnek göstermiştir.Yine yarışmalarda derece alan öğrencilerin başarılarının ödüllendirildiğini zaman zaman okul idaresinin,kendilerinden destek istediğini sözlerine ekledi.

Okul memuresi de okul aile birliği başkanına katıldığını ve her konuda yönetimin okul personeline yardımcı olmaya çalıştığını belirtmiştir.

Güvenlik görevlisi ise idare ile ilgili olumlu görüş bildirip, özellikle okul yönetimi ve veliler arasındaki ilişkiyi takdir ettiğini belirtmiştir. Gözlemediği diğer okullarda, yönetim veli ilişkisinin bu kadar açık ve net olmadığını görüşlerine eklemiştir.

Kantin personeli ise idarenin kendileriyle ilgilendiğini ve destek olduğunu belirtmiştir. İdarenin hangi ürünlerin satılıp, satılmaması gerektiği konusunda görüş bildirdiğini eklemiştir.

### Eğitim Paydaşlarının Etkili Okul'un "Öğretmen" Boyutuna İlişkin Değerlendirmesi

|   |   | Yönetici<br>$\bar{X}$ | Öğretmen<br>$\bar{X}$ | Öğrenci<br>$\bar{X}$ | Veli<br>$\bar{X}$ |
|---|---|-----------------------|-----------------------|----------------------|-------------------|
| 1 | Eğitim öğretimle ilgili konularda işbirlikçi çalışmaya önem verirler. | 2,5                   | 2,61                  | 2,75                 | 2,55              |
| 2 | Bütün öğrencilerin temel becerileri öğrenebileceğine inanırlar.       | 3                     | 2,23                  | 2,6                  | 2,6               |
| 3 | Öğrencilerden beklentileri yüksektir.                                 | 2,5                   | 2,07                  | 2,55                 | 2,6               |
| 4 | Mesleki yönden gelişmeye önem verirler.                               | 3                     | 2,23                  | 2,6                  | 2,6               |
| 5 | Kullandığı öğretim teknikleri öğrenme hedeflerine uygundur.           | 2                     | 2,46                  | 2,85                 | 2,4               |

Tüm paydaşlar, öğretmenlerin işbirlikçi çalışmaya önem verdikleri görüşünü içeren maddeye 2'nin üzerinde bir ortalama ile katılmışlardır. 2,75'lik bir ortalama ile öğrenciler bu maddeye en çok katılan paydaş olmuşlardır.

Öğretmenlerin tüm öğrencilerin temel becerileri kazanabileceğine inandıkları görüşüne tüm paydaşlar katılmışlardır. Yöneticiler ise 3 ortalama ile bu maddeye tamamen katıldıklarını belirtmiştir.

Tüm paydaşlar; öğretmenlerin, öğrencilerden beklentilerinin yüksek olduğu görüşüne katılmışlardır. Bu maddeye 2,6'lık ortalama ile en çok veliler katılmıştır.

Öğretmenlerin mesleki yönden gelişmeye önem verdikleri görüşüne tüm paydaşlar ikinin üzerinde cevap ortalaması ile katıldıklarını belirtmişlerdir. Yöneticiler, 3 ortalama ile bu maddeye tamamen katıldıklarını belirtmişlerdir.

Öğretmenlerin kullandıkları öğretim tekniklerinin öğrenme hedeflerine uygun olduğu görüşüne tüm paydaşlar katılmışlardır. Yöneticilerin bu madde için cevap ortalaması 2 olup yöneticiler bu görüşe en az katılan paydaş olmuşlardır. Öğrenciler ise 2,85'lik cevap ortalaması ile bu görüşe en çok katılan paydaş olmuşlardır.

Okul aile birliği başkanı ise okulda zümre öğretmenleri arasında işbirlikçi bir çalışmanın olduğunu, özellikle derste kullanılabilecek materyalleri paylaştıklarını söyledi. Yine öğretmenlerin öğrencilerin başarılı olacağına ilişkin beklentilerinin, öğrencileri ve velileri motive ettiğini gözlemediğini belirtti.

Okul memuresi ise okul aile birliğinin görüşlerine katıldığını belirterek, öğrenci motivasyonunu sağlamada öğretmenlerin belirgin bir etkisi olduğunu görüşlerine ekledi.

### Eğitim Paydaşlarının Etkili Okul'un "Öğrenci" Boyutuna İlişkin Değerlendirmesi

|   |   | Yönetici<br>$\bar{X}$ | Öğretmen<br>$\bar{X}$ | Öğrenci<br>$\bar{X}$ | Veli<br>$\bar{X}$ |
|---|---|-----------------------|-----------------------|----------------------|-------------------|
| 1 | Başarılı olma konusundaki beklentileri yüksektir.               | 2,5                   | 2,15                  | 2,45                 | 2,5               |
| 2 | Kendileriyle ilgili kararlar alınırken söz hakkına sahiptirler. | 2,5                   | 2,15                  | 2,55                 | 2,55              |

|   |  |     |      |      |      |
|---|--|-----|------|------|------|
| 3 | Kendilerinden bekleneni bilirler.                              | 1,5 | 2,07 | 2,45 | 2,45 |
| 4 | Okuldaki zamanlarının çoğunu öğrenme etkinliklerine ayırırlar. | 2   | 2,23 | 2,5  | 2,2  |
| 5 | İşbirliği içinde çalışmaya ve sorumluluk almaya isteklidirler. | 2,5 | 2,07 | 2,35 | 2,65 |

Eğitim paydaşlarının hepsi öğrencilerin başarılı olma konusundaki beklentilerinin yüksek olduğuna inanmaktadır. Bütün paydaşların verdikleri cevapların ortalamaları 2'ni üzerindedir. Yönetici ve veliler ise bu maddeye en çok katılan paydaş olmuşlardır. Her iki paydaşın cevapları ortalamaları 2,5'tir.

Eğitim paydaşlarının , öğrencilerin kendileriyle ilgili kararlar alınırken söz sahibi olduklarına inancı yüksektir. Bu maddeye en çok katılan paydaş öğrenci ve veliler olmuştur. Her iki paydaşın cevapları ortalamaları 2,55'tir.

Öğretmen, öğrenci ve veliler , öğrencilerin kendinden bekleneni bildikleri konusunda hem fikirdirler. Ancak yöneticilerin ortalaması 1,5 çıkmıştır. Yöneticiler , öğrencilerin kendilerinden bekleneni bildikleri fikrine çok fazla katılmadıklarını göstermektedir.

Eğitim paydaşları, öğrencilerin okuldaki zamanlarının çoğunu öğrenme etkinliklerine ayırdıkları konusunda hem fikirdir. Paydaşların cevap ortalamaları çok farklılık göstermemektedir. Bu maddeye 2,5 'lik cevap ortalaması ile öğrenciler olmuştur.

Eğitim paydaşları, öğrencilerin işbirliği içinde çalışmaya ve sorumluluk almaya istekli oldukları görüşünde hem fikirdir. 2,65'lik ortalama ile veliler , bu maddeye en çok katılan paydaş olmuşlardır.

Okul aile birliği başkanının da öğrenci boyutuna ilişkin değerlendirmeleri olumludur. Ancak öğrencilerin kendileriyle ilgili kararlar alınırken söz hakkına sahip oldukları görüşüne kısmen katıldığını belirtmiştir. Diğer maddelerin hepsine katıldığını belirtmiştir.

Okul memuresi ise öğrencilerin verilen özelliklerin hepsini taşıdığını söylemekle birlikte en çok iş birliği ile çalışma özelliği gösterdiklerini sözlerine eklemiştir.

Okul hizmetlileri ise öğrencilerle ilgili olumsuz bir değerlendirmede bulunmamışlardır. Maddelere katıldıklarını belirtmişlerdir.

Okul kantin işletmecileri ise öğrencilerin bilinçli birer tüketici olduklarını, aldıkları ürünlerin markasına ve üretim tarihine önem verdiklerini belirtmiştir. Bahçede öğrencileri izlediğinde ise birlikte vakit geçirmekten hoşlandıklarını ve birbirlerine yardımcı olduklarını gözlemlediğini belirtmiştir.

### Eğitim Paydaşlarının Etkili Okul'un "Okul çevresi ve Veli" Boyutuna İlişkin Değerlendirmesi

|   |  | Yönetici<br>$\bar{X}$ | Öğretmen<br>$\bar{X}$ | Öğrenci<br>$\bar{X}$ | Veli<br>$\bar{X}$ |
|---|--|-----------------------|-----------------------|----------------------|-------------------|
| 1 | Veliler okulun kendilerinden neler beklediğini bilir ve bu doğrultuda okula destek olmaya çalışırlar | 2,5                   | 1,92                  | 2,65                 | 2,3               |
| 2 | Velilerle, okul arasında açık bir iletişim vardır.   | 3                     | 2,46                  | 2,45                 | 2,6               |
| 3 | Veliler bilinçli ve sorumluluk sahibidir.  | 1,5                   | 1,84                  | 2,75                 | 2,25              |
| 4 | Öğrenci disiplini konusunda okul ve aile birbirine desteklidir..                                     | 2,5                   | 1,76                  | 2,6                  | 2,4               |
| 5 | Okul ve öğretmen ziyaretini sık yaparlar.  | 3                     | 1,84                  | 2,35                 | 2,35              |

Yönetici, öğrenci ve veliler, velilerin okulun kendilerinden neler beklediğini bildiğini ve okula bu doğrultuda destek olmaya çalıştıkları görüşüne katıldıklarını belirtmişlerdir. Hepsinin ortalaması 2'nin üzerindedir. Öğretmenler ise 1,92'lik cevap ortalaması ile çok fazla bu görüşe katılmadıklarını belirtmiştir

Eğitimin tüm paydaşları, veliler ile okul arasında açık bir iletişim olduğu konusunda hem fikirdir. Bu maddede tüm paydaşların cevap ortalaması ikinin üzerindedir. Yöneticileri cevap ortalaması ise 3'tür. Bu ise yöneticileri bu maddeye tamamen katıldıklarını göstermektedir.

Velilerin bilinçli ve sorumluluk sahibi olduğunu belirten maddeye veli ve öğrencilerin verdikleri cevapların ortalamaları 2'nin üzerinde iken öğretmen ve yöneticilerin verdikleri cevapların ortalamaları 2'nin altındadır. Yönetici ve öğretmenler, velilerin yeterince bilinçli ve sorumluluk sahibi olmadıklarını düşünmektedir.

Yönetici, öğrenci ve veliler; öğrenci disiplini konusunda okul ve ailenin birbirine destek olduğunu düşünmekte ancak öğretmenler bu görüşe katılmamaktadır. Öğretmenlerin bu maddeye verdikleri cevapların ortalaması 1,76'dır.

Yönetici, öğrenci ve veliler, velilerin okul ve öğretmen ziyaretini sık yaptığını düşünmektedir. Yöneticilerin bu maddeye verdikleri cevapların ortalaması 3, öğrencilerin ve verdikleri cevapların ortalaması 2,35'dir. Ancak öğretmenlerin verdikleri cevapların ortalaması ise 1,84'tür. Yani öğretmenler, velilerin okul ve öğretmen ziyaretini sık yapmadıklarını düşünmektedir.

Okul aile birliği başkanı ise veliler arasında okula her türlü konuda destek olabilecek bilinçli veliler olduğu gibi zaman zaman bilinçsiz velilerle de karşılaştıklarını belirtti. Ancak velilerin genellikle okula destek olmaya çalıştıklarını, okulun baya badana gibi bazı işlerini ücretsiz yaptıklarını belirtti. Ayrıca ekim ayı içinde yapılan okul aile birliği toplantısına katılımın yüksek olduğunu belirterek, bununla velilerin bilinçli olduğu konusunda bir gösterge olabileceğini belirtti.

Okul memuresi ise okul aile birliği başkanına katıldığını belirterek, özellikle birinci sınıf velilerinin okula maddi manevi destek verme konusunda daha istekli olduklarını belirtti.

Okul hizmetlileri de velilerle ilgili maddeler hakkında olumlu görüş belirttiler. Okul güvenlik görevlisi ise velilerin genellikle sabahları okula çocuklarını kendilerinin bıraktığını ve bu süre içinde çocuklarıyla iletişimlerinin iyi olduğunu gözlemlediğini belirtti.

### **Tartışma**

Bu araştırmada ise etkili okul yaratan faktörlerin Yakuplu Kemal Arıkan İlkokulu'nda ve Ortaokulu'nda bulunup bulunmadığının değerlendirilmesi Mortimore'un (1995) belirlemiş olduğu faktörler açısından değerlendirilmiştir.

Mesleksi liderlik açısından söz konusu okullara baktığımızda, okul yönetiminin hedeflerinin olduğunu ve bu hedeflerin hem öğrenci hem de öğretmenlerin motivasyonunu artırdığını görmekteyiz. Okullardaki öğretmen, öğrenci ve velilerin okul yönetimi boyutunda değerlendirmelerinin ortalamalarının hemen hepsi 2'nin üzerindedir. Sadece öğretmenler okul yönetiminin ziyaretlerini ve rehberliğini yeterli görmemektedir. Öğretmenlerin söz konusu maddeye ilişkin cevap ortalamaları 1,75'tir.

Öğretmenler boyutunda ise yine paydaşların değerlendirme ortalamalarının hepsi 2'nin üzerinde çıkmıştır. Yönetici, öğrenci ve veliler; öğretmenlerin mesleki yönden yeterli olduklarını ve sürekli gelişmeye açık olduklarını belirtmişlerdir.

Söz konusu okulların vizyon ve amaçları eğitim paydaşları arasında kabul görmüş durumdadır ki anketteki sorulara verilen cevapların neredeyse tümünde bir tutarlılık olduğu görülmektedir. Okullar da hedef birliği sağlanmış durumdadır. Öğretmenler arasında işbirliği olduğu gibi zümreler arasında da işbirliği olduğu hem anket sonuçlarından hem de görüşme yoluyla fikirlerine başvuru diğer paydaşların açıklamalarından anlaşılmaktadır.

Öğrenme ortamı açısından bakacak olursak, söz konusu okullarda olumlu bir okul iklimi olduğunu ve bununla meslektaş ilişkisine pozitif bir yönde katkısı olduğunu söylemek mümkündür. Bu görüşe, hem anket sonuçlarından hem de paydaşların görüşlerinden ulaşılmaktadır. Ayrıca, veli ile okul arasında da işbirliği olduğu, paydaşlar tarafından belirtilmiştir ki söz konusu okullarda sadece öğretmenler arasında değil diğer paydaşlar arasında da işbirliği vardır. Bu

işbirliği ise okulların yararına kullanılabilir. Gerektiğinde veliler okullara kaynak sağlayabilmekte veya direkt olarak kendileri okullara yardım edebilmektedir. Bu ise her iki okul içinde takdire şayan bir durumdur. Çoğu okul kaynak yetersizliğinden yakınırken söz konusu okullarda bu durum veli desteğiyle kısmen halledilebilmiş durumdadır.

Öğretim ve öğrenmeye yoğunlaşma açısından bakacak olursak her iki okul kadrosunun başarıya odaklanmış olduğunu, bunun içinde işbirliği içinde çalıştıkları hem gözlenmiştir hem de anket sonuçları ile desteklenmiştir.

Hedef öğretme faktörüne göre söz konusu okullar hakkında fikir belirtecek olursak, hedeflerin net olduğu ve öğrencilerin kendilerinden bekleneni bildiklerini söylemek mümkündür. Okul idaresi dışında diğer tüm paydaşlar öğrencilerin kendinden bekleneni bildikleri konusunda hem fikirdirler. Okul idaresinin söz konusu maddeyle ilgili değerlendirme ortalaması 1,5 çıkmıştır.

Yüksek beklenti faktörü açısından okullar hakkında bir görüş belirtecek olursak paydaşların birbirleri hakkında yüksek beklentiye sahip oldukları söylenebilir. Bu okullarda sadece öğrencilerden değil öğretmenlerden de yüksek beklentiler söz konusudur.

Olumlu pekiştirme faktörüne göre okulları değerlendirecek olursak, okullarda açık bir disiplin anlayışının olduğunu ve bu anlayışı sağlamak için her iki okulun ve velilerinin birbirine destek olduğunu söylemek mümkündür. Anketle konuyla ilgili verilen cevapların ortalamaları bunu destekler niteliktedir. Yine söz konusu okullarda başarı değerlidir ve ödüle layıktır. Okullar belirli yarışmalarda dereceye giren öğrencileri ödüllendirmektedir. Geçen yıl ilkököl bölümünden resim dalında bir ilçe birincisi ve iki ilçe ikincisi çıkmıştır. Bu sene ise yine aynı dalda bir ilçe birinciliği ve bir de ilçe ikinciliği vardır. Okul, resim alanında öğrencilere destek sağlamak için aynı okulun ortaokul kısmında görev yapan görsel sanatlar öğretmeninden destek almıştır. Ayrıca her ay her sınıftan bir öğrenci ayın öğrencisi seçilerek, okul panosuna resmi ve adı asılmaktadır.

Gelişimin yönetimi faktörü açısından söz konusu okullarla ilgili görüş belirtecek olursak, öğrencilerin performanslarının gelişimiyle ilgili öğretmenler arasında işbirlikçi bir çalışmanın olduğunu ve okul idaresinin çalışmalarının da bunu destekler nitelikte olduğunu söylemek mümkündür.

Öğrenci hak ve sorumlulukları açısından söz konusu okulları değerlendirecek olursak, öğrencilerin sorumluluk almaya istekli olduklarını söyleyebiliriz. Anketin söz konusu maddesine eğitim paydaşlarının hepsinin verdiği cevapların ortalaması 2'nin üzerinde çıkmıştır.

Öğrencilerin kendi başarılarıyla ilgili sorumluluk sahibi olduklarını da söylemek mümkündür. Çünkü “ öğrencilerin başarılı olma konusundaki beklentileri yüksektir “ maddesine paydaşların hepsinin 2'nin üzerinde bir ortalama ile katıldığını görmekteyiz.

Söz konusu okulların öğrenen bir örgüt olup olmadığı hakkında bir bilgi verecek olursak, öğrenciler için evet öğrenen bir örgüttür demek mümkündür. Anket sonuçlarına göre öğretmenlerin mesleki yönden gelişmeye önem verdiklerini söylemek mümkündür. İlgili maddeye paydaşların verdikleri cevapların ortalamaları 2'nin üzerindedir. Ancak mesleki ilerleme daha çok yeni bir şey öğrenen bir öğretmenin öğrendiğini diğer meslektaşları ile paylaşması sonucu sağlanmaktadır.

## Sonuçlar

Tüm boyutların kendi arasında ağırlıklı ortalamalarını aldığımızda ortaya çıkan tablo;

- Yönetici Boyutu : 2,51
- Öğretmen Boyutu : **2,53**
- Öğrenci Boyutu : 2,31
- Okul Çevresi ve Veli Boyutu :2,35

Yukarıdaki tabloyu yorumlayacak olursak; ankete katılan eğitim paydaşlarına göre bir okulu etkili okul yapan en önemli boyutu öğretmendir. Bunu sırasıyla; yönetici, okul çevresi ve veli boyutu ve öğrenci boyutu izlemektedir.

Genel bir değerlendirme yapacak olursak Yakuplu Kemal Arıkan İlkokulu ve ortaokulu etkili okulun pek çok özelliğini taşımaktadır. Söz konusu okulda açık akademik amaçların, öğrenci hakkında yüksek beklentinin, olumlu bir okul ikliminin, toplumsal destek ve katılımın, paydaşlar arasında açık bir iletişimin ve işbirliğinin olduğunu söyleyebiliriz. Bunların oluşmasında ise okul yönetiminin bütünleşmeyi sağlayıcı bir kültür oluşturma gayreti yatmaktadır.

### **Kaynakça**

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# EĞİTİM TEKNOLOJİSİ STANDARTLARININ (NETS) TÜRKİYE'DE UYGULANABİLİRLİĞİ

İsmail Tonbuloğlu  
Enformatik Bölümü  
Yıldız Teknik Üniversitesi  
Türkiye  
ismailt@yildiz.edu.tr

**Özet:** Eğitim teknolojisi bir çok yenilikle eğitim ortamlarında yer bulmaktadır. Ancak eğitim teknolojilerinin ülkemiz düzeyinde bir standardizasyonu belirlenmemiştir. Bu çalışma çerçevesinde ISTE (International Society for Technology in Education) kurumu tarafından belirlenen NETS (National Educational Technology Standards) standartları çerçevesinde Türkiye'de yapılan çalışmalar araştırılmıştır. Yapılan literatür taraması sonucunda NETS standartlarının Türkiye'de uygulanabilirliği incelenmiş ve önerilerde bulunulmuştur.

**Anahtar Kelimeler:** NETS, Eğitim Teknolojisi Standartları, Eğitim Teknolojisi

## Giriş

Bilgisayar teknolojileri eğitimin her alanında yer bulmaktadır. Gelişen ve değişen teknolojiler hızla eğitim teknolojilerine adapte olmakta ve öğretim ortamına yansımaktadır. Eğitim ortamında görev yapan öğretmenlerin, öğrenen öğrencilerin ve okul yöneticilerinin eğitim ortamındaki teknoloji becerileri, geçirdikleri eğitim süreçlerinin farklılığından dolayı farklılıklar oluşturmaktadır.

Günümüzde bilgi öğretiminin daha etkili nasıl gerçekleştirilebileceği konusunda bilgisayar teknolojileri çok önemli bir yer tutmaktadır(Uşun, 2004). Fakat eğitim teknolojisi sadece bilgisayar teknolojisi anlamına gelmemektedir.Öğrenci ile öğretilecek konu arasındaki etkileşimin öğrencinin anlayacağı düzeye indirgenmesine yardımcı olan her tür araç ve gereç eğitim teknolojisinin çalışma alanı içerisinde(Akpınar, 2004).

Öğretmenlerin eğitim teknolojilerinin kullanımına yönelik tutumları, bu teknolojilerin kullanımı yönündeki eğilimlerini de etkilemektedir (Handal, 2004). Akkoyunlu da (1996) öğretmenlerin teknolojik bilgilerinin, teknolojiye karşı tutumlarını etkilediğini ve teknolojilerden haberdar oldukları ölçüde öğretmenlerin teknolojiyi kullandıklarını ifade etmektedir. Günümüzde aynı yerde, aynı branşta görev yapmalarına karşın, iki farklı öğretmenin derslerinde eğitim teknolojilerinden faydalanma şekilleri değişebilmektedir. Bunun en önemli nedenlerinden biri öğretmenlerin bu konuda eğitim almamış olmalarıdır(Sugar, 2002, Çoklar ve Kuzu, 2006).

## NETS Nedir?

Amerika Birleşik Devletleri'nde ortaya çıkan ve tüm dünyaya yayılan Ulusal Eğitim Teknolojisi Standartları (National Educational Technology Standards – NETS) eğitim teknolojilerinin kullanımı konusunda eğitim sürecinin bireyleri olan öğretmen, öğrenci ve yöneticilere bir rehber olarak kabul edilebilir. NETS standartları öğretmen (NETS-T), öğrenci (NETS-S) ve yönetici (NETS-A) standartları ile eğitim ortamının eğitim teknolojileri açısından neleri içermesi gerektiği ve nasıl olması gerektiğini standartlarla ifade etmektedir. ISTE, bu standartları belirleyerek eğitim teknolojisinin eğitim sürecinde uygulanmasına katkı sağlamaktadır.

## NETS-A

Uluslararası Eğitim Teknolojileri Topluluğu (International Society for Technology in Education - ISTE), Okul Yöneticileri İçin Ulusal Eğitim Teknolojisi Standartları'nda (The National Educational Technology Standards for Administrators - NETS-A) okul yöneticilerinin teknoloji liderliği rollerini 6 boyut altında belirlemiştir(Sezer 2011).

Bu boyutlar kısaca şu şekilde özetlenmiştir:

**Liderlik ve Vizyon:** Teknoloji lideri olarak okul yöneticileri, paydaşları ile birlikte teknoloji hedefleri geliştirmelidirler. Bu süreçte okul yöneticileri paydaşları ile işbirliği sağlamalı, gerekli ortamı oluşturmalı ve gereksinim duydukları kaynakları temin etmelidirler.

**Öğrenme ve Öğretim:** Okul yöneticileri, öğrencilerin üst düzey düşünme becerilerini ve işbirliğini destekleyecek öğrenme çevreleri sağlamalıdır.

**Ölçme ve Değerlendirme:** Okul yöneticileri, öğrencileri, personeli ve eğitim ortamını teknoloji destekli yöntemlerle izlemeli ve değerlendirmelidirler.

**Destek, Yönetim ve İşlemler:** Okul yöneticileri okulda bulunan tüm destek sistemleri, araçlar, ağ, yazılım, personel harcamaları ve alınan kararların duyurulması gibi işlemlerin teknoloji destekli olarak yürütülmesini sağlamalıdır.

**Verimlilik ve Mesleki Uygulama:** Okul yöneticilerinin verimliliği artırma ve iletişim konularında teknolojiyi kullanarak diğer personele model olması gerekmektedir.

**Toplumsal, Yasal ve Etik Konular:** Okul yöneticileri teknolojiye erişimde ve güvenli kullanımda eşitliği sağlamalı, teknoloji kullanımı ile ilgili toplumsal, yasal ve etik konuları dikkate almalıdırlar.

ISTE'nin 2002 yılında okul yöneticileri için belirlediği standartları 2009 yılında güncellenmiştir. Güncellenen **NETS-A** standartları aşağıda yer almaktadır.

**Vizyoner Liderlik:** Okul yöneticileri, değişim sürecinde başarıya ulaşmak ve teknolojinin eğitim ortamlarına etkili bir biçimde kaynaştırılmasını sağlamak için ortak bir hedefin geliştirilmesine ve uygulanmasına liderlik etmelidirler. Bu amaçla okul yöneticileri, belirlenen hedefler doğrultusunda teknolojiyle bütünleştirilmiş planlar geliştirmeli ve uygulamalıdırlar.

**Dijital Çağ Öğrenme Kültürü:** Okul yöneticileri bilişim çağında öğrencilerin var olan gereksinimlerine uygun öğrenme ortamları geliştirmelidirler. Bu amaçla, teknolojinin öğretim programına kaynaştırılmasını sağlamaları ve teknolojiyle donatılmış öğrenci merkezli ortamları oluşturmaları gerekmektedir.

**Meslekî Uygulamada Mükemmellik:** Okul yöneticileri, öğretmenleri güçlendiren yenilikçi bir öğrenme ortamı oluşturmalı ve onların gereksinimleri doğrultusunda teknolojik kaynakları sağlamalıdırlar. Öte yandan okul yöneticileri, teknolojinin kullanımıyla ilgili sürekli hizmet-içi eğitimler düzenlemeleri ve yeni teknolojilerin etkilerini değerlendirmeleri gerekmektedir.

**Sistemli İyileştirme:** Okul yöneticileri, okullarında bilişim teknolojileri uygulamalarını başarılı bir biçimde kullanarak, okullarının lider bir duruma gelmesini sağlamalıdırlar. Bu amaçla okul yöneticileri, öğrenme hedeflerinin en üst düzeyde gerçekleşmesi için değişim sürecini planlı bir biçimde yönetmelidirler. Ayrıca okul yöneticileri, öğretmenlerin performansını değerlendirmelidirler.

**Dijital Vatandaşlık:** Okul yöneticileri, toplumsal, yasal ve etik konularının anlaşılmasına yardımcı olmalıdırlar. Bu bağlamda okul yöneticilerinin, teknoloji kaynaklarına eşit erişim sağlamaları, bu teknolojilerin yasal, etik ve güvenli kullanımını desteklemeleri ve bu konuda model olmaları gerekmektedir. Ayrıca okul yöneticileri bilişim teknolojileri aracılığıyla, evrensel sorunlarla ilgilenen bir okul kültürü gelişimine yardımcı olmaları da beklenmektedir(Sezer,2011).

## NETS-T

Uluslararası Eğitim Teknolojileri Birliği (The International Society for Technology in Education-ISTE) öğretmenlerin eğitim teknolojisi standartlarını belirlemiş, sitesinde yayınlamıştır. ISTE'ye göre öğretmen standartları, teknoloji okuryazarı olmayı, derslerinde teknolojiyi kullanabilmeyi, öğrencilerini teknolojiyi kullanmaya yönltebilmeyi, öğrenme çevresini öğrencilerin teknolojiyi kullanabilecekleri biçimde düzenleyebilmeyi ve meslektaşları ile İnternet üzerinden iş birliği yapabilmeyi (ISTE,2000; ISTE, 2008) kapsamaktadır.

ISTE'nin öğretmen standartları incelendiğinde, öğretmenlerin bir yandan teknoloji kullanabilen bir yandan da sınıf ortamını öğrencilerinin teknolojiyi kullanabilecekleri şekilde düzenleyebilen becerilere sahip olmaları gerektiği anlaşılmaktadır. Öğretmenler açısından bu becerilere sahip olmak, meslektaşlarıyla daha fazla etkileşimde bulunmaları anlamına gelmektedir (Akkoyunlu, 2001). Öte yandan ISTE, ulusal eğitim teknolojileri standartları ve performans göstergeleri (National Education Technology Standards (NETS•T) and Performance Indicators for Teachers) başlıklı bir çalışmada öğretmenler için bir dizi teknoloji okur-yazarlığı standardı ve performans göstergesi tanımlamıştır. Buna göre bütün öğretmenlerin aşağıdaki standartları karşılamaları beklenmektedir (ISTE, 2008, Aktaran, Seferoğlu 2009):

- 1- Öğrencilerin öğrenmelerini kolaylaştırmak ve yaratıcılıklarını teşvik etmek: Öğretmenler alan bilgilerini, öğrenme-öğretme süreçlerini ve teknolojiyi kullanarak yüz yüze ve sanal ortamlarda öğrencilerin öğrenmelerini, yaratıcılıklarını ve yenilikçi özelliklerini geliştirecek etkinlikler düzenlerler.
- 2- Bilgi (dijital) çağının gereklerine uygun öğrenme yaşantıları ve değerlendirme etkinlikleri tasarlamak ve geliştirmek: Öğretmenler, etkili öğrenmelerin gerçekleşmesi için çağdaş öğrenme araçları ve kaynaklarıyla bütünleştirilmiş özgün öğrenme etkinlikleri tasarlar, geliştirir ve değerlendirirler.
- 3- Bilgi (dijital) çağında çalışma ve öğrenme konusunda model olmak: Öğretmenler, yenilikçi bir meslek adamı olarak bilgi toplumunun gereklerine uygun bir şekilde çalışır, buna uygun bilgi ve beceriler sergilerler.
- 4- Bireyleri, bilgi (dijital) toplumu üyesi bir bireyin taşıması gereken sorumluluklarla ilgili olarak teşvik etmek ve onlara model olmak: Sürekli gelişen ve değişen bilgi toplumunda yerel ve evrensel toplumsal sorunlar ve sorumluluklar konusunda bilgi sahibi olan öğretmenler meslek yaşamlarında etik ve yasal kurallara uymaya özen gösterirler.
- 5- Mesleki gelişim ve liderlik etkinliklerine katılmak: Öğretmenler, sürekli bir şekilde mesleki olarak kendilerini geliştirir, yaşam boyu öğrenme konusunda model olur, çalıştıkları okullarda elektronik (dijital) araç ve kaynakları etkili bir şekilde kullanarak liderlik davranışları sergilerler.

ABD'de bu standartlara göre öğretmen adaylarının öğretmenlik sertifikasına sahip olabilmeleri için bu standartları karşılamış olma koşulu aranmaktadır. Bu da, bütün öğretmen adaylarının teknoloji standartlarını ve teknoloji performans göstergelerini karşılayabilmeleri için hizmet öncesinde yetiştirilmeleri gerektiği anlamına gelmektedir. Bu bağlamda YÖK tarafından, çağdaş öğretmen yetiştirme programlarında bulunması gereken unsurlar göz önünde bulundurulacak gerçekleştirilen yeniden yapılanma çalışmaları kapsamında 1998 yılında bilgisayar dersi Eğitim Fakültesi programlarına eklenmiştir. Daha sonra "Bilgisayar 2" dersi de programlara eklenerek tüm öğretmen

adaylarının en az iki adet bilgisayar dersi almaları sağlanmıştır. Bu yönüyle YÖK'ün yaptığı çalışmalar ISTE benzeri bir standarda ulaşmada bir aşama olarak görülebilir (Seferoğlu 2009).

Bilim ve teknoloji sürekli olarak gelişmekte ve bu durum toplumsal yaşamda birçok şeyi değiştirmektedir. Örneğin ISTE'nin 2002 yılında belirlediği standartlar değişen dünyada ortaya çıkan yeni ihtiyaçlar göz önüne alınarak 2006 yılında değiştirilmiştir. Toplumsal yaşamda yaşanan değişikliklerin mesleki yaşama da yansımaları olacaktır. Bu yüzden yeni durumlara uyum çalışmalarının sürekli bir şekilde yapılması gerekir. Bu nedenle mesleki gelişim kavramını tartışmak yararlı olacaktır.

2006 yılında düzenlenen NETS-T 6 başlık ve bu başlıkların altında 23 gösterge yer almaktadır.

**NETS-T : Öğretmenlere Yönelik Öğretmenlere Yönelik Ulusal Eğitim Teknolojisi Standartları (NETS, 2006. Çeviren: Çoklar 2008).**

Tüm öğretmenler aşağıdaki performans göstergeleri ve standartları karşılayabilir nitelikte olmalıdırlar.

#### **I. Teknolojik İşlemler ve Kavramlar Bilgisi**

Öğretmenler teknolojik işlemleri ve kavramları etkili bir şekilde ifade edebilirler veya gerçekleştirebilirler.

#### **II. Öğrenme Ortamları ile Öğrenme Yaşantılarının Planlanması ve Tasarlanması**

Öğretmenler teknoloji destekli etkili öğretim ortamları ve yaşantılarını planlar ve tasarlarlar.

#### **III. Öğrenme, Öğretim ve Eğitim Programı**

Öğretmenler öğrenci öğrenmelerini en üst düzeye çıkartmak için teknoloji ile kullanılabilir yöntem ve stratejileri içeren öğretim planlarını uygularlar.

#### **IV. Ölçme ve Değerlendirme**

Öğretmenler farklı ve etkili ölçme-değerlendirme stratejilerini kolaylaştırmak için teknolojiyi kullanırlar.

#### **V. Verimlilik ve Mesleki Uygulamalar**

Öğretmenler verimliliklerini artırmak ve mesleki deneyimlerini zenginleştirmek için teknolojiyi kullanırlar.

#### **VI. Sosyal, Etik, Yasal ve İnsani Konular**

Öğretmenler ilköğretim okullarında teknoloji kullanımı ile ilişkili olabilecek sosyal, etik, yasal ve insanla ilgili konuları anlar ve uygulamalarında bunları uygularlar.

### **NETS-S**

Eğitim teknolojisi kullanımında öğrencilerin neler yapmaları gerektiğini ortaya koyan boyut ise NETS-S ile standartlaştırılmıştır. NETS-S'nin P-12 olarak adlandırılan anaokulu dönemden ortaöğretim 12. sınıfa kadar olan eğitim düzeyine ait standartları kapsamaktadır. Bu grup içerisinde bulunan öğrenciler gelişim düzeylerine uygun olarak 4 farklı kategoride toplanmış, buna göre standartlar oluşturulmuş, anaokulu öğrencileri ile lise öğrencilerinin eğitim teknolojilerini kullanımları konusunda aynı düzeyde olmayacakları dikkate alınmıştır. Bu dört kategori; 2. sınıftan önceki öğrenciler için standartlar Grades PreK – 2), 3. ve 5. sınıflar arası öğrenciler için standartlar (Grades 3 – 5), 6. ve 8. sınıflar arası öğrenciler için standartlar (Grades 6 – 8) ve son olarak 9. ve 12. sınıflar arası öğrenciler için standartlar (Grades 9-12)'dir.

NETS-S standartları ortaya koyarken, öğrencilerin sahip olması gereken eğitim teknolojisi standartlarını 6 başlıkta ve her bir standart için dörder performans göstergesi belirtmiştir (NETS-S, 2007). ISTE'nin ilk defa 1998 yılında yayımladığı, NETS-S (Öğrenciler İçin Ulusal Eğitim Teknolojileri Standartları) projesinde, dünya genelinde kabul gören bu eğitim teknolojisi standartları öğrencilerin 21. yüzyıl becerilerini kazanmaları ve kullanmaları açısından önemlidir. ISTE'nin öğrenci standartlarını son olarak 2007 yılında güncellediği sürümü NETS-S (NETS-S, 2007), bu çalışmanın ölçeğine kaynaklık etmektedir. Aşağıda NETS tarafından öğrenciler için belirlenmiş eğitim teknolojisi standartları listelenmiştir (Gürol ve Diğerleri 2009).

Öğrenciler için eğitim teknolojisi standartları;

- Yaratıcılık ve ileri görüşlülük,
- İletişim ve işbirlikli çalışma,
- Araştırma ve bilgiye ulaşma,
- Eleştirel düşünme, problem çözme ve karar verme,
- Teknolojiyi ortak kullanan kişiler,
- Teknoloji etkinlikleri ve kavramları.

### **NETS Çerçevesinde Türkiye'de Yapılan Çalışmalar**

Yapılan çalışmada Türkiye'de NETS standartları temel alınarak yapılan çalışmaları incelenmiştir.

Çoklar 2008, Anadolu Üniversitesindeki "Öğretmen adaylarının eğitim teknolojisi standartları ile ilgili özyeterliklerinin belirlenmesi" isimli, öğretmen adaylarının görüşleri doğrultusunda eğitim fakültelerinde verilen eğitim teknolojisi ile ilgili eğitimin ilgili standartlar açısından değerlendirilmesi, üniversitelerdeki durumun belirlenmesi ve cinsiyet ile öğrenim görülen bölüm açısından sahip olunan özyeterliklerin farklılaşp farklılaşmadığının belirlenmesi amacıyla yaptığı doktora tezinde eğitim fakültelerinde öğrenim gören öğretmen adaylarının eğitim teknolojisi standartları açısından yüksek düzeyde özyeterliğe sahip olduklarını belirlemiştir. Tezin diğer sonuçları şu şekildedir;

"Öğretmen adayları eğitim sürecinde özellikle temel düzey olarak adlandırılacak daha yaygın bilinen teknolojilerin kullanımı konusunda kendilerini yüksek derecede yeterli görmüşlerdir. Ölçme değerlendirme hizmetlerinde teknoloji daha çok geleneksel ölçme değerlendirme becerilerine yönelik algılanırken, performans dayalı ölçme değerlendirme hizmetlerinde öğretmen adayları kendilerini daha az yeterli bulmuşlardır. İnternet kullanımının ön plana çıktığı verimlilik ve mesleki uygulamalar alt boyutu en yeterli olunan alt boyuttur. Sosyal, etik, yasal ve insani konular ile bireysel farklılıklara ve özel ihtiyaçlara göre öğretimi planlama alt boyutunda öğretmen adayları empatik eğilimleri doğrultusunda kendilerini yüksek düzeyde yeterli gördüklerini belirtmişlerdir. Üniversitelere göre gerek faktör genelinden gerekse alt boyutları açısından öğretmen adayları yüksek özyeterliğe sahiptir. Cinsiyet açısından eğitim teknolojisi standartları genelinde özyeterlikler değişmemektedir. Ancak alt boyutlar açısından incelendiğinde teknolojik işlemler ve kavramlar bilgisi, sosyal, etik, yasal ve insani konuları alt boyutlarında erkekler kendilerini daha yeterli görürken, verimlilik ve mesleki uygulamalar alt boyutunda kadınlar kendilerini daha yeterli bulmaktadır. Öğrenim görülen bölüme göre incelendiğinde ise Bilgisayar ve Öğretim Teknolojileri Öğretmenliği bölümünün hem ölçek genelinde, hem de ölçenin tüm alt boyutlarında farklılık ortaya koyduğu görülmektedir. Matematik öğretmenliği bölümü de hem ölçek genelinden, hem de çoğu alt boyutta aldığı düşük özyeterlik puanı ile farklılığın oluşmasında önemli bir etken olmuştur."

Seferoğlu (2009), "Standartlar ve Bilişim Teknolojilerindeki Gelişmeler Işığında Öğretmenlerin Sürekli Mesleki Eğitimi" isimli çalışmasında MEB'in belirlemiş olduğu öğretmen yeterlikleri ile NETS-T standartlarının örtüştüğü kısımlara ve karşılaştırmalarına yer vermiştir. Ayrıca standartların öğretmenlerin niteliklerini yükselttiğini ve sınıfta daha etkili olmalarını sağlamaya yönelik çabaları beraberinde getirdiğini belirtmiştir. Çalışmasında ülkemizde öğretmen standartlarına dönük yapılan düzenlemelerin detaylarına yer vermiştir. Öğretmenlerin etkili olabilmesinin yolunu, gerek hizmet öncesi gerek hizmet içinde kendisini geliştirecek olanaklara sahip olmasına bağlamıştır. Çalışmada standartizasyonların öğretmenler üzerinde ki yansımalarına ve sonuçlarına da yer verilmiştir.

Gürol ve diğerlerinin (2009), "Öğretmen Adaylarına Göre Eğitim Fakültelerinde Eğitim Teknolojisi Standartları Ve Performans Göstergelerinin Uygulanma Durumu (Fırat Üniversitesi Örneği)" isimli çalışmada Fırat Üniversitesi, teknik eğitim ve eğitim fakültesi öğrencilerinin ulusal eğitim teknolojisi standartlarına ve performans göstergelerine yönelik durumları belirlenmeye çalışılmıştır. Araştırmada ISTE (International Society for Technology in Education)'nin öğrenciler için belirlemiş olduğu NETS (National Educational Technology Standards) ulusal eğitim teknolojisi standartları ve performans göstergeleri çalışmasından Türkçeye uyarlanmıştır. Çalışmada eğitim teknolojisi standartları ve performans göstergeleri anketi haline getirilmiştir. Toplamda 547 kişiye anket uygulanmıştır. Araştırma sonucunda, öğretmen adaylarının eğitim teknolojisi standartları ve performans göstergeleri açısından kendilerini orta düzeyin üstünde yeterli gördükleri saptanmıştır. Bununla birlikte, fakülteler ve bölümler arasında anlamlı farklılık olmadığı görülmüştür.

Çoklar ve diğerleri (2009), "Öğretmen Adaylarının Uygulayabilecekleri Ölçme-Değerlendirme Yaklaşımları İle Ölçme değerlendirme Amaçlı Teknoloji Kullanım Özyeterlikleri" isimli çalışmada öğretmen adaylarının alternatif ve geleneksel ölçme-değerlendirme yaklaşımlarından meslek yaşamlarında hangilerini uygulayabilecekleri ile ölçme ve değerlendirme amaçlı teknoloji kullanımı konusunda kendilerini ne kadar yeterli gördüklerini belirlemek amaçlanmıştır. Yapılan çalışma sonuçları şu şekildedir;

"Geleneksel ölçme-değerlendirme yaklaşımlarının çoğunda kendilerini "yeterli" görmelerine karşın, alternatif yaklaşımlarda (proje, gözlem, ürün dosyası, problem çözme ve görüşme gibi) kendilerini "daha yeterli" görmüşlerdir. Öğretmen adayları ölçme-değerlendirme amaçlı teknoloji kullanımı konusunda da kendilerini "ileri" düzeyde yeterli bulmuşlardır. Ölçme-değerlendirme amaçlı teknoloji kullanımı konusunda erkek adaylar kadın adaylara, kaldığı yerde bilgisayar olan adaylar olmayanlara, kaldığı yerde internet erişimi olan adaylar ise olmayanlara göre kendilerini teknoloji kullanımı konusunda "daha yeterli" görmüşlerdir. Öğretmenlik programları arasında öz yeterlikler bakımından anlamlı bir farklılık bulunmaktadır."

Çoklar ve Odabaşı (2009) "Eğitim Teknolojisi Standartları Açısından Öğretmen Adaylarının Ölçme Ve Değerlendirme Özyeterliklerinin Belirlenmesi" isimli çalışmasında NETS-T standartları açısından araştırmada değerlendirmede bulunmuştur. Araştırma sonucunda eğitim teknolojisi standartları açısından öğretmen adaylarının ölçme ve değerlendirme hizmetlerinde kendilerini iyi düzeyde yeterli gördükleri sonucuna ulaşılmıştır. Özyeterlikler konusunda cinsiyet önemli bir değişikliğe neden olmazken, öğrenim görülen üniversite ve öğrenim görülen bölüme göre sahip olunan ölçme-değerlendirme özyeterliklerinin farklılaştığı görülmüştür. Bilgisayar ve Öğretim Teknolojileri ile Sınıf Öğretmenliği bölümleri öğretmen adayları bu konuda kendilerini daha yeterli görürken, Matematik Öğretmenliği bölümü öğretmen adayları daha az yeterli görmüşlerdir.

Kurt ve diğerleri (2008) "Evaluation Of The Skills Of K-12 Students Regarding The National Educational Technology Standards For Students (Nets\*S) In Turkey" isimli çalışma sonucunda öğrencilerin eğitim teknolojileri standartları açısından orta seviyede olduğunu tespit etmişlerdir. Ayrıca çalışmada kendi bilgisayarları ile öğrencilerin internete erişebilmesi ve ebeveynlerin eğitim düzeyinin öğrencilerin eğitim teknolojileri becerileri geliştirme noktasında etkilediği ve yardımcı olduğu sonucunu ortaya koymuştur.

Akpınar (2004), "Eğitim Teknolojisiyle İlgili Öğrenmeyi Etkileyebilecek Bazı Etmenlere Karşı Öğretmen Yaklaşımları" isimli çalışmada öğretimi etkileyecek etkenleri tespit etmeyi amaçlamıştır. Araştırmacı çalışmada;

1. Kadın öğretmenler öğretimin başarısını etkileyebilecek literatürde geniş kabul gören bazı etmenleri erkek öğretmenlerden daha fazla önemsemektedir.
2. Hizmetiçi eğitimlere gönüllü katılan öğretmenler hizmetiçi eğitimleri daha fazla önemsemektedirler.
3. Öğrenci yeteneğinin iyi bir öğretimle gelişebileceğini, sınıfta çok soru sorulmasının öğretimin etkinliğini azaltmayacağını, öğretmenliğin doğuştan gelen bir yetenek olmadığını ve öğrenme ortamı estetiğinin öğrenmeyi etkilediğini düşünen öğretmenler öğrenim araç/gereçlerine daha fazla önem vermektedir sonuçlarına ulaşmıştır.

Karal ve Berigel 2004 "Eğitim Fakültelerinin Öğretmenlerin Teknolojiyi Eğitimde Etkin Olarak Kullanabilme Yeterlilikleri Üzerine Etkileri Ve Çözüm Önerileri" isimli çalışmada öğretmenlerin teknolojiyi eğitimde kullanmaları ve teknolojiye bakış açılarını ölçmeyi içeren sorulardan oluşan bir anket aracılığı ile veriler toplanmıştır. Araştırma sonunda elde edilen bulgulara göre öğretmenler eğitimde teknolojiyi kullanmakta ve yeni teknolojik gelişmeleri eğitime adapte etmede sorunlar yaşamakta ve yaşadıkları sorunların çözümünün Eğitim Fakültelerinde alacakları eğitimle aşılabileceğini belirtmektedirler.

Sezer (2011) "İlköğretim Okul Yöneticilerinin Teknoloji Liderliği Rollerine İlişkin Yeterlilikleri" isimli yüksek lisans tezinde yöneticilerin NETS-A standartlarından liderlik rolleri üzerinde şekillenmiş teknoloji liderliği rollerine ilişkin yeterlilikleri belirlenmiştir. Araştırmanın sonuçları şöyledir: Okul yöneticilerinin ve öğretmenlerin görüşlerine göre, okul yöneticilerinin teknoloji liderliği rollerinin alt boyutları olan "Gelişim ve Değerlendirme", "Destek", "Planlama ve Denetim" ve "Etik ve Güvenlik" rollerini yerine getirme düzeylerinin yüksek olduğu belirlenmiştir. Meslekî kıdem değişkeni açısından okul yöneticilerinin görüşleri arasında "Gelişim ve Değerlendirme", "Destek" ve "Planlama ve Denetim" alt boyutlarındaki rollerini yerine getirmelerine ilişkin anlamlı farklılaşmalar bulunurken, "Etik ve Güvenlik" alt boyutundaki rollerine ilişkin anlamlı bir farklılaşma bulunmamıştır. Eğitim durumu değişkeni açısından okul yöneticilerinin teknoloji liderliği rollerine ilişkin görüşleri arasında anlamlı bir farklılık bulunmamıştır.

Ergişi (2005) "Bilgi Teknolojilerinin Okulda Etkin Kullanımı İle İlgili Okul Yöneticilerinin Teknolojik Yeterliliklerinin Belirlenmesi (Kırıkkale İli Örneği)" isimli yüksek lisans tezinde şu sonuçlara ulaşmıştır:

1. Okul yöneticileri, bilgisayar ve diğer bilgi teknolojilerini tanıma ve kullanma boyutu ile okullarında bilgi teknolojilerinin etkin bir şekilde kullanılmasını sağlama boyutunda kendilerini yeterli olarak görmektedirler.
2. Okul yöneticilerinin, temel bilgisayar kullanım becerileri konusundaki yeterliliklerinin daha fazla; sunu hazırlama, elektronik tablo yazılımları, elektronik posta kullanımı konularında daha az yeterli oldukları görülmüştür.
3. Okul yöneticilerinin okulun yönetim süreçleri ile ilgili işlerde bilgisayardan daha çok yararlandıkları, eğitim öğretim ortamlarında, kütüphane ve rehberlik servisi gibi birimlerde ise bilgisayar kullanımına daha az destek verdikleri görülmüştür.
4. Ortaöğretim okullarında görev yapan yöneticiler ile ilköğretim okullarında görev yapan yöneticilerin teknolojik yeterlilikleri arasında ortaöğretim okul yöneticileri lehinde anlamlı farklar bulunmuştur.
5. Bilgisayar ve diğer bilgi teknolojilerini tanıma ve kullanma boyutundaki yeterliliklerde okul müdürleri ile müdür yardımcıları arasında anlamlı farklar bulunmuş, müdür yardımcılarının yeterliliklerinin daha yüksek olduğu görülmüştür.
6. Bilgisayar ve diğer bilgi teknolojilerini tanıma ve kullanma boyutundaki yeterliliklerde sınıf öğretmeni olan yöneticiler ile genel bilgi ve meslek dersleri öğretmeni olan yöneticiler arasında anlamlı farklar bulunmuştur. Anlamlı fark genel bilgi ve meslek dersleri öğretmeni olan yöneticiler lehindedir.
7. Okul yöneticilerinin teknolojik yeterlilikleri öğrenim durumu açısından değerlendirildiğinde, ön lisans ve lisans mezunu yöneticiler arasında anlamlı farklar bulunmuştur. Bu farklar lisans mezunları lehindedir.
8. Okul yöneticilerinin teknolojik yeterlilikleri yöneticilik kıdemlerine göre değerlendirildiğinde ise, eski ve yeni yöneticiler arasında da anlamlı farklar bulunmuştur. Bu farkların yeni yöneticiler lehinde olduğu görülmüştür.

## Sonuçlar

Araştırma çerçevesinde yapılan çalışmalar incelediğinde eğitim sistemiz içerisinde öğrenme, öğretme ve yönetim sürecinde eğitim teknolojilerine yer verildiği görülmüştür. Fakat ülkemizde bu konuya ait standart geliştirilemediğinden dolayı öğrenme, öğretme ve yönetsel anlamda farklılaşmalar tespit edilmiştir. Teknoloji yansımalarını homojen bir şekilde eğitim sistemimizde uygulamamız gerekmektedir. ABD'de geliştirilen NETS standartları İngiltere, Çin, Avustralya ve birçok Avrupa ülkelerinin yaptığı gibi aynen kabul edip uygulanabilir veya bazı ülkelerin gerçekleştirdiği gibi NETS standartları temel alınıp kendi ülkemiz için bunun üzerinden uyarlama yapılarak bir "Ulusal Eğitim Teknolojisi Standartları" oluşturulabilir. Standartların ülkemizde oluşturulup temel alınması öğrenme ortamının vazgeçilmezi haline gelen eğitim teknolojilerinin bir düzey çerçevesinde öğretmen, öğrenci ve yöneticiler açısından ortak bir temel alınarak şekillendirilmesini sağlayacaktır. Gelişen teknolojinin her geçen gün öğretim hayatına yansımalarını artırdığı gerçeği de bu standartların oluşturulmasının önemini göstermektedir.

Uygulamaya dönük öneriler;

- Öğretmen adaylarına ülkemiz tarafından belirlenmiş standartlara göre sertifikasyon işlemi uygulanabilir.

- Öğretmen ve yöneticilere ülkemiz tarafından oluşturulacak standartları kazanabilecekleri etkili hizmet içi eğitimler düzenlenebilir.

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# EĞİTİMDE LEGO-LOGO UYGULAMALARI VE TÜRKİYE'DEKİ DURUMU

Bariş ÇUKURBAŞI

Department of Computer And Instructional Technologies Education

Bartın University

Turkey

bcukurbasi@bartin.edu.tr

**Özet:** LEGO-LOGO uygulamaları, LEGO parçaları ile programlanabilir bir aygıt (NXT, RCX gibi), step motorlar ve çeşitli özellikteki sensörler birleştirilerek oluşturulan mekanik aracın (robotics), yine LEGO parçaları oluşturulmuş ortamda belirli işlemleri yerine getirmesi için programlanması ve o işlemleri yerine getirmesinin sağlanması şeklinde gerçekleşmektedir. Bu programlama işlemi LOGO programlama dili ile yapılmaktadır. Soyut kavramların öğretilmesi sürecinde kullanılabilir bir uygulama olan LEGO-LOGO uygulamaları, çocukların zihinsel yapılarının ve motor becerilerinin gelişmesine de büyük katkılar sağlamaktadır. Özellikle nesne tasarımı, programlama ve uygulama süreçlerinin tamamında çocukların aktif rol üstlenmesi ve kontrolün çocukta olması da LEGO-LOGO uygulamalarının önemini arttırmaktadır. Bu ve benzeri özelliklerinden dolayı LEGO-LOGO uygulamaları eğitim-öğretim sürecinde de kullanılmaktadır ve kullanımı giderek yaygınlaşmaktadır. Bu çalışmada, dünya genelinde eğitim-öğretim ortamlarında yaygın olarak kullanılan LEGO-LOGO uygulamaları ile ilgili literatür incelenmiş ve elde edilen veriler doğrultusunda eğitim-öğretim sürecinde kullanılan LEGO-LOGO uygulamalarının Türkiye'deki durumu tartışılmıştır.

**Anahtar Kelimeler:** LEGO, LOGO, öğretim, LEGO-LOGO uygulamaları.

## Giriş

LEGO, çeşitli renklerdeki yapı parçalarından oluşan, üzerindeki girinti ve çıkıntılar vasıtasıyla birbirlerine kolayca kenetlenen ve hemen hemen her şeyin inşa edilmesine olanak veren bir oyuncak çeşididir. 1932 yılında Danimarka'da üretimi başlayan LEGO, gelişerek günümüze kadar gelmiş ve tüm dünya tarafından tanınan bir oyuncak haline gelmiştir. 1980'li yıllara gelindiğinde ise, LEGO eğitsel ürün departmanı kurulmuştur (Mortensen, 2012). Daha sonra LEGO parçalarına programlanabilir (RCX, NTX gibi) araçlar eklenmiş ve LOGO (Language of Graphical Output) programlama dili ile bir arada kullanılmaya başlanmıştır. Böylece LEGO-LOGO uygulamaları ortaya çıkmıştır.

LEGO-LOGO uygulamaları, LOGO programının kaplumbağa ile çalışması temeline dayanan; LEGO parçaları ile plastik küçük yapı materyallerinin, programlanabilir tuğlaların, küplerin, dişlilerin, motorların, makaraların, sensörlerin ve diğer çeşitli parçaların kombinasyonu sonucunda oluşan, LOGO programlama dili ile birlikte kullanılan uygulamalardır (McDaniel, 2004). LEGO-LOGO uygulamalarında ilk önce genellikle bir durum veya problem ortaya konmaktadır. Bu durumlar LEGO parçalarından oluşan bir sistemle öğrencilere sunulabileceği gibi farklı yöntemlerle de (sözlü, yazılı, görsel vb.) öğrencilere sunulabilmektedir. Bu durum veya probleme bağlı olarak öğrenciler LEGO parçaları ile nasıl bir mekanizma ortaya koymaları ve bu mekanizmayı nasıl hareket ettirmeleri gerektiğine, (LOGO programlama dili ile) dolayısıyla ilgili durum veya problemle nasıl başa çıkacaklarına ilişkin kararlar vermektedir. Verdikleri bu kararlar doğrultusunda LEGO-LOGO uygulamasını geliştirip işlemi test etmekte ve sonucu görebilmektedirler. Eğer test sonucu başarılı olmadıysa tekrar düşünülüp yeni bir çözüm önerisi ortaya konmakta ve işlemler tekrarlanmaktadır. LEGO-LOGO uygulama sürecinin her aşamasında öğrenci aktif rol üstlenmekte ve sonuca ulaşmakta; tüm uygulama boyunca kontrol öğrencide olmaktadır. Bu bağlamda, LEGO-LOGO uygulamalarının, öğrencilerin sınırsızca düşünmelerini sağladığı ve düşüncelerini hayata geçirmelerine olanak verdiği söylenebilir (Çayır, 2010).

Günümüz öğrenme ortamlarında çeşitli teknolojiler bir arada kullanılarak öğrenme etkinlikleri düzenlenebilmektedir. Farklı teknolojilerinin bir arada kullanılmasıyla ortaya çıkan ürünler öğrencilerin problem çözme süreçlerinin çeşitli aşamalarını desteklemekte ve özellikle teknoloji tabanlı faaliyetler öğrencilerin karşılaşılan durumu formüle etmelerine, ardından bu durumu test etmelerine olanak tanımaktadır. Böylece o durumla ilgili sonuçlar ortaya çıkarmalarına ve genellemelerde bulunmalarına olanak tanınır (Erbaş, 2005). Bu teknolojiler eğitsel amaçlı geliştirilmiş araçlardan oluşmasının yanı sıra oyuncaklar, bilgisayar programları ve benzeri farklı amaçlarla geliştirilmiş araçlardan da oluşmaktadır. LEGO-LOGO uygulamaları da, farklı teknolojilerinin bir arada kullanılmasıyla ortaya çıkan uygulama araçlarındandır.

LEGO, oyun amaçlı geliştirilmiş bir ürün olmasının yanında çocukların zihinsel yapılarının ve motor becerilerinin gelişmesine önemli katkılar sağlamaktadır. Bir öğrenme dili olan LOGO, görsel çıktı dili anlamına gelmektedir ve soyut olguları öğretmek için çocuğun belirli bir yaşa gelmesinin gerekmediği; farklı uygulamalarla soyut kavramların öğretilebileceği düşüncesinden yola çıkarak LOGO programlama dili geliştirilmiştir (Yiğit, 2002).

Etkileşim olanağı, esnek ve modüler olması, öğrenme için bir araç olarak geliştirilen LOGO programlama dilinin öne çıkan özelliklerindedir (Redick, 2007). LOGO sayesinde öğrenciler yaratıcılıklarını ve bilgisayar programlama yeteneklerini geliştirmişlerdir (İşman, 2003). LEGO ve LOGO uygulamaları bir arada kullanılmasıyla birlikte bilgisayar destekli yazılımlar kullanılarak soyut kavramlarla ilgili benzetimlerin ve öğrencilerin aktif bir şekilde öğrenme sürecine katılmalarına imkan veren canlandırmaların kullanılması ile öğrencilerin anlamakta güçlük çektikleri kavramları zihinlerinde daha kolay yapılandırmalarını sağlayabilen bilgisayar destekli öğretim uygulamalarına bir yenisi eklenmiştir (Karamustafaoğlu, Aydın, ve Özmen, 2005).

LEGO-LOGO uygulamaları kullanılarak dünya genelinde birçok eğitim-öğretim aktivitesi düzenlenmektedir ((McDaniel, 2004; McWhorter, 2008; Beisser, 2006; Mojica, 2010; Tian, 2007; Adams ve Keene, 2005; Jarvinen, 1998; Chambers, Carbona ve Rex, 2007). Ancak Türkiye’de çok az LEGO-LOGO uygulamaları ile gerçekleştirilmiş eğitim-öğretim aktiviteleri bulunmaktadır (Çayır, 2010). LEGO-LOGO uygulamalarının öğrencilere sağladığı olumlu özellikler dikkate alındığında Türkiye’deki LEGO-LOGO uygulamalarının sayısının artırılması gerekliliği ortaya çıkmaktadır. Bu doğrultuda çalışmada, dünya genelinde var olan eğitim-öğretim ortamlarında kullanılan LEGO-LOGO uygulamaları ile ilgili alan yazın incelenmiş ve elde edilen veriler doğrultusunda eğitim-öğretim sürecinde kullanılan LEGO-LOGO uygulamalarının Türkiye’deki durumu tartışılmıştır.

## **Dünya Genelinde Eğitim-Öğretim Ortamlarındaki LEGO-LOGO Uygulamaları**

Dünya genelinde LEGO-LOGO uygulamaları ile birçok eğitim-öğretim aktivitesi gerçekleştirilmektedir. Bu aktiviteler genellikle öğrencilerin bilişsel yapılarındaki, motivasyonlarındaki, problem çözüme becerilerindeki ve başarılarındaki değişimleri inceleyen çalışmalar şeklinde olmaktadır. Bu bölümde dünya genelinde eğitim-öğretim ortamlarında gerçekleştirilmiş LEGO-LOGO uygulamaları ile ilgili alan yazın incelemesi verilmiştir.

İlköğretim öğrencilerine yönelik gerçekleştirilen bir çalışmada, LEGO-LOGO uygulamalarının öğrencilerin bilimsel süreç becerilerini ve sistemlerinin geliştirilmesiyle ilişkisi incelenmiştir. Bu bağlamla deneysel bir çalışma gerçekleştirilmiş ve ön test – son test ile veriler toplanıp analiz edilmiştir. Analiz sonuçlarına göre ön test – son test değerleri arasında anlamlı bir farklılık vardır. LEGO-LOGO uygulamalarına katılan öğrencilerin düşünme becerileri ile bilimsel süreç becerileri olumlu yönde gelişmiştir. Ayrıca, bu uygulamalar sonucunda öğrencilerin sistemleri anlayışı gelişmiştir (Sullivan, 2008).

İşitme engelli öğrenciler ile yapılan çalışmada, problem çözüme becerileri ile dilsel ifadeleri fark etmelerini sağlayacak LEGO-LOGO uygulamaları geliştirilmiştir. Beş oturumluk LEGO-LOGO uygulaması süresince öğrenciler kamera ile kayıt altına alınmıştır. Her oturumda katılımcılar LOGO komutları ve LEGO yapıları ile LEGO-LOGO aktivitesini tamamlamışlar. Veriler grup çalışması becerileri, dil, zaman yönetimi ve cinsiyet temaları altında analiz edilmiştir. Çalışmanın sonucunda, öğrencilerin grup çalışmasına yönelik becerileri, dil becerileri ve zaman yönetimi becerileri gelişmiş; cinsiyetin becerilerin gelişmesine etkisi olmadığı görülmüştür. Ayrıca, öğrencilerin akademik becerilerinin geliştirilmesi için gerekli olan becerileri kazandığı görülmüştür (McDaniel, 2004).

Beisser tarafından (2006) gerçekleştirilen çalışmada, ilköğretim düzeyinde çeşitli yaşlarda öğrencilerin bulunduğu sınıfta, LEGO-LOGO teknolojisi kullanarak bilgisayar kullanma etkinliği gerçekleştirilmiştir. kız ve erkek öğrenciler, öğretmenin teşvik edici öğrenme stratejisi ile bilgisayar merkezli problem çözüme etkinliklerini yapmışlardır. Çalışmanın sonucunda, kızların teknolojik sınıflarda bilgisayar teknolojisini kullanmaya yönelik özyeterliliklerinin önemli derece arttığı ve algılarının olumlu yönde geliştiği görülmüştür.

McWhorter (2008) tarafından gerçekleştirilen çalışmada, üniversite bilgisayar programcılığı dersindeki uygulamada özdüzenleyici öğrenme ile LEGO Mindstorms Robotic aktiviteleri arasındaki öğretim ile ilgili bağlantıları açıklamak amaçlanmıştır. Bu doğrultuda öğrencilerin motivasyonları, öğrenme stratejileri ve dersin amaçlarını gerçekleştirmeleri incelenmiştir. Çalışmanın sonucunda iki grup arasında anlamlı bir farklılık bulunamamıştır. Bu durumun sebebi olarak, yetersiz sayıda LEGO malzemesinin ve kullanılabilir robotun olması verilmiştir. Ancak, yapılan ankete göre öğrencilerin LEGO aktiviteleri sırasında eğlendikleri; LEGO kullanarak birçok öğrenme aracı ya da etkinliğini öğrenme ortamlarında birçok yolla kullanılabileceği sonucuna ulaşılmıştır. Ayrıca, LEGO üniversite düzeyinde bilgisayar programcılığı dersi öğretimi için etkili bir araç olduğu görülmüştür.

Yapılan yarı deneysel bir çalışmada, 105 8. Sınıf öğrencisi ile 7 aylık bir proje gerçekleştirilmiştir. Projede LEGO-LOGO uygulaması, dijital hikaye anlatımı ve marble maze oyunu teknolojilerinin kullanılmıştır. Araştırmanın sonucuna göre öğrencilerin üst düzey eleştirel düşünme becerilerinin olumlu etkilendiği ve bu üç teknolojik eğitim biriminin kullanılmasının kadınlara daha çok fayda sağladığı görülmüştür (Mojica, 2010). Pullock tarafından (1997) öğrencilerin bilişsel yeteneklerini ve okula yönelik tutumlarını incelemek için LEGO-LOGO bilgisayar grubu ile kontrol grubunun kullanıldığı bir deneysel çalışma gerçekleştirilmiştir. Çalışmanın sonucuna göre deney ve kontrol grupları arasında anlamlı bir farklılık çıktığı görülmüştür. Bu farklılık LEGO-LOGO grubu lehinedir.

## **Türkiye’deki Eğitim-Öğretim Ortamlarında LEGO-LOGO Uygulamaları**

Dünya genelinde LEGO-LOGO uygulamaları çok yaygın olarak kullanılmasına rağmen Türkiye’de durum aynı değildir. Yapılan alan yazın taraması sonucunda çok az sayıda Türkiye’deki eğitim-öğretim ortamlarında gerçekleştirilmiş LEGO-LOGO uygulamasına rastlanılmıştır (Çayır, 2010). Literatürde LEGO ile ilgili yapılmış çalışmalar bulunmasına rağmen, eğitim-öğretim ortamlarında LEGO kullanılarak gerçekleştirilen bir bilimsel çalışmaya

rastlanılmamıştır. Ancak, LOGO programlama dilinin kullanıldığı birçok çalışmaya rastlanılmıştır (Baki ve Özpinar, 2007; Çataloğlu ve Başer, 2005; Karakırık ve Durmuş, 2005; Yiğit ve Akdeniz, 2003; Yiğit ve Kurnaz, 2002).

Türkiye'deki eğitim-öğretim ortamlarındaki LEGO-LOGO uygulaması olan çalışmada, LEGO-LOGO ile desteklenmiş öğrenme ortamının ilköğretim 8. Sınıf öğrencilerinin bilimsel süreç becerisi ve benlik algısı üzerindeki etkileri incelenmiş; LEGO-LOGO ile desteklenmiş öğrenme ortamının öğrencilerin gelişimi için önemli olan benlik algısı ve bilimsel süreç becerisi üzerinde olumlu etkileri bulunduğu görülmüştür (Çayır, 2010). Türkiye'deki eğitim-öğretim etkinliği olarak gerçekleştirilmiş başka bir LEGO-LOGO uygulamasına rastlanılmamıştır. Ancak, 1998 yılında pilot uygulamayla başlayıp 1999 yılında tüm dünyada "First Lego League" (FLL) isimli bir yarışma gerçekleştirilmektedir (First LEGO League). Bu yarışma kapsamında en fazla 10 öğrenci ve bir takım koçu ve danışmanından oluşan gruplar robot oyunu ve bir proje gerçekleştirerek ve FLL temel değerlerine sahip çıkarak yarışılır.

FLL robot oyununda takımlar belli görevler yapacak otonom bir robot meydana getirirler ve onu programlarlar. Projede ise takımlar, o yıl belirlenen temaya uygun olarak ir sorun tanımlayıp, araştırma yapıp, çözüm üretip, paylaşımlarda bulunurlar. FLL temel değerleri olarak da öğrencilerin takım çalışmalarına bakılmaktadır. Bu çalışmalar takım koçu ve danışmanı rehberliğinde öğrenciler tarafından hazırlanmaktadır. Bütün bu çalışma boyunca öğrenciler bilim ve teknolojinin yaşama olumlu katkılarını daha iyi anlarlar ve aşağıdaki becerileri elde ederler (Bilim Kahramanları, 2012):

- Katılımcı takım çalışması
- Araştırma becerisi
- Beyin fırtınası becerisi
- Tartışma becerisi
- Ortak çözüm becerisi
- İletişim becerisi
- Sunum becerisi

1999 yılından bu yana gerçekleştirilen yarışmaya 2005 yılında Türkiye'de dahil olmuştur ve bu yıl yarışma Türkiye'deki 9. yarışma gerçekleştirilmiştir. Her yıl çeşitli devlet okulları, özel okullar ve çeşitli öğrenci vakıf ve kulüplerinden FLL'ye katılmak isteyenler takımlarını kurarak yarışmalara katılmaktadır. Türkiye'de eğitim-öğretim ortamlarında gerçekleştirilen LEGO-LOGO uygulamalarının azlığından dolayı bu yarışmanın gerçekleştirilmesi ve yarışmaya etkin katılımların sağlanması öğrencilerin gelişmesine katkılar sağlayacağından ötürü önem arz etmektedir.

## Sonuç ve Tartışma

LEGO-LOGO öğrenme ortamları tamamen öğrenci merkezlidir ve hem kendi kendilerine ve kendi öğrenme hızlarında öğrenmeleri hem de grup çalışmasıyla öğrenmeleri açısından etkili ortamlardır (Akçay, Aydoğdu, Yıldırım, ve Şensoy, 2005). Ayrıca grup çalışması yapılarak gerçekleştirilen etkinlikler ile öğrencinin işbirlikli çalışma becerilerinin gelişmesine katkılar sağlayacağı söylenebilir.

LEGO-LOGO ortamı öğrenciler için konforlu, eğlenceli ve kendilerini rahat hissettikleri bir ortamdır (Jarvinen, 1998). Sınıf ortamında LEGO-LOGO uygulamaları gerçekleştirilerek sınıfları normal bir sınıf havasından kurtarıp, öğrencilerin kendilerini daha rahat hissettikleri ve öğrenirken eğlendikleri ortamlar ortaya konabilir.

Uygulama boyunca kontrolün öğrencide olması ve tüm süreç boyunca öğrencinin aktif rol üstlenmesinden dolayı, LEGO-LOGO uygulamaları öğrencilerin anlamakta güçlük çektikleri kavramları zihinlerinde daha kolay yapılandırılmalarını sağlamaktadır (Karamustafaoğlu, Aydın, ve Özmen, 2005; Çayır, 2010). Dolayısıyla bu etkinlikler farklı öğrenme etkinlikleri ile birlikte sunulurken sınıfa taşınabilir. Böylece öğrencilerin yeni öğrendikleri bilgileri yapılandırması ve öğrenmenin kalıcı olması yönünde etkili uygulamalar gerçekleştirilebilir.

LEGO-LOGO uygulamaları ile öğrenciler farklı teknolojilerin bir arada kullanılmasıyla gerçekleşen etkinlikler olduğu için öğrencilerin problem çözüme becerilerinin gelişmesine katkı sağlanmaktadır (Erbaş, 2005). Lindh ve Holgersson tarafından (2007) yapılan araştırmaya göre problem çözmeye yönelik etkinlikleri seven öğrencilerin başarılarında artma olduğu görülmüştür. Bu bakımdan LEGO-LOGO uygulamalarının eğitim-öğretim ortamlarında kullanılmasının öğrencilerin başarılarını da olumlu yönde etkileyeceği söylenebilir. Ayrıca, bu etkinlikler sayesinde ortaya çıkan öğrenme ortamları ile de öğrencilerin yaratıcılarının gelişmesine olumlu yönde etkilenmektedir (İşman, 2003).

LEGO-LOGO aktiviteleri ile öğrenciler kendi öğrenmelerinden sorumlu hale gelmektedirler ve kendi kendilerine öğreneceklerinden dolayı daha anlamlı öğrenmeler sağlanmaktadır (Hiltunen ve Jarvinen, 2000). Sullivan tarafından (2008) yapılan araştırmanın sonucuna göre eğitim-öğretim ortamlarında LEGO-LOGO uygulamalarının öğrencilere sunduğu avantajları şu şekilde sıralamıştır:

- Zengin araçların olduğu bir ortam
- Anında geri bildirim olanağı
- Sınırlanılmamış ve genişletilmiş sorgulama ile her şeyi test etme imkanı
- Sürekli olarak test etme imkanı sunmasından dolayı kolayca hata ayıklama olanağı

Eğitsel bir araç olarak LEGO-LOGO uygulamaları öğrencilerin bilimsel prensipleri daha iyi anlamalarını sağlamak için önemli bir rol üstlenmektedir (Chambers, Carbona ve Murray, 2008). Bu uygulamalar, öğrencilere çeşitli fen, matematik ve tasarım alanlarında tasarım, robot yapımı ve programlama yapma olanağı sunmaktadır. Ayrıca,

öğrenciler bilgisayar programcılığı, mekanik tasarım, fizik, matematik, hareket, çevresel faktörler ve işbirlikli grup ortamında problem çözme konularında yaratıcılıklarını keşfedebilmektedirler (Chambers, Carbona ve Rex, 2007).

Ülkemizde FLL yarışmaları yapılmasına rağmen henüz çok fazla bilinmemektedir. Buna rağmen etkili katılımların sağlandığı söylenebilir. Ancak, FLL'ye katılan gruplar devlet okulu gruplarından daha çok özel okullar ve vakıflar ve öğrenci kulüplerinin oluşturduğu gruplardır. Devlet okullarının FLL'ye katılma ve hazırlanma konusunda desteklenmesi gerekmektedir.

Dünyada çok yaygın kullanımı ve birçok avantajı olmasına karşın eğitim-öğretim ortamlarında gerçekleştirilen LEGO-LOGO uygulamaları ülkemizde çok az sayıdadır. Bu sebepten dolayı okullarda LEGO-LOGO uygulamalarına yer verilebilecek olanakların sağlanması ve desteklenmesi öğrencilerin bilişsel ve motor becerilerinin olumlu bir şekilde gelişmesi sağlanması açısından önerilmektedir.

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## ELASTASE INHIBITION AND ANTIOXIDANT ACTIVITIES OF COCOA POD EXTRACT

Azila, A.K.<sup>1</sup>, Azrina, A.<sup>2,3\*</sup>, Puziah, H.<sup>3</sup>, Amin, I.<sup>2</sup> and Nur Azilah, A.<sup>1</sup>

<sup>1</sup> Cocoa Innovation & Technology Centre, Malaysian Cocoa Board, PT12621, Nilai Industrial Area, 71800 Nilai, Negeri Sembilan, Malaysia

<sup>2</sup> Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

<sup>3</sup> Laboratory of Halal Science Research, Halal Products Research Institute, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

\*corresponding author; Tel.: +6-03-8947-2466; Fax: +6-03-8942-6769.  
Email: [azrina@medic.upm.edu.my](mailto:azrina@medic.upm.edu.my); [aziela@koko.gov.my](mailto:aziela@koko.gov.my)

### ABSTRACT

Cocoa pod, an outer part of cocoa fruit (*Theobroma cacao*) that being discarded into plantation floor during extraction of beans for cocoa processing. Poor management of the discarded pods leads to plant disease to cocoa fruits such as black pod disease. In this study, cocoa pod extract was investigated for its antioxidant properties (DPPH, FRAP and  $\beta$ -carotene bleaching assays) and anti-wrinkles activities (porcine pancreas elastase assay) in the search for its application as cosmeceutical ingredients. Excellent antioxidant properties ( $EC_{50}$  of 20.35  $\mu$ g/ml by DPPH assay,  $EC_1$  at 14.90  $\mu$ g/ml by FRAP assay and  $EC_{50}$  at 83.75  $\mu$ g/ml by  $\beta$ -carotene bleaching assay) and high potential of elastase inhibition ( $IC_{50}$ =0.588) were observed indicating its potential as active ingredients for anti-wrinkles product.

### INTRODUCTION

Elastin forms extracellular matrix structure with collagen strengthens the dermal layer resulting supple and smooth skin. However, the naturally presence of elastase, a responsible enzyme, degrades the elastin fibrous protein in human when activated by UV light during exposure and reactive oxygen species (ROS). The capability of elastase enzyme was described extensively by Kim, et al. (2008). Mukherjee (2011) also reported on mechanism of skin wrinkles formation and role of plant bioactive compounds, such as catechin, epicatechin and gallic acid, as anti-wrinkles agent. Polyphenolic substances from plants were reported to delay skin aging by ROS, in-vitro (Rutter, et al. 2003) and exhibited UV-radiation protection (Nichols and Katiyar, 2010). These compounds have high antioxidant activity as reported by Evans and Johnson (2010) as phenolic compounds such as catechin, epicatechin, quercetin and kaempferol had reduced oxidative stress related effects such as skin wrinkles and photoaging (Jung, et al. 2007). Thus antioxidant activity of plant phenolic extract offers an alternative source of ingredients in producing natural anti-wrinkles cream (Baumann, 2007; Masaki, 2010).

In cocoa processing plant, abundant of waste is created which can be turned into value-added end products. It was estimated that only 25% from total weight of fresh cocoa fruits were used to produce cocoa beans for cocoa and chocolate processing. Other parts, including the pods, are discarded. However, despite of being thrown away, cocoa pods has been used as sources of fertilizer, animal feed and production of activated carbon (Fisal, 2005). Other potential uses of cocoa pods is in producing gum (Samuel, 2006), potash in soap-making as well as colorant (Figueira, et al. 1993; Azila, 2005). Vriesmann et al. (2011) reported that cocoa pods contained 45.6–46.4 mg gallic acid equivalent of soluble phenolic; 32.3% carbohydrate, 21.44% lignin, 19.2% sugars, 8.6% protein and 27.7% minerals. Similar amount of total phenolic content (49.54 $\pm$ 3.39mg gallic acid equivalent/g extract) was reported by Azila et al. (2012a) with total flavonoid content of 22.42 $\pm$ 0.09mg rutin equivalent/g extract. Thus, cocoa pod extract can be used as a new source of active ingredients in making cosmeceutical (functional cosmetic) product. Hence, an investigation that turn plant waste into a new value added product is worth carried out by first identifying the antioxidant and elastase inhibition properties of the cocoa pod extract using in-vitro methods, prior to formulation of a cosmeceutical product such as for anti-wrinkle effect.

### MATERIALS AND PROCEDURES

#### Sample preparation

Ripe cocoa pod was collected randomly from Cocoa Research & Development Centre in Jengka, Pahang, Malaysia, during extraction of beans for fermentation. The pod was rinsed with water and chopped into 1cm<sup>2</sup>. The chopped pod was then dried under sunlight and ground to 1mm mesh size. After sieved, 1g of powder form sample was extracted using 20ml of aqueous ethanol (80% v/v, Hmbg), for 30 minutes at 40°C in water bath shaker (120rpm). Decanted

portion was filtered, evaporated until dryness and weighed. The extract was re-dissolved in ethanol prior to serial dilution of 1000-7.81 µg/ml for determination of antioxidant and elastase inhibition properties.

#### DPPH scavenging assay and EC<sub>50</sub>

Antioxidant activity by 1,2-diphenyl-2-picrylhydrazyl (DPPH, C<sub>18</sub>H<sub>8</sub>N<sub>5</sub>O<sub>6</sub>, Aldrich, MW 394.23g/mol) assay as described by Patil, et al. (2010); Kim, et al. (2008); Mustafa, et al. (2006); Kim, et al. (2009) was implemented with modifications. In brief, the DPPH stock solution was prepared by dissolving 0.2M of DPPH in ethanol. Solution of DPPH was made by diluting 1.2ml of DPPH stock solution with 3ml ethanol and 0.5ml DMSO. Then, 270 µl of DPPH solution was added to 30 µl sample at different concentration, shake and left it to react for at least 10 minutes before measuring the absorbance at 550nm. Gallic acid standard was used as positive control. Blank was ethanol with addition of DPPH solution (Lee, et al., 2003). Calculation of EC<sub>50</sub> (the concentration needed to reduce DPPH by 50%) was obtained using linear regression (Marxen, et al., 2007) on the graph plotted of the remaining DPPH percentage versus concentration ratio of sample to DPPH. Small value EC<sub>50</sub> indicates low concentration of sample required to exhibit antioxidant activity by the assay.

#### FRAP assay and EC<sub>1</sub>

Method of conducting FRAP assay for cocoa pod extract was carried out with modification of method from Benzie and Strain (1996); Szollosi, et al. (2002); Katalinic, et al. (2004); Arnous, et al. (2002); Pulido, et al. (2000); Bub, et al. (2000). In brief, ferric chloride solution was made by dissolving 3 mM of Ferric chloride in 5 mM citric acid with distilled water. TPTZ solution was prepared by dissolving 1 mM of TPTZ in 0.05M hydrochloric acid. Standard calibration curve was obtained by different concentration of FeSO<sub>4</sub>.7H<sub>2</sub>O (1.0 – 0.1 mM Fe (II)). To measure the FRAP value, 15 µl of sample or standard was added to 270 µl of TPTZ solution and measure at 620nm for initial reading using micro plate reader. Ferric chloride solution (15 µl) was added and measurement was carried out at immediate. The sample was incubated for 30 minutes (30-37°C) with interval measurement for 2-3 minutes. The result was compared with gallic acid and ascorbic acid. EC<sub>1</sub> is equivalent concentration 1, where equivalent concentration of the extract with reducing ability equivalent to 1 mmol Fe (II)/L, expressed as µg/ml (Pulido, et al, 2000). Higher value indicated lower antioxidant activity, which means high concentration of extract was needed to reduce 1 mol of Fe (III) to Fe (II) referring to the mechanism of antioxidant compound to FRAP assay.

#### B-carotene bleaching assay and EC<sub>50</sub>

This assay was carried out using method by Othman, et al. (2007); Fukumoto, et al. (2000); Rodrigues, et al. (2011); Jayaprakasha, et al. (2001); with some modifications. Solution of β-carotene was prepared by dissolving 2mg of β-carotene powder (MP Biomedicals, LLC) in 100 µl chloroform. Immediately, 0.2ml of linoleic acid (SAFC Sigma-Aldrich) was added followed by 2ml of Tween 20 (Merck). Then, 20ml of distilled water was added and the mixture was vortex vigorously until the emulsion turn into clear solution. In 96-well micro plate, 20 µl of diluted sample or standard was pipetted and added with 200 µl of β-carotene solution. Measurement was carried out at 450nm after incubation at 50°C for 20 minutes. Monitoring of the degradation was carried out at an interval of 20 minutes for at least 2 hours or longer to determine the degradation rate. Degradation rate ( $D_R$ ) was calculated by the following equation;  $D_R = [\ln (a/b)]/t$ ; where,  $a$  is initial absorbance at time  $0$ ,  $b$  is absorbance at time  $t$  and  $t$  is time of measurement. The antioxidant activity by β-carotene bleaching assay was calculated as antioxidant activity (AA%) =  $[(D_{RC} - D_{RS})/D_{RC}] \times 100$ ; where  $D_{RC}$  is degradation rate of control and  $D_{RS}$  is degradation rate of sample or standard. Effective concentration at 50% (EC<sub>50</sub>) is concentration of extract needed to exhibit 50% antioxidant activity and obtained by plotting graph on antioxidant activity versus concentration ratio of sample to β-carotene. In addition, butylated hydroxytoluene (BHT, MW 220.35g/mol) was used as standard due to ineffective gallic acid and ascorbic acid as positive control in β-carotene bleaching assay. Negative control was ethanol solution with β-carotene solution.

#### Elastase inhibition assay and IC<sub>50</sub>

Substrate N-Succinyl-Ala-Ala-Ala-p-nitroanilide (SANA, Sigma-Aldrich, MW 451.43 g/mol) was used for this assay using method by Lee and Choi (1998); Thring, et al. (2009); Kim, et al. (2009); Moon, et al. (2010), with several modifications. The substrate (0.374 mM) was dissolved in 5ml of dimethylsulfoxide (DMSO, Merck) and diluted with 10ml of aqueous methanol (50% v/v) and HEPES buffer (0.1M, Calbiochem, MW 238.3g/mol) to make a substrate solution. Porcine pancreas elastase enzyme (PPE, Sigma-Aldrich) was dissolved in water at concentration of 1110 µg/ml. In 96-well micro plates, 25 µl of diluted cocoa pod extract was pipetted into well with addition of 25 µl PPE and left for 15 minutes at 25°C. The substrate solution at 200 µl was added into well and measured at 405nm wavelength for initial measurement followed by incubation at 25°C for 15 minutes. Reading was monitored at every 2 minutes for 40 minutes. Gallic acid and ascorbic acid in serial dilution was used as positive control. Inhibition of elastase was calculated by the following;  $Inhibition (\%) = [1-B/A] \times 100$ ; where  $A$  is enzyme activity without extract and  $B$  is enzyme activity with extract. Inhibition concentration at 50% (IC<sub>50</sub>) was obtained using linear regression on the graph plotted of inhibition percentage versus ratio concentration of the extract to enzyme concentration.

#### Statistical analysis

Minitab Software version 14.2 was used for statistical analysis where appropriate. All data were expressed as mean  $\pm$  standard deviation. Two sample t-test was used to verify the difference of value obtained for samples and standards used in this study. Significant difference was considered at p level of  $<0.05$ .

## RESULTS

### DPPH scavenging assay and $EC_{50}$

Principally, DPPH assay was used to scavenging of stable radical species by (Pulido, et al, 2000). Therefore, determination of scavenging effect out to the extract of cocoa pod. At the scavenging effect of cocoa pod  $86.8 \pm 3.5\%$  which, however, was lower than gallic acid ( $94.5 \pm 0.2\%$ ).

To understand more on the antioxidant using DPPH assay, effective concentration was determined (Figure

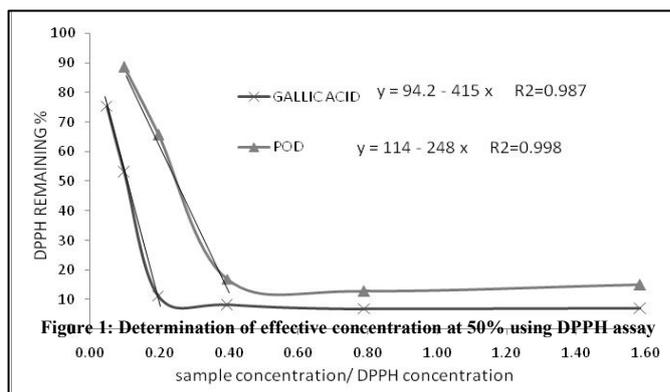


Figure 1: Determination of effective concentration at 50% using DPPH assay

1). It was indicated that cocoa pod has low  $EC_{50}$ . Although the  $EC_{50}$  value was two-folds lesser than the gallic acid (Table 1), it exhibited good antioxidant activity. It was suggested that the antioxidant activity in cocoa pod extract was due to presence of color pigments. The pigments in the fruit pods can be the results of bioactive compounds such as chlorophyll, carotenoids and phenolics (Lancaster, 1997) which contributed to the observed antioxidant activity.

### FRAP assay and $EC_1$

This assay is related to reducing ability of antioxidant in the extract to the ferric ion (Prior, et al, 2005). FRAP cocoa pod extract at  $250 \mu\text{g/ml}$  was compared with gallic acid (Figure 2). It was indicated that at this concentration,  $454.44 \pm 0.40 \mu\text{mol Fe(III)}$  was reduced to the presence of cocoa pod extract, which was significantly lower than gallic acid;  $918.83 \pm 0.25 \mu\text{mol}$  and ascorbic acid;  $727.90 \pm 0.04 \mu\text{mol Fe(II)/L}$ .

When  $EC_1$  was determined, the result indicates that cocoa extract has  $EC_1 = 14.90 \mu\text{g/ml}$ . The value was even lower comparison with gallic acid as a standard ( $EC_1 = 23.24 \mu\text{mol/L}$ ) as well as ascorbic acid ( $EC_1 = 17.42 \mu\text{g/ml}$ ). This revealed that cocoa pod extract has good antioxidant activity by FRAP assay.

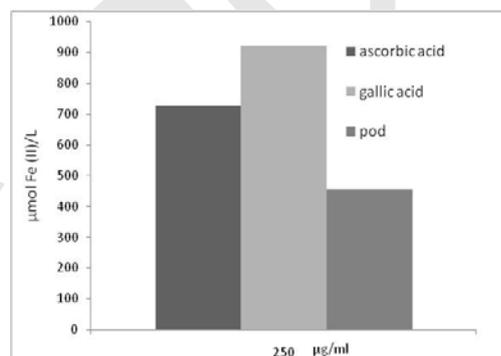


Figure 2: Antioxidant activity using FRAP assay at  $250 \mu\text{g/ml}$

### $\beta$ -carotene bleaching assay and $EC_{50}$

Degradation rate of  $\beta$ -carotene solution in the cocoa pod extract (labelled 250) and gallic acid concentration of  $250 \mu\text{g/ml}$  is as plotted in According to Othman, et al. (2007), low rate of a control indicates a relatively higher activity of a sample in protecting oil/fat based. In this study, good degradation rate of cocoa was exhibited resulting to high antioxidant this concentration ( $81.55 \pm 0.01\%$ ) in comparison acid ( $14.19 \pm 0.04\%$ ), although lower than BHT ( $99.17 \pm 0.01\%$ ).

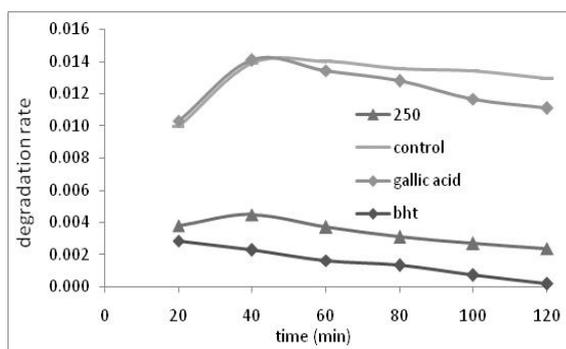


Figure 3: Degradation rate of  $\beta$ -carotene in the presence of cocoa pod extract, gallic acid and BHT at  $250 \mu\text{g/ml}$

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Effective concentration of cocoa pod extract to inhibit 50% degradation of  $\beta$ -carotene ( $EC_{50}$ ) was determined at 0.838 or 83.75 $\mu$ g/ml. This value was lower than concentration needed for gallic acid standard (1976 $\mu$ g/ml) although higher than BHT (Table 1), indicating a promising potential as antioxidant agent by inhibition of lipid peroxidation (Pulido, et al, 2000). It can be suggested that the antioxidant activity observed was contributed by numerous compounds that act synergistically in the cocoa pod extract.

### Elastase inhibition assay and $IC_{50}$

During reaction or cleavage of p-nitroanilide with elastase, the substrate will degrade into p- which is yellow in color that can be measured at Therefore, for yellowish extract like cocoa pod, measurement (absorbance at 405nm subtracted solvent) must be carried out in parallel with measurement of elastase activity to avoid false results. Figure 4 shows the percentage of cocoa pod extract in comparison with gallic ascorbic acid and BHT standards at concentration of 500 $\mu$ g/ml. BHT has the elastase inhibition (97.78 $\pm$ 0.01%) activity tested extract and standards. Although lower the cocoa pod extract (68.89 $\pm$ 0.48%) has significantly higher elastase inhibition activity compared with ascorbic acid (15.56 $\pm$ 0.60%) and (17.78 $\pm$ 0.01%) at this concentration.

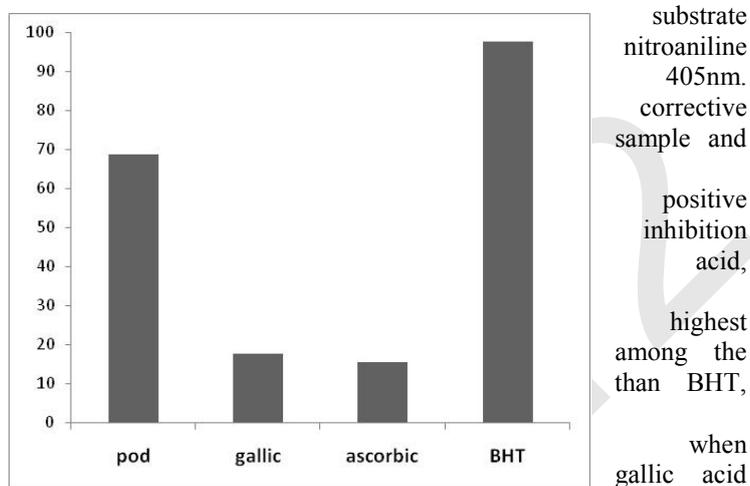


Figure 4: Elastase inhibition percentage of cocoa pod extract in comparison with gallic acid, ascorbic acid and BHT at 500 $\mu$ g/ml

The inhibition percentage of cocoa pod extract was calculated using linear regression obtained from the graph of inhibition percentage versus ratio samples to PPE concentration used in this study. In this experiment, to inhibit 1110 $\mu$ g/ml PPE activity at 50%, the concentration of cocoa pod extract required was 306.36 $\mu$ g/ml, doubled the ascorbic acid (190.92 $\mu$ g/ml) and significantly higher than BHT (17.76 $\mu$ g/ml). However, the concentration of elastase enzyme used in this experiment was higher compared to concentration used by Kim, et al (2009); Kim, et al (2008); Shasrabudhe, et al (2010); Lee (1998) at concentration of 1 $\mu$ g/ml. Also, different concentration of substrate was utilized in this study (0.374mM) whereas the previously mentioned studies were using 0.8mM of SANA. To consider equivalent comparison with available elastase inhibition value in other research works, we recommend calculating the  $IC_{50}$  value by multiplying value obtained at  $IC_{50}$  with ratio of 0.8mM substrate to concentration of substrate in this experiment. Therefore, as shown in Table 1, the cocoa pod extract ( $IC_{50}$ =0.588) inhibited PPE activity similar to gallic acid ( $IC_{50}$ =0.588), which was lower than ascorbic acid ( $IC_{50}$ =0.366) and BHT ( $IC_{50}$ =0.034).

Table 1: Elastase inhibition and antioxidant properties of cocoa pod extract

| Sample        | Elastase  |  | $\beta$ -carotene |  | DPPH      |  | FRAP                 |
|---------------|-----------|--|-------------------|--|-----------|--|----------------------|
|               | $IC_{50}$ | Concentration ( $\mu$ g/ml) at $IC_{50}$ | $EC_{50}$         | Concentration ( $\mu$ g/ml) at $EC_{50}$ | $EC_{50}$ | Concentration ( $\mu$ g/ml) at $EC_{50}$ | $EC_1$ ( $\mu$ g/ml) |
| Pod           | 0.588     | 306.36                                   | 0.838             | 83.75                                    | 0.258     | 20.35                                    | 14.90                |
| Gallic acid   | 0.588     | 306.36                                   | 19.76             | 1976                                     | 0.106     | 8.36                                     | 23.24                |
| BHT           | 0.034     | 17.76                                    | 0.023             | 2.30                                     | -         | -  | -                    |
| Ascorbic acid | 0.366     | 190.92                                   | -                 | -  | -         | -  | 17.42                |

### CONCLUSION

Elastase inhibition activity of cocoa pod extract was in proportion to the antioxidant activity based on the  $IC_{50}$ ,  $EC_{50}$  and  $EC_1$  values; where high antioxidant activity leads to good inhibition of elastase. The crude extract containing various compounds acts synergistically towards the tested *in-vitro* system providing the potential activities. The extract was even have better performance as antioxidant when compared with gallic acid using  $\beta$ -carotene and FRAP assay, although gallic acid acts better as ROS scavenger (DPPH assay). However, they have similar elastase inhibition activity. Nevertheless, the results suggested that cocoa pod extract has good potential for elastase inhibition and antioxidant properties for development of skin anti-wrinkle ingredient and efforts are already underway to formulate the product.

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# ELASTİK ZEMİNE OTURAN ŞERİT TEMELLER İÇİN DİNAMİK EMPEDANS FONKSİYONU: ADAPAZARI ZEMİN DURUMU

Osman KIRTEL, Erkan ÇELEBİ  
Sakarya Üniversitesi  
İnşaat Mühendisliği Bölümü  
Türkiye  
okirtel@sakarya.edu.tr, ecelebi@sakarya.edu.tr

**Özet:** Bu çalışmada, Adapazarı bölgesi için üstyapıların tasarımında kullanılmak üzere elastik zemine oturan yüzeysel şerit temeller için yatay ve düşey doğrultularda dinamik empedans çarpanları elde edilmiştir. Çalışmada öncelikle dinamik analizlerde kullanılacak Sonlu Eleman Modelinin (SEM) doğrulaması yapılmıştır. Bunun için literatürdeki mevcut statik empedans fonksiyonları kullanılmıştır. Adapazarı bölgesindeki farklı zemin durumları göz önüne alınarak analizler yapılmış ve modelin geçerliliği sağlanmıştır. Statik durum için sayısal model doğrulaması yapıldıktan sonra dinamik analizlere geçilmiştir. Harmonik yük etkisi altında çalışmalar yapılırken sonlu eleman boyutunun uygunluğu, geometrik ve malzeme sönümü etkisi de dikkate alınmıştır.

**Anahtar Kelimeler:** sonlu elemanlar yöntemi, yapı-zemin etkileşimi, empedans fonksiyonları, enerji yutucu sınırlar

## Giriş

Son yıllarda yapılan araştırmalar ile birlikte üst yapıların (baraj, nükleer santraller, köprü ve viyadükler, binalar vb.) tasarımında, bu yapıların oturdukları zeminin üst yapı davranışını büyük oranda etkilediği görülmüştür. Yapı-zemin etkileşimi olarak tanımlanan bu durumu çözümlmek için farklı yaklaşımlar ve formülasyonlar geliştirilmiştir. Genel olarak “Doğrudan çözüm yaklaşımı” ve “Altsistem yaklaşımı” olarak iki farklı yöntem ışığında bütün çalışmalar yapılmaktadır. Doğrudan çözüm yaklaşımında yapı ve zemin bölgesi ortak olarak ele alınmaktadır. Altsistem yaklaşımında ise yapı ve zemin bölgesi ayrı ayrı değerlendirilmekte, etkileşim bölgesinde belirli fonksiyonlarla bu ayrı yapılar birleştirilmektedir (Aydinoğlu, 1994). Empedans değerleri altsistem yaklaşımı ile elde edilmiş fonksiyonlardır. Dünyada Amerika (FEMA 356) ve Almanya (DGGT, 2002) gibi ülkelerde bu fonksiyonlar tasarımlarda kullanılmaktadır. Zemin ortamının şekil değiştirme özelliğini ifade eden bu fonksiyonların belirlenmesinde analitik veya yarı analitik çözüm yöntemleri kullanılarak farklı temel tipleri için çalışmalar yapılmıştır. Günümüzde bu yöntemlere ilave olarak sınır elemanlar ve sonlu elemanlar gibi nümerik çözüm yöntemleri, bu iki yöntemi de kapsayan karma (melez) teknikler kullanılmaktadır.

Çelebi ve diğ. (2006), sınır eleman yöntemini kullanarak frekans bölgesinde çalışmalar yapmış zemin ortamının elastik olması durumunda yüzeysel ve gömülü temel durumları için dinamik empedans fonksiyonlarını malzemenin Poisson oranına bağlı olarak hesaplamışlardır. Aynı şekilde Domingez ve Roeset (1978) sınır elemanlar yöntemi ile elastik zeminler için dikdörtgen temellere ait empedans fonksiyonlarını elde etmişlerdir. Dobry ve Gazetas (1986), çalışmalarında farklı geometrik şekillere sahip gömülü olmayan temeller için empedans fonksiyonlarının kesin çözümlerini hesaplamışlardır. Mita ve Luco (1989) gömülü kare temellerin bağlaşık ötelenme-dönme titreşimlerini elde etmek için karma çözüm tekniğini kullanmışlardır. Bu analitik ve yarı analitik çözüm yöntemlerinin yanı sıra sonlu elemanlar yöntemi kullanılarak dikdörtgen temellerin gömülü olması durumunda da çalışmalar yapılmış ve fonksiyonlar hesaplanmıştır (Wolf ve Song 1997). Ayrıca Gazetas ve Roeset (1976) tabakalı zemin ortamında şerit temeller için titreşim analizleri yapmıştır. Spyarakos ve Chaojin (2004) çalışmalarında sonlu eleman ve sınır eleman yöntemlerini beraber kullanarak tabakalı zemin ortamında şerit temellerin dinamik analizini incelemişlerdir. Çalışmalarında temelin rijitliğinin, kütesinin ve gömülme durumunun etkisine de bakılmıştır. Tsai ve diğ. (1974) dinamik rijitliğin titreşim kaynağının frekansına bağlı olması durumu hareket denkleminin çözümünü zorlaştırdığından empedans fonksiyonlarını frekanstan bağımsız tanımlamışlardır.

Ülkemizde bina tasarımında zeminin etkisi kabaca tanımlanmış olan “statik yatak katsayıları” ile ele alınmaktadır. Burada yapı ile zemin arasındaki etkileşim sabit bir yatak katsayısı yoluyla tanımlanır. Bu değer temel taban basıncı dağılımına ve temelin şekil değiştirmesine bağlıdır. Elastik zemine oturan kirişler teorisine dayanan bu yöntemle sürekli temellerin kesit tesirleri hesaplanabilmektedir (Bowles 1996). Temel taban basıncı dağılımının doğru bir şekilde elde edilmesi ve temelin şekil değiştirmesinin hesaplanması çok zor olduğundan hesaplanan yatak katsayısı değerinin doğru sonucu vermesi pek mümkün değildir. Ayrıca bu katsayılar sadece statik durum için tanımlanmış ve düşey yük etkisi altında oluşacak iç kuvvetlerin hesabında kullanılmaktadır. Büyük oranda kuvvetli depremlerin meydana geldiği Kuzey Anadolu fay hattı üzerinde bulunan Adapazarı bölgesi zemin özellikleri bakımından da çok özel bir yapıya sahiptir. Bu yüzden

özellikle binaların deprem etkisi altında ki davranışı incelenirken kaba yaklaşımlar yerine zemin etkilerini daha gerçekçi yansıtan, proje mühendislerinin kolayca kullanabilecekleri empedans fonksiyonlarının kullanılması daha tutarlı sonuçlar verecektir.

Bu çalışmada binaların oturdukları zemini ifade eden, literatürde şerit temeller için geliştirilmiş statik empedans fonksiyonları referans alınarak Adapazarı bölgesinin çeşitli zemin özelliklerini sağlayan Sonlu Eleman Modeli (SEM) geliştirilmiş ve bu model farklı zemin bölgeleri için yatay ve düşey doğrultularda doğrulanmıştır. Statik durum için doğrulanan SEM kullanılarak depremin etkin frekans değerlerine göre (0-5 Hz) tanımlanmış boyutsuz frekansa bağlı, yatay ve düşey doğrultularda Adapazarı bölgesi için kullanılacak dinamik empedans çarpanları elde edilmiştir.

## Sayısal Modelin Kurulması ve Statik Durum İçin Doğrulaması

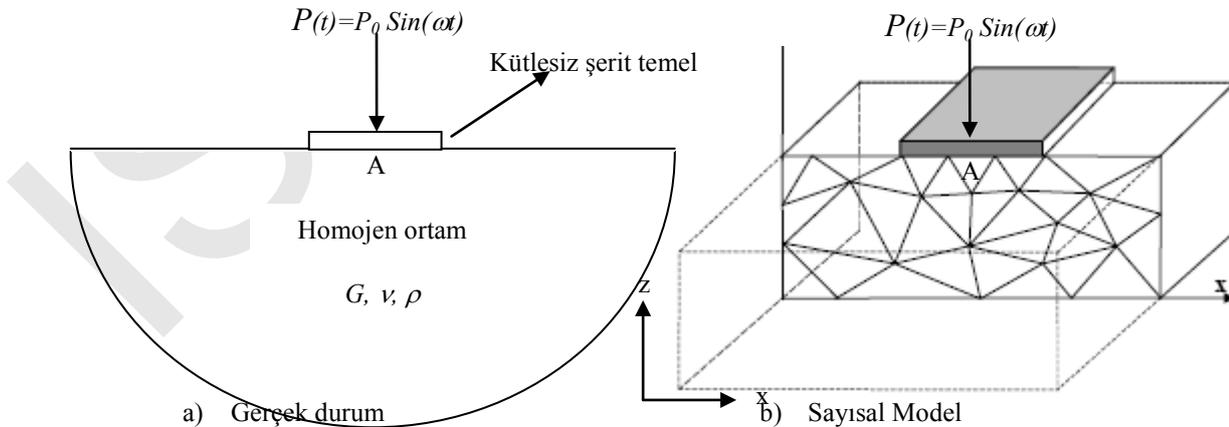
Sistemdeki yatay ve düşey etkileri görebilmek amacı ile düzlem - şekildeğiştirme problemi olarak kurulan sonlu eleman sisteminin doğruluğunu tanımlamak için statik etki altında yarı sonsuz elastik ortamlara oturan temel rijitliğini ifade eden fonksiyonlar kullanılacaktır (Gazetas, 1991).

Sonlu eleman modeli düzlem şekildeğiştirme problemi olarak ele alındığı için doğrulamada boyutları  $2B \times 2L$  olan şerit temeller için verilen fonksiyonları dikkate alınmıştır. Burada temelin yataydaki genişliği  $2B$ , düzleme dik doğrultudaki genişliği ise  $2L$ 'dir. Gazetas (1991) tarafından geliştirilen, elastik zemine oturan şerit temeller için yatay ve düşey empedans fonksiyonları Tablo 1'de verilmiştir. Burada temelin oturduğu zeminin özellikleri olarak  $G$ ; kayma modülünü,  $\nu$ ; poisson oranını ifade etmektedir.

**Tablo 1:** Elastik zemine oturan şerit temeller için empedans fonksiyonları

| Şerit Temel İçin Empedans Fonksiyonları ( $2L \rightarrow \infty$ ) |   |
|---|---|
| Düşey (z)   | $\frac{\alpha_z}{2\alpha} = \frac{0.73\alpha}{1 - \nu}$ |
| Yatay (x)   | $\frac{\alpha_x}{2\alpha} = \frac{2\alpha}{2 - \nu}$    |

Bu çalışmada Plaxis 2D V10 sonlu elemanlar programı kullanılarak Adapazarı bölgesi için statik empedans fonksiyonları doğrulanacak ve doğrulaması yapılan model yardımı ile frekansa bağlı dinamik ötelenme rijitlikleri elde edilecektir. Empedans fonksiyonlarının doğru bir şekilde elde edilebilmesi için kurulacak sonlu eleman modelinde (SEM) analizlere etki eden bütün parametreler detaylı bir şekilde incelenmeli ve model bu incelemeler sonucunda en uygun şekilde kurulmalıdır. Yapılacak SEM'nin şematik görünümü Şekil 1'de gösterilmiştir.



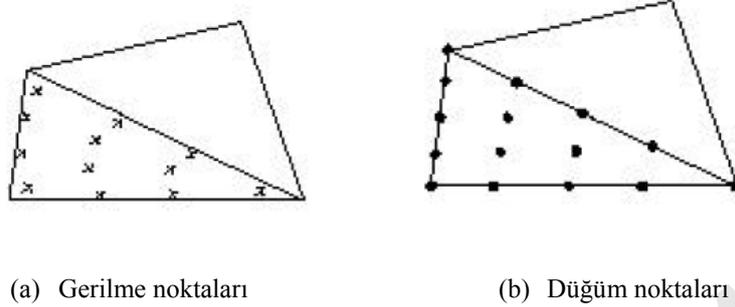
**Şekil 1:** Yapı-zemin etkileşimi probleminin modellenmesi

Plaxis 2D program aracılığı ile;

- Sınır şartları
- Malzeme özellikleri
- Çözüm ağı yoğunluğu (mesh)

- Malzeme sönümü ve geometrik sönüm

gibi yapı-zemin dinamik etkileşimi probleminin çözümüne etki eden temel parametreler ele alınabilmektedir. Bu çalışmada ki problem için belirtilen parametreler tek tek incelenmiştir. Modelde yük-temel-zemin sistemi düzlem şekil değiştirme analizi kullanılarak idealize edilmiştir. (Şekil 1b). Zemin bölgesinin ayrıklaştırılmasında 12 gerilme noktasına sahip 15 düğüm noktalı üçgen şeklinde sonlu eleman tipi kullanılmıştır (Şekil 2).



Şekil 2: Üçgen eleman

Kurulan modelde  $2B=2$  m genişliğinde ve 0.25 m kalınlığında betonarme şerit temel kullanılmıştır. Başlangıç parametrelerini belirlemek amacı ile Adapazarı bölgesi için en olumsuz malzeme durumu dikkate alınmıştır (Sert 2003). Modelde kullanılan temel ve zemin malzemelerinin özellikleri Tablo 2’de verilmiştir. Burada zemin ortamı için lineer malzeme davranışı ele alınarak sayısal model oluşturulmuştur.

Tablo 2: Malzemelerin mekanik özellikleri

| Parametre                        | Boyut                | Temel | Zemin |
|----------------------------------|----------------------|-------|-------|
| Elastisite Modülü ( $E$ )        | [kN/m <sup>2</sup> ] | 3.107 | 20000 |
| Poisson Oranı ( $\nu$ )          | [-]                  | 0.2   | 0.35  |
| Birim Hacim Ağırlık ( $\gamma$ ) | [kN/m <sup>3</sup> ] | 24.5  | 18.5  |

Statik durum için doğrulama yapılmasına rağmen, dinamik durumda sınır şartlarının, malzeme ve geometrik sönümün ve sonlu eleman boyutlarının etkisi önem kazandılarından, dış yük olarak, genliği 100 kN ve deprem hareketinin etkin frekans aralığını da içerisine alan  $f=10$  Hz frekansında bir harmonik yük kullanılarak modele etki eden parametreler incelenmiştir. Sayısal modelde sonuçların tutarlılığı ve doğruluk düzeyi açısından sonlu eleman boyutunun ( $\Delta h$ ) üst değeri en kısa dalga boyuna ( $\lambda_{min}$ ) göre sınırlandırılmıştır (Kuhlemeyer and Lysmer 1973).

$$\Delta h \leq \frac{\lambda_{min}}{10} = \frac{v_j}{10 \cdot f} \quad (1)$$

Burada,  $k$  çarpan sabiti sonlu eleman tipine ve kullanılan şekil fonksiyonuna bağlı  $5 \leq k \leq 10$  aralığında değişmektedir. Dinamik yüke ait en büyük frekans değeri  $f_{maks}$  ile gösterilmiştir. Zemin ortamının kayma dalga hızını,  $v_j$  ifade etmektedir. Çalışmanın amacına göre en uygun değerler alınarak (maksimum frekans ve ‘ $k$ ’ değerleri) kullanılacak sonlu elemanların maksimum boyutu sayısal olarak belirlenmiştir ( $\Delta h \leq 0.598$  m). Geliştirilen çözüm yönteminde sistemden dışarıya doğru yayılan ve zeminin sonsuzluğu nedeni ile zemin ortamında kaybolan enerjiyi tanımlamak için bölgenin sınırlarında eşdeğer anlamda kullanılan, radyasyon sönümü adı verilen ve malzeme sönümü ile ilgisi bulunmayan bir sönüm mekanizması kullanılmıştır. Viskoz sönümleyici türü olan bu sınır şartlarında, soğurma etkisini düzenlemek için boyutsuz iyileştirme katsayıları ( $c_1$  ve  $c_2$ ) kullanılmaktadır. Basınç dalgası sınırlara dik geldiği için literatürde (Lysmer ve Kuhlemeyer 1969, Brinkgreve ve diğ. 2002)  $c_1=1$  alınması uygun görülmüştür. Kayma dalgasının sınırlarda rasyonel ölçüde geçirimsizliğini sağlamak için  $c_2=0.2-0.3$  aralığında tavsiye edilmiştir (Brinkgreve ve diğ. 2002). Sonlu eleman bölgesinin boyutları olarakda, sınır şartları dalgaların yansımaları engelleyecek şekilde tanımlanmasına rağmen literatürdeki (Rosset ve Kausel 1976), bu sınır yerlerinin üstyapıdan en az temel taban genişliğinin 8–10 katı kadar uzakta düzenlenmesi tavsiyesine uyulmuş ve ayrıklaştırılan bölge, 50 m genişliğinde 20 m yüksekliğinde olacak şekilde seçilmiştir. Malzeme sönümü olarak rayleigh sönümü (2) dikkate alınmıştır. Burada  $\alpha$ , kütle katılım katsayısını  $\beta$  ise rijitlik katılım katsayısını ifade etmektedir. Yapılan araştırmalara göre yapı-zemin etkileşim problemlerinde malzeme sönümüne kütle katılım katkısı ihmal edilecek seviyededir (Hashash ve Park 2002). Bu nedenle dinamik analiz bölümünde kütle katılım katsayısı dikkate alınmayacaktır. Rijitlik katılım katsayısı ise dinamik analizde kullanılacak malzemenin doğal titreşim frekanslarına bağlı olarak hesaplanmıştır (Hashash ve Park 2002).

Statik analizler, dinamik durum için belirlenen ayrıklaştırılmış bölge boyutları ve sonlu eleman ağ yoğunluğu kullanılarak yapılacaktır. Adapazarı bölgesi için statik durumda modelin doğrulaması yapılırken bölge merkezinde 1999 Kocaeli depremi sonrası yapılmış saha deneyleri yardımıyla elde edilmiş zemin özellikleri kullanılmış böylece modelin geçerliliği daha sağlam temele oturtulmuştur. Analizlerde Adapazarı bölgesi için 11 farklı noktada yapılan geoteknik çalışmalar sonucunda elde edilen zemin özellikleri kullanılmıştır (Youd ve diğ. 2000, Bray ve diğ. 2000).

$$C = \alpha M + \beta K \quad (2)$$

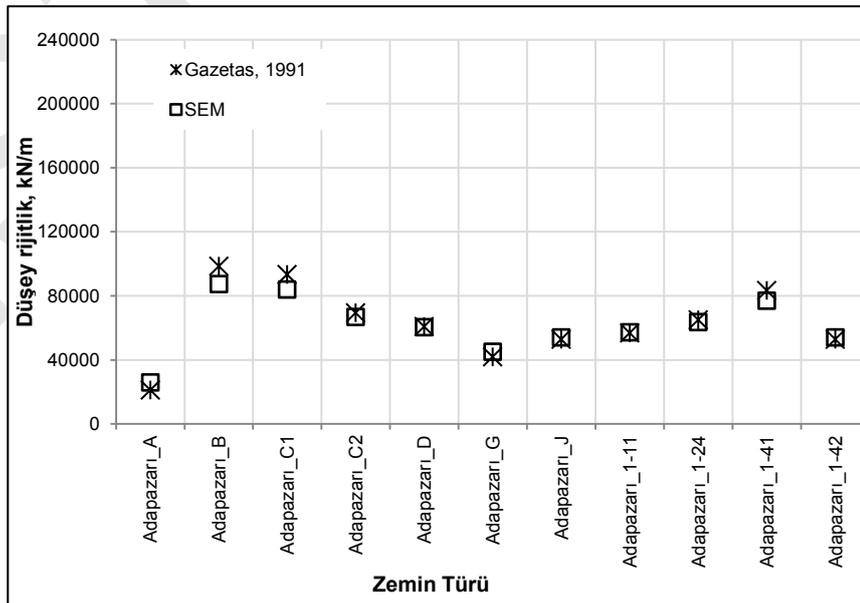


Şekil 3: Zemin özellikleri için deney yapılan noktalar

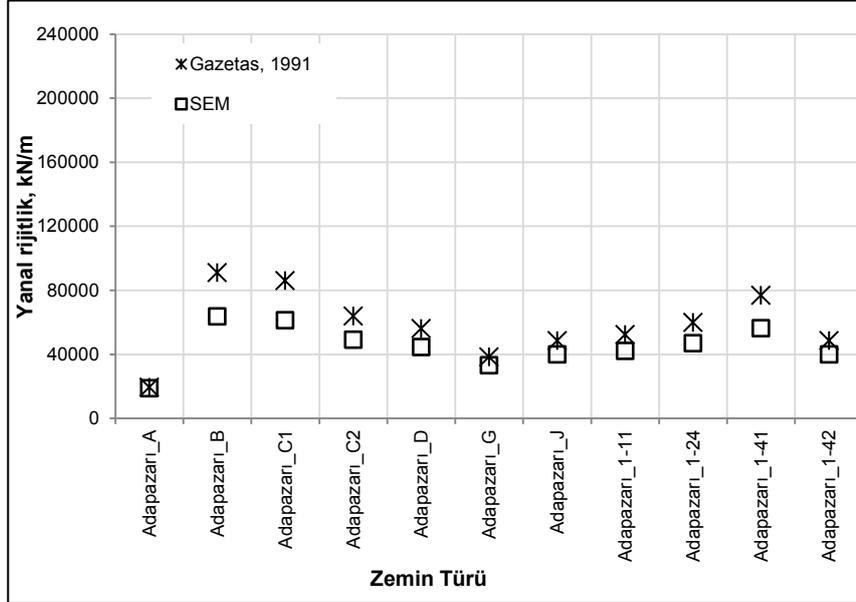
Tablo 3: Adapazarı bölgesi malzeme özellikleri

| Malzeme        | $G$ [kN/m <sup>2</sup> ] | $\rho$ [t/m <sup>3</sup> ] | $v_s$ [m/s] | $\nu$ [-] |
|----------------|--------------------------|----------------------------|-------------|-----------|
| Adapazarı_A    | 14450                    | 2                          | 85          | 0.4984    |
| Adapazarı_B    | 68450                    | 2                          | 185         | 0.4923    |
| Adapazarı_C1   | 64800                    | 2                          | 180         | 0.4927    |
| Adapazarı_C2   | 48050                    | 2                          | 155         | 0.4946    |
| Adapazarı_D    | 42050                    | 2                          | 145         | 0.4953    |
| Adapazarı_G    | 28800                    | 2                          | 120         | 0.4968    |
| Adapazarı_J    | 36450                    | 2                          | 135         | 0.4959    |
| Adapazarı_1-11 | 39200                    | 2                          | 140         | 0.4956    |
| Adapazarı_1-24 | 45000                    | 2                          | 150         | 0.4949    |
| Adapazarı_1-41 | 57800                    | 2                          | 170         | 0.4935    |
| Adapazarı_1-42 | 36450                    | 2                          | 135         | 0.4959    |

Yatay ve düşey yük etkisi altında modelin davranışı incelenmiş ve sonlu eleman analizlerinden elde edilen rijitlik fonksiyonları ile Gazetas'ın tanımladığı rijitlik fonksiyonları 11 farklı zemin türü için hesaplanmıştır. Hesaplanan bu değerler doğrultusunda kurulan modelin yatay ve düşey doğrultu için yeterli derecede doğruluk gösterdiği Şekil 4 ve Şekil 5'de görülmektedir.



Şekil 4: Zemin türüne göre düşey rijitliğin değişimi



Şekil 5: Zemin türüne göre yatay rijitliğin değişimi

## Dinamik Durum için Nümerik Analiz

Model doğrulaması yapıldıktan sonra yatay ve düşey doğrultularda dinamik rijitlik analizlerinde Adapazarı bölgesini temsil edecek zemin özellikleri kullanılacaktır. Kullanılacak zemin parametreleri, yapılan geoteknik çalışmaların yanı sıra Sert (2003) ve Bowles'tan (1996) alınmıştır. Zemin özellikleri aşağıda verilmiştir.

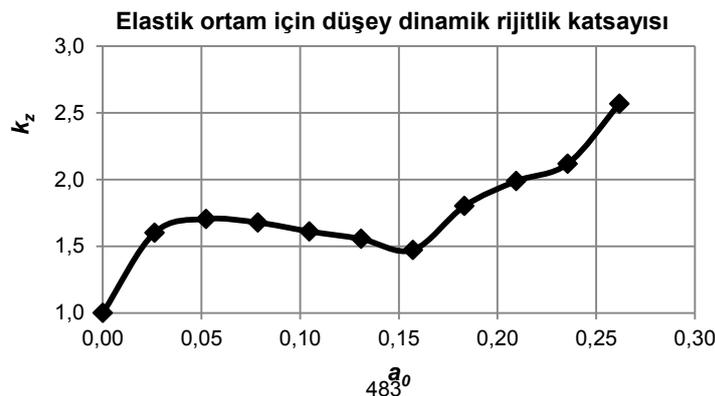
**Tablo 4:** Parametrik çalışmalarda kullanılan zemin özellikleri

|                   |                            |        |
|-------------------|----------------------------|--------|
| Yoğunluk          | $\rho$ [t/m <sup>3</sup> ] | 2      |
| Poisson Oranı     | $\nu$ [-]                  | 0.4968 |
| Elastisite Modülü | $E$ [kN/m <sup>2</sup> ]   | 86216  |
| Kayma modülü      | $G$ [kN/m <sup>2</sup> ]   | 28800  |
| Kayma dalga hızı  | $v_s$ [m/s]                | 120    |

Plaxis 2D Dynamic programında yapılan çalışmalarda, dinamik yükün frekans değeri olarak, deprem hareketinin etkin frekans içeriğinin küçük değerlerde olması nedeniyle frekans aralığı 0 - 5 Hz ve frekans artımı ise  $\Delta f = 0.5$  Hz olarak alınmıştır. Dinamik etki sonucunda malzeme davranışına bağlı tepkiler elde edildikten sonra Adapazarı bölgesi için dinamik rijitlik katsayıları boyutsuz frekans parametresine ( $a_0$ ) bağlı olarak yatay ve düşey yük durumları için elde edilmiştir (Şekil 6, 7). Boyutsuz frekans parametresi aşağıdaki denklemle tanımlanır.

$$a_0 = \frac{\omega \cdot B}{v_s} \quad (3)$$

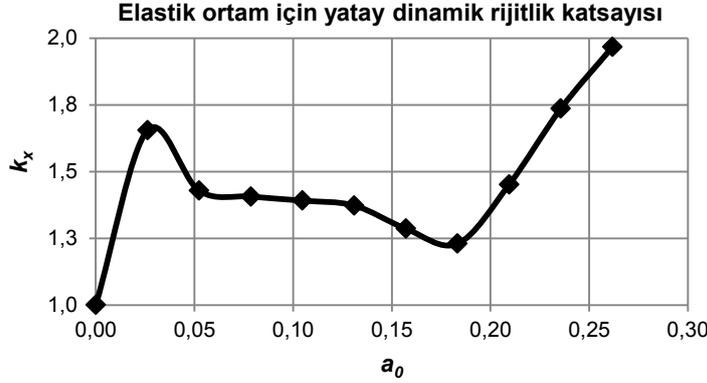
Yukarıdaki denklemde  $\omega$ , dış yükün açısal frekansını,  $B$ ; şerit temel yarı genişliğini ve  $v_s$ ; zeminin kayma dalga hızını ifade etmektedir.



**Şekil 6:** Boyutsuzlaştırılmış düşey dinamik empedans fonksiyonlarının frekans parametresine bağlı değişimi

$$\frac{K_{Dz}}{K_{Sz}} = \frac{\square\square}{\square\square} \quad (4)$$

Burada  $k_z$  düşey doğrultu için dinamik rijitlik katsayısını,  $K_{Dz}$  her bir frekans değerindeki dinamik yük için hesaplanan rijitliği,  $K_{Sz}$  ise statik durumdaki rijitliği ifade etmektedir. Grafik incelendiğinde hesap edilen boyutsuz frekans aralığında dinamik çarpan 2.5'e kadar çıkmaktadır (Şekil 6). Ayrıca boyutsuz frekansın küçük değerleri için (0.05) daha yüksek bir çarpan var iken, 0.15'e kadar bir azalma görülmüş daha sonra tekrardan artma eğilimine girmiştir.



**Şekil 7:** Boyutsuzlaştırılmış yatay dinamik empedans fonksiyonlarının frekans parametresine bağlı değişimi

$$\frac{K_{Dx}}{K_{Sx}} = \frac{\square\square}{\square\square} \quad (5)$$

Denklem 5'de  $k_x$  yatay doğrultu için dinamik rijitlik katsayısını,  $K_{Dx}$  her bir frekans değerindeki dinamik yük için hesaplanan rijitliği,  $K_{Sx}$  ise statik durumdaki rijitliği ifade etmektedir. Dinamik analizlerden elde edilen sonuçlara bakıldığında,  $0 \leq a_0 \leq 0.3$  aralığındaki boyutsuz frekans değeri için dinamik yatay rijitlik  $a_0$ 'a bağlı olarak dalgalı bir seyir izlemekte fakat incelenen frekans aralığının tamamında statik empedans değerlerinin üstünde kalmaktadır (Şekil 7). Yatay ve düşey doğrultu için elde edilen dinamik çarpanlar incelendiğinde, aynı frekans parametrelerinde benzer davranış sergiledikleri görülmüştür. Fakat düşey doğrultu için katsayı değerlerinin yatay doğrultuya göre daha büyük olduğu görülmüştür.

## Sonuçlar

Bu çalışmada, aktif ve kuvvetli bir fay hattı üzerinde bulunan Adapazarı bölgesi için proje mühendislerinin deprem etkisindeki yapı davranışlarını, zeminin etkisini daha gerçekçi bir şekilde ele alacakları dinamik empedans fonksiyonları geliştirilmiştir. Bu değerler yardımı ile zemin etkisi statik veya dinamik analiz yaparken daha basit bir şekilde ele alınabilecektir. Herhangi bir deprem hareketi etkisinde bir yapı tasarlandığında, ilgili depremin frekans içeriğine bakılarak uygun dinamik rijitlik değerleri alınabilecektir. Ayrıca, bu yaklaşım ülkemizde sıklıkla kullanılmakta olan fakat mekanik açıdan gerçekçi olmayan yatak katsayılarına karşı bir alternatif olarak sunulmaktadır.

## Teşekkür

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# ELECTRODE COMPOSITE MATERIALS WITH CATALYTIC PROPERTIES BY COMPLEXATION AND ELECTROREDUCTION OF NICKEL IN POLYMER FILMS.

A. Zouaoui<sup>a</sup>, T. Melki<sup>a</sup>, N. Boudissa<sup>a</sup>, J.-C. Moutet<sup>b</sup>

<sup>a</sup>Laboratoire de croissance et caractérisation de nouveaux Semi-conducteurs, Faculté de Technologie, Université Ferhat Abbas – Sétif, 19000 Sétif, Algeria.

<sup>b</sup>Département de Chimie Moléculaire, UMR CNRS-5250, Université Joseph Fourier Grenoble 1, Cedex 9, France.

e-mail: a\_zouaoui\_dz@yahoo.fr, Tél. 00213 7 72 55 03 02

melkitahar02@yahoo.fr

n\_boudissa@yahoo.fr

jean-claude.moutet@ujf-grenoble.fr

**Abstract:** This led us to make our contribution to the development of modified electrodes by immobilization on their surface chemical microstructures. The synthesis of metal particles-polymer composites were done by different approaches. One of them is the synthesis and characterization of the monomer pyrrole-succinic acid with complexing properties, with two carboxylic groups present in the monomer.

The electrochemical study showed the possibility on one hand that the preparation of stable films of controlled size and on the other hand, the inclusion of metallic particles of copper and nickel in the film of poly [pyrrole-succinic acid] by electroreduction and complexation of metal cations.

**Keywords :** Modified electrodes, Polypyrrole, Nickel, Complexation, Electrocatalysis.

## Introduction

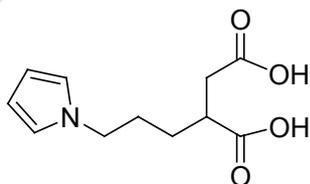
The inclusion of small metal particles in organic matrix, particularly polymers, is attracting increasing research efforts [1]. Studies on the incorporation by electrochemical reduction of metal particles with catalytic properties in polymer films have been mainly devoted to the incorporation of noble metals (Pt, Pd, Rh) [2]. However, only few examples are found in the literature concerning the inclusion in polymer films of particles of non-noble transition metals such as nickel, copper or cobalt [3]. This composite material can be applied as cathode electrocatalytic hydrogenation of both ketones and enones and showed a good electrocatalytic activity [4].

## Experimental

### Synthesis of monomer

(3-pyrrol-1-ylpropyl)succinic acid (was synthesized as follows: a solution of *n*-BuLi in hexanes, was added to *i*-Pr<sub>2</sub>NH dissolved in THF. The mixture was stirred, then mono-*tert*-butylsuccinate dissolved in THF was added dropwise. The reaction vessel was warmed to 0 °C, stirred at this temperature for two hours, and cooled again to -78 °C before N-(3-bromopropane-1-yl)pyrrole was added drop wise. The reaction vessel was then allowed to warm to room temperature and stirred. The solid residue was partitioned between and water. The organic layer was then dried with anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude mixture was purified by chromatography on silica gel to afford 2-[(3-pyrrol-1-yl)propyl]*tert*-butylsuccinate as an oily residue (yield 70%).

A solution of 2-[(pyrrole-1-yl)propyl]*tert*-butylsuccinate and KOH in absolute ethanol was refluxed for two days at 75 °C. After cooling the mixture to room temperature the solvent was removed under reduced pressure and the residue was partitioned between dichloromethane and water. The biphasic mixture was protected from light, cooled at 0 °C with an ice bath and stirred vigorously. Aqueous 1 mol L<sup>-1</sup> HCl was then added drop wise until the pH reached a value between 2-3. The organic phase was then collected and the aqueous phase was extracted with dichloromethane and diethyl ether. The organic fractions were collected, dried over anhydrous sodium sulfate, filtered and the solvent was evaporated under reduced pressure to afford the product as a light brown solid material. (yield 59%).



Pyrrole-succinic acid monomer

## Electrodes, electrochemical cell and instrumentation

All electrochemical experiments were carried out using an EGG PAR model 273 potentiostat equipped with an x-y recorder. A standard three-electrode cell was used for analytical experiments. Potentials are referred to the Ag|AgCl in 3

mol L<sup>-1</sup> KCl reference electrode in aqueous electrolytes, and to the Ag|Ag+10<sup>-2</sup> mol L<sup>-1</sup> in CH<sub>3</sub>CN + 0.1 mol L<sup>-1</sup> TBAP in acetonitrile electrolyte. Glassy carbon disc electrodes (3 mm diameter, from CH Instruments) were polished with 1- $\mu$ m diamond paste. For FT-IR measurements, films were grown on a 0.5 cm<sup>2</sup> Pt foil. Spectra were recorded using a Perkin-Elmer GX spectrophotometer equipped with a variable angle specular reflectance accessory. All experiments were run at room temperature under an argon atmosphere.

## Preparation of the modified electrodes

The polymer films were grown from unstirred solutions of monomer (4 x 10<sup>-3</sup> mol L<sup>-1</sup>) in CH<sub>3</sub>CN containing 0.1 mol L<sup>-1</sup> TBAP as supporting electrolyte, by potentiostatic oxidative electropolymerization at 0.85-0.90 V vs Ag|Ag+ 0.01 mol L<sup>-1</sup>. Polymerization experiments were controlled through the anodic charge recorded during the electrolysis. The amount of pyrrole units in the films and thus, the apparent surface coverage in complexing units ( $\Upsilon_L$ , mol cm<sup>-2</sup>) were determined after transfer of the modified electrodes into monomer-free CH<sub>3</sub>CN electrolyte from the integration of the polypyrrole oxidation wave recorded at low scan rate (10 m V s<sup>-1</sup>).

For electrocatalytic hydrogenations, polymer films were grown on carbon felt (RVC 2000, 65 mg cm<sup>-3</sup>, from Le Carbone Lorraine) electrodes (20 x 25 x 4 mm). Procedures used for the incorporation of nickel metal into the different polymeric matrices will be described in the results and discussion section.

## Electrocatalytic hydrogenation procedure

Electrocatalytic hydrogenations were carried out in a H-shaped three-compartment cell. The carbon felt electrodes modified with nickel-polymer composite films were placed in the cathodic compartment filled with 50 mL of a deaerated equivolumic water-methanol solution containing 0.1 mol L<sup>-1</sup> NaCl + 0.1 mol L<sup>-1</sup> H<sub>3</sub>BO<sub>3</sub> (initial pH 5.3). The potential was maintained at -1.2 V for several min (hydrogen evolution). The current was then fixed at 20 mA and the substrate (1 mmol) was added. The working potential stabilized at around -1 V in these experimental conditions. The reaction progress was followed by periodic withdrawals. Samples were extracted with diethylether and analyzed by GC. The identification of products was based on GC comparison with authentic samples.

## Results and Discussion

### Electrochemical behavior of the pyrrole-succinic acid

The electrochemical behavior of the pyrrole-succinic acid in CH<sub>3</sub>CN + 0.1 mol L<sup>-1</sup> TBAP is shown in figure 1. Cyclic voltammetry curves exhibit the regular irreversible oxidation peak at 1 V/ Ag|Ag+ 0.01 mol L<sup>-1</sup> (figure 1 a) and an irreversible reduction peak ( $E_{pc}$  ca. -1.2 V on Pt) attributed to the reduction of the protons of the carboxylic acid groups (figure 1 b).

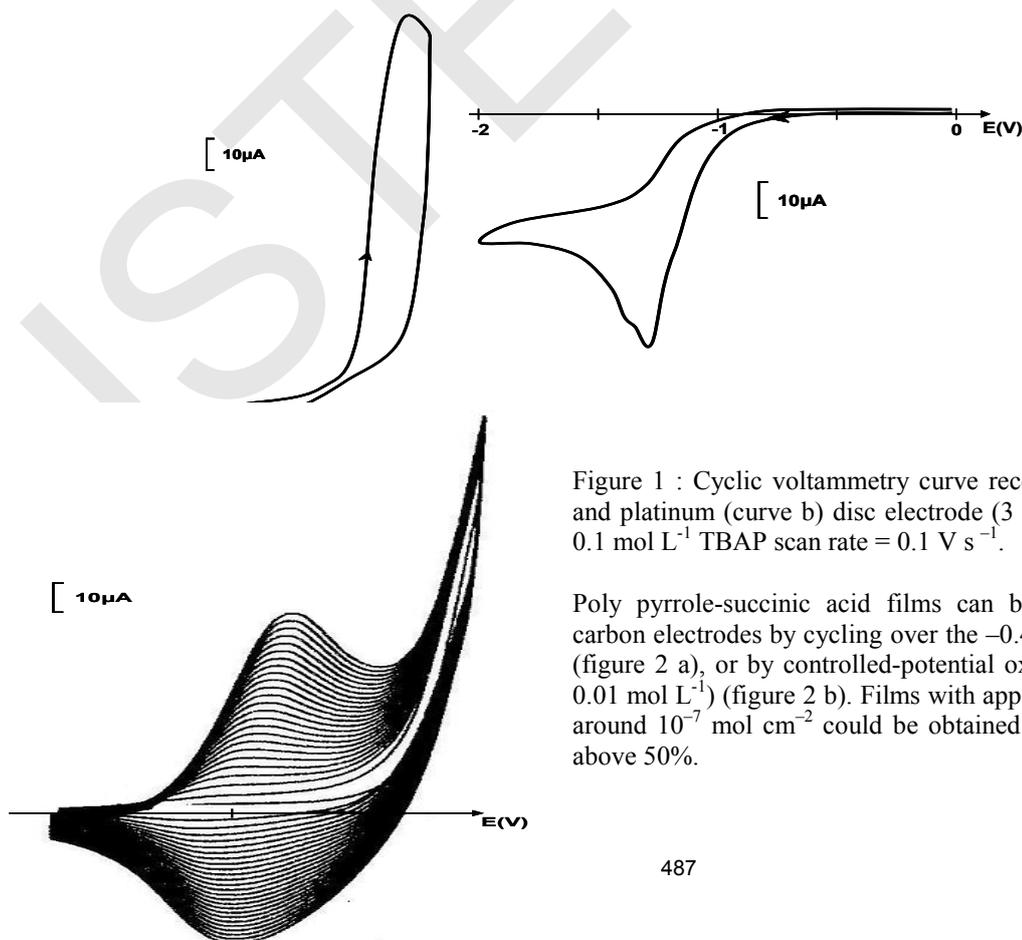


Figure 1 : Cyclic voltammetry curve recorded at a carbon (curve a) and platinum (curve b) disc electrode (3 mm diameter) in CH<sub>3</sub>CN + 0.1 mol L<sup>-1</sup> TBAP scan rate = 0.1 V s<sup>-1</sup>.

Poly pyrrole-succinic acid films can be grown on platinum and carbon electrodes by cycling over the -0.4 V to 0.9 V potential range (figure 2 a), or by controlled-potential oxidation at 0.85 V (Ag|Ag+ 0.01 mol L<sup>-1</sup>) (figure 2 b). Films with apparent surface coverage ( $\Gamma_L$ ) around 10<sup>-7</sup> mol cm<sup>-2</sup> could be obtained with polymerization yields above 50%.

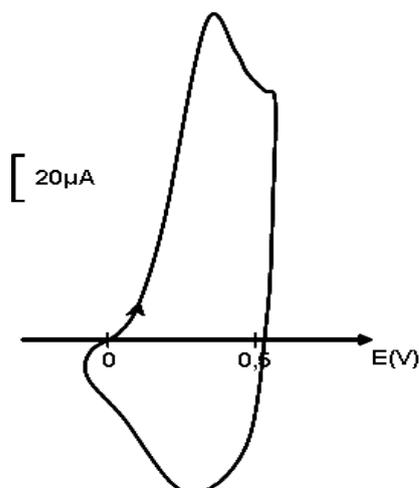


Figure 2 : Cyclic voltammety curve of pyrrolesuccinic acid recorded at a carbon disc electrode (3 mm diameter) in  $\text{CH}_3\text{CN} + 0.1 \text{ mol L}^{-1}$  TBAP scan rate =  $0.1 \text{ V s}^{-1}$ .

A : successif balayage B : after oxidation at  $0.85 \text{ V}$  ( $\text{Ag}|\text{Ag}^+ 0.01 \text{ mol L}^{-1}$ ), charge passed 6 mC.

## Deposition of nickel in polypyrrole-succinic acid films

### Electrochemical behavior of nickel

The electrochemical behavior of nickel sulfate in  $\text{H}_2\text{O} + 0.1 \text{ mol L}^{-1} \text{ Na}_2\text{SO}_4$  and  $0.1 \text{ mol L}^{-1}$  succinic acid is shown in figure 3. Cyclic voltammety curves exhibit the regular irreversible reduction peak at  $-1.4 \text{ V}$  /  $\text{Ag}|\text{Ag}^+$  attributed to the deposition of the nickel ions and an oxidation peak at  $1.6 \text{ V}$  corresponding to the oxidation of nickel metal reduced.

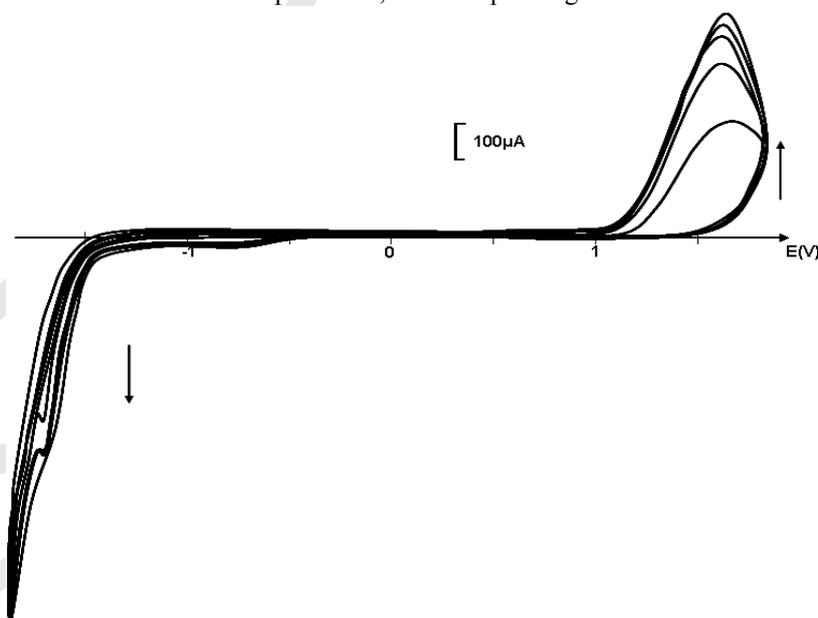


Figure 3 : Cyclic voltammety curve recorded at a carbon disc electrode (3 mm diameter) in  $0.1 \text{ mol L}^{-1} \text{ H}_3\text{BO}_3$  (pH 5.5) containing  $1 \text{ mmol L}^{-1} \text{ NiSO}_4$  and  $0.1 \text{ mol L}^{-1}$  succinic acid; scan rate =  $0.1 \text{ V s}^{-1}$ .

The complexation ability of succinic acid towards transition metal cations is weaker than that of malonic acid. In particular, it is known that succinic acid forms with nickel(II) a  $\text{NiL}$  complex characterized by a lower complexation constant ( $\log\beta_1 = 1.6$ ) than the corresponding nickel-malonic acid complex ( $\log\beta_1 = 3.2$ ). The effective complexation of nickel(II) cations and the electroreductive deposition of nickel metal in polypyrrole-succinic acid films has been demonstrated following the same basic procedure. C|polymere modified electrodes have been soaked in aqueous  $\text{NiSO}_4$  ( $0.1 \text{ mol L}^{-1}$ , pH 5.5), thoroughly rinsed and reduced at  $-1.4 \text{ V}$  in  $0.1 \text{ mol L}^{-1} \text{ Na}_2\text{SO}_4$  containing  $0.1 \text{ mol L}^{-1} \text{ H}_3\text{BO}_3$ .

Then the anodic nickel metal dissolution was studied by CV in clean  $\text{Na}_2\text{SO}_4 + \text{H}_3\text{BO}_3$  electrolyte. A typical curve, characterized by a strong nickel anodic stripping peak at 1.5 V is shown in figure 4. It confirms the successful deposition of nickel metal in polypyrrole-succinic acid films using the complexation-electroreduction procedure.

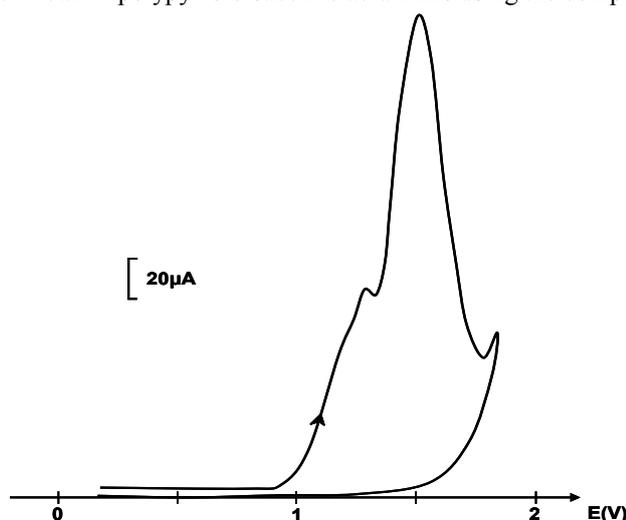


Figure 4 : Anodic stripping wave in  $0.1 \text{ mol L}^{-1} \text{Na}_2\text{SO}_4$  for nickel metal deposited in a polysuccinic acid film ( $GL = 10,7 \times 10^{-8} \text{ mol cm}^{-2}$ ) soaked for 30 min in  $0.1 \text{ mol L}^{-1} \text{NiSO}_4$  (pH 5.2), then reduced at  $-1.4 \text{ V}$  in clean  $0.1 \text{ mol L}^{-1} \text{Na}_2\text{SO}_4$ , pH 5.4; scan rate =  $0.01 \text{ V s}^{-1}$ .

### Electrocatalytic hydrogenation at Ni-polysuccinic acid cathodes

The main results of the electrocatalytic hydrogenation of 2-cyclohexenone are summarized in Table 1.

The poly(pyrrole-succinic acid)-nickel electrode material shows a catalytic activity very similar to that observed at poly(pyrrole-malonic acid)-Ni(0) film modified electrodes. Moreover, the polymere-nickel electrode material appeared rather stable.

**Table 1 :** ECH of 2-cyclohexenone at C|polymere-Ni(0) cathodes<sup>a</sup>

| entry | cathode <sup>b</sup>                               | N°manip | Products      | 4F Product yield <sup>c</sup> / % | Current efficiency <sup>d</sup> / % |
|-------|--|---------|---------------|-----------------------------------|-------------------------------------|
| 1     | °C/Polysuccinique-Ni<br>2 incorporations de nickel | 02      | Cyclohexanone | 43                                | 78                                  |
|       |  |         | cyclohexanol  | 57                                |                                     |
| 2     | °C/Polysuccinique-Ni<br>2 incorporations de nickel | 05      | Cyclohexanone | 66,6                              | 65                                  |
|       |  |         | cyclohexanol  | 32                                |                                     |

<sup>a</sup>Carried out in 50 mL of water-methanol equimolar mixtures containing  $0.1 \text{ mol L}^{-1} \text{NaCl} + 0.1 \text{ mol L}^{-1} \text{H}_3\text{BO}_3$  (initial pH 5.3) and 1 mmol of cyclohexenone; electrolysis current 20 mA ( $-0.9 \text{ V} < E_{\text{app}} < -1.0 \text{ V}$ ). <sup>b</sup> $20 \times 25 \times 4 \text{ mm}$  modified carbon felt electrodes. <sup>c</sup>GC yield, measured after the consumption of 4 electrons per molecule of 2-cyclohexenone. <sup>d</sup>Calculated taking into account that reduction of 2-cyclohexenone to cyclohexanone and cyclohexanol requires 2 and 4 electrons, respectively. <sup>e</sup>Nickel deposition by complexation (30 min in  $0.1 \text{ mol L}^{-1} \text{NiSO}_4$ , pH 5)-reduction ( $-1.4 \text{ V}$  in  $0.1 \text{ mol L}^{-1} \text{Na}_2\text{SO}_4 + 0.1 \text{ mol L}^{-1} \text{H}_3\text{BO}_3$ , pH 5) in a film containing *ca.*  $1.8 \times 10^{-5} \text{ mol}$  of succinic acid units.

### Conclusion

In this work, an effective dispersion of nickel particles into s electrogenerated functionalized polypyrrole were investigated, by electroreduction of nickel(II) cations complexed into poly(pyrrole-carboxylate) films. The electrocatalytic activity and the operational stability of various composite electrode materials have been evaluated in the course of the electrocatalytic hydrogenation of ketones and enones in aqueous media. The main result is that cathodes synthesized by the electroreduction of nickel(II) ions complexed into polycarboxylate films are characterized by a higher catalytic activity and a significant improvement of the operational stability. Moreover, the complexing polycarboxylate matrix may act as a stabilizer to prevent metal particles from aggregation, which can also be responsible of the better operational stability observed for these cathodes.

Work is now in progress to manipulate the catalytic properties of the nanocomposites through the interaction of the nickel surface with functional groups of the polymer. One of our main objectives is to achieve enantioselective electrocatalytic hydrogenation with nickel-based cathodes synthesized using polymer films containing optically active polycarboxylate ligands.

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# EVALUATING THE ROLE OF JOINT VENTURE FOR TECHNOLOGY TRANSFER IN PETROCHEMICALS INDUSTRY AT JUBAIL, KSA

Noor Iskanadarani\*, Mansour E. Abou Gamila\*\* and Ali Shash\*\*\*

\* Arabian Gulf University, Kingdom of Bahrain, noor.iskanadarani@gmail.com

\*\*Arabian Gulf University, Manama, Kingdom of Bahrain, 26671, mansoursma@agu.edu.bh

\*\*\* King Fahad University for Petroleum and Minerals, Kingdom of Saudi Arabia, ashash854@gmail.com

In the petrochemical's sector, where the market evolves incessantly around new processes and functions, companies are forced to be continuously innovative by acquiring or developing technologies. This is a crucial element in the competitive strategy of any enterprise. The ongoing integration between the Saudi market and the international market liberalizes and enhances the competitive pressure within companies, in particular joint ventures and alliances. As well as, it increases technological development needs. This study was conducted to evaluate the role of Joint Venture for technology transfer in petrochemicals at Jubail Industrial City, Saudi Arabia. A questionnaire was developed to collect the necessary data from joint-ventures companies. Seventeenth companies completed and returned the questionnaire. The obtained data were analyzed using SPSS package. The results indicate that several Technologies including product, process, marketing, organizational, strategic, and systematic have been successfully transferred to the Petrochemical industry in Saudi Arabia. The majority of these technologies have been transferred mainly through joint venture companies. Joint venture companies consider and control many internal and external aspects to assure a successful technology transfer. Association with suitable partner, commitment of the top management, education and training, flexible organizational culture, intra-organization coordination and use of information and communication technology are essential ingredients of any technology transfer process. Also, the results show that patents play a main role in increasing profits for the joint venture companies. Language is considered as the major factor in creating a gap toward success in Joint Venture.

**Key words:** Product technology transfer, process technology transfer, strategic technology transfer, marketing technology transfer, top management, education and training, flexible organizational culture and barriers to technology transfer.

## 1. Introduction

Transfer of technology is more than just the moving of high-tech equipment from the developed to the developing world, or within the developing world. Moreover, it encompasses far more than equipment and other so-called "hard" technologies. It also includes total systems and their component parts, including know-how, goods and services, equipment, and organizational and managerial procedures. Thus, technology transfer is the suite of processes encompassing all dimensions of the origins, flows and uptake of know-how, experience and equipment amongst, across and within countries, stakeholder organizations and institutions (Gately, 2011). Multinational enterprises have a number of options for technology transfer. These include contractual arrangements, such as technology licensing agreements, joint ventures, technical assistance and management contracts, turnkey projects and direct foreign investment in wholly-owned subsidiaries or affiliates. Transfers also occur, for example, through education of students abroad and through trade in capital goods between unrelated parties. Technology transfer can be understood as the process by which technology moves from one physical or geographic location to another for the purpose of application towards an end product (Simon and Herman, 2001). Nevertheless, the transfer process can take place either domestically from one sector to another or from one country to another covering the required knowledge, experiences and skills.

Technology transfer may comprise some or all of the following: fabricated materials and capital goods such as machines, instruments, equipment and the rest of the technology and its necessities such as design and execution works; preparation of feasibility studies for projects, including technological experiences and skills comprising knowledge relating to production, patents, documents, drawings, operation programs, maintenance instructions, training and education activities (Bresman, Birkinshaw, and Nobel, 2010).

A joint venture is a strategic alliance where two or more parties, usually businesses, form a partnership to share markets, intellectual property, assets, knowledge, and of course, profits (Patton and Rayan, 2009). This

partnership can develop between two big parties in an industry. It can also occur between two small businesses, which believe partnering will help them successfully compete against their bigger competitors. Likewise, companies with identical products and services can also join forces, to penetrate markets they otherwise would not take on, without investing tremendous resources. Furthermore, due to local regulations, some markets can only be penetrated via joint venturing with other local businesses. In some cases, a large company will form a joint venture with a smaller business, empowering it to quickly acquire critical intellectual property, technology, or resources otherwise hard to obtain, despite adequate cash at their disposal (Raff and others, 2009).

Saudi Arabia is a pioneer in the field of petrochemicals in the Middle East region. Over the last two decades it has built itself from a modest beginning into a position of strength (Al Dabibi, 2003). One of the unique characteristics of the petrochemical industry is the great interaction between feedstock, technologies, products and by products. For the production of many petrochemicals, there may be more than one process of technology involving different combinations of feedstock and by products. To date, out of the distribution of foreign direct investment by major foreign companies in Saudi Arabia, it is mainly chemicals and petrochemical companies which have contributed 60% of the total. Wilson (2004) and others concluded that ExxonMobil is the largest foreign investor in Saudi Arabia, accounting for 23% of the total foreign direct investment, with a total cumulative investment exceeding \$14 billion. There exist giants such as the state owned Saudi Aramco and Saudi Basic Industries Corporation, ranking among the world's largest petrochemical products.

## 2. Literature Review

Technology transfer framework attempts to incorporate economic, social, and political influences that affect the ability of different corporations to both create new knowledge and deploy that knowledge in economically useful ways and thereby contribute to economic growth and prosperity. The objective mostly is to build a more general understanding of firm–industry relationships and their role in knowledge-based innovation systems (Bercovitz and Feldman, 2006). Olayan (2004) said that understanding technology may only be acquired by training, education, experimentation, research and previous experience. There are two main approaches with regard to the types of technology that need to be transferred: vertical and horizontal transfer. Vertical technology transfer is transference from general to specialized levels, or transference from the scientific level to the final product form. Whereas, horizontal technology transfer is transference from one country to another, or from one application to another, e. g. uses of warfare technology to the civilian sector.

Kogut (2006) said that joint ventures can be summarized as an instrument of organizational learning and movement of knowledge. In light of this, Muller and Schnitzer (2006) examined why multinational firms would prefer to enter joint venture agreements albeit the fear of spillovers. It was summarized with one phrase only: Knowledge Movement. Thus, the clear direct policies like taxation have always been taken into consideration, particularly for the new born international joint ventures companies. Furthermore, a joint venture company is set when a host country influences an international one to share its knowledge, development, objectives and existing technologies towards the achievement of both parties' benefits and success. (Roy and Oliver, 2009). An overlooked factor affecting the success or failure of international joint ventures is the effectiveness of the leadership. Obviously, the main feature of leadership teams in a joint venture, are in its demand to identify ways to improve the manpower's effectiveness. Blalock and Gerlter (2008) had identified five key elements of the joint venture leadership - team composition, process, structure, incentives, and the leader's behaviour which has important implications toward joint venture success. Their analysis was based on the literature regarding top management teams, cross-cultural behaviour, international joint ventures, and their own in-depth interviews with leadership teams, from international joint ventures. Hagedoorn and Schkaenraad (2006) studied the strategic technology partnering between firms, and it has become a growing subject of interest, to both companies experimenting with this mode of economic organization and researchers from a wide variety of academic disciplines. Also, the effort was made to measure the effect of strategic technology partnering on companies engaged in such joint efforts.

High-technology industries have led the way in the globalization of international business in recent years. Success often depends on how well a firm transfers technology to another firm or market in a foreign country (Keller, 2008). Abdul Wahab and others (2010) stated that the inter-firm technology transfers through international joint ventures, have significantly contributed to a higher degree of local innovation performance/capabilities, technological capabilities, competitive advantage, organizational learning effectiveness, productivity, technological development of local industry, and the economic growth of the host country. Since the focus of inter-firm in developing countries has shifted to the degree of technology transfer, organizations in developing countries are attempting to assess not only the significant role of technology transfer

in strengthening their corporate and human resource performance, but also to influence other critical variables. These variables include the size of the multinational company, age of joint ventures, country of origin, and the multinational company type of industries. Contractor and Woodly (2010) proved that the effective knowledge transfer process, monitoring the opportunity, maximizing the joint venture synergetic values, technology providers, and the share is equal with the net benefits; all these elements can be controlled systematically and implemented successfully, based on how tight or loose the relationship is between the joint venture's partners according to their own decision and the global and/or local market status.

Al Ghamdi (2008) said that the transfer of technology process aims to: reduce the country's dependence on oil and to utilize national resources more efficiently, and to investigate the factors affecting the transfer and the conditions related to the technology in question - the receiving entities are also analyzed. Keller (2008) stated that many of the important factors are ambiguous by nature and difficult to measure. For instance, the technology to be transferred and the target markets may be changing, estimating costs and prices can be difficult, and the competition may consist of only a small number of firms or governments. Several critical factors may be external to the firms involved, such as political, cultural, and economic conditions. It is important, under these conditions, for management to have a good understanding of the international technology transfer process and the barriers and bonds that determine success. The success of the technology transfer among joint venture companies is always been measured by the degree of the technology transferred to the local party. Furthermore, a joint venture is the most efficient mechanism to insert any new technologies, skills, or knowledge. However, to make this process occur smoothly and easily, the parties need to conform to the relationship quality and mutual trust and the degree of tacit explicit knowledge (Abdul-Wahab et al., 2011). Henrik and others (2010) concluded in their case study that the success of technological know-how occurs when it is facilitated by excellent communication, visits and meetings between the partners on a regular basis.

Caves (2003) stated that one way of viewing a multinational enterprise in Saudi Arabia, is as an economic institution that owns, in whole or in part, controls and manages income-generating assets in more than one country. However, normally multinational corporations (MNCs) possess some advantages enabling them to produce and compete successfully in an unfamiliar foreign environment. A number of technologies have been imported into the Kingdom of Saudi Arabia. This experience has affirmed the conviction that technology can make an invaluable contribution to the growth of the Kingdom of Saudi Arabia. However, in doing so the Kingdom of Saudi Arabia, like other nations, faces some questions of possible obstacles, trials and errors during the course of industrial development and technology transfer. These can be addressed by utilizing science and technology efficiently to develop many sectors, improving output of industry, developing standards and status of national manpower and its utilization. (Al Ankari, 2004)

Gately and others (2011) analyzed Saudi Arabia's growth in oil consumption, and they found that the oil consumption domestically is nearly 3 million barrels/day, which is one-fourth of the total production. Moreover, they concluded the rapid growth in consumption is 57% annually, which is 50% faster than the income growth, which in turn will challenge Saudi Arabia's abilities to increase its oil exports. Additionally, Jinagl and Chao (2010) supported the above statements by examining the Sahara oil reservoir in B Block of Saudi Arabia, and came up and said that it has very low porosity and permeability. However, Saudi is forming a three-way joint venture as a n-butanol plant in Jubail industrial city in the east of Saudi Arabia, as well as another JV between Saudi Aramco and Dow Chemicals being formed in the near future, in order to build the largest petrochemicals complex in the Middle East – this, will also be located in Jubail industrial city (Young, 2011). The Gulf Petrochemicals and Chemicals Association's annual report which was published in 2008, aimed to provide a comprehensive information source, which would cover developments in all countries of the Gulf. The report assured that Saudi Arabia continues to lead capacity development in the region with activity. As the Saudi government encourages economic diversification, the kingdom is now moving firmly upstream into refining and downstream to industrial development (Tracy and others, 2011). Over the past 10 years, there was a huge expansion of petrochemical production in the Middle East - two essential factors were responsible: (1) the availability of feedstock at low prices as a consequence of the large oil production, (2) the strategic location of the Middle East enabled the area to supply the Atlantic and Far East needs of petrochemicals, in particular the enormous demands from China. (Seddon and Duncan, 2010).

Saudi Arabia was the first country of the Gulf Cooperation Council, to implement an offset related investment program with foreign contractors, to help build its technological and human capital through technology transfer. Ramady (2005) examined the various offset programs undertaken and compares these with private sector non-offset joint venture investments, to assess the effectiveness of technology transfer in the petrochemical sector using a model of technology transfer "packaging comprehensiveness". The results indicated a greater degree of technology transfer for the offset related programs, but the current Saudi

educational structure needs to be directed towards science based subjects in order for such technology transfers to become self sustaining and high value job generating in the future. (Mathews, 2003).

### 3. Research Problem

With the exception of Saudi Basic Industries Corporation projects, about 70% of all the current petrochemical projects in Saudi Arabia are joint ventures with major chemical companies. Literature review based assessments of joint ventures in Saudi Arabia, indicated that these businesses are enjoying comfortable monetary benefits from economic endeavours in Saudi Arabia. Nevertheless, there seems to be insufficient information available on the impact of these joint ventures on technology transfer in terms of know-how, employment, and adoption. Lack of incentive or mandatory clauses may also act as an obstacle to joint venture agreements.

### 4. Research Significance

- The government desires to build strong and lasting industrial sectors to benefit from the country's available capital plants, which are considered major assets for the country. Assessing the problems facing this industry will help in eliminating them and syncing industrialization with advanced technology attainable through technology transfer.
- The success of the petrochemicals industry in the Kingdom of Saudi Arabia is very important to achieve the government's plan of diversifying the country's revenues.
- Transferring the petrochemicals technology into the Kingdom of Saudi Arabia is an attempt to promote Saudi development and training in this sector, as well as, the indigenous petrochemicals industry in the Kingdom. The creation of such a sector would give a boost to the Saudi economy as it would bring high value and high technology jobs to the region.
- Study the open door policy to further foreign direct investment into Saudi Arabia, from established global energy and petrochemicals firms. Examining joint ventures should allow considerable technology transfer, though their sheer size will also necessitate more diversified and imaginative financing solutions.

### 5. Research Objectives

The main objective of this research is to evaluate the role of joint venture for technology transfer in petrochemicals at Jubail industrial city, Saudi Arabia. To accomplish the main objectives, the following sub-objectives are to be met:

- Go over the current situation for technology transfer through joint venture in petrochemicals at Jubail industrial city, Saudi Arabia,
- Determine the causes and effects facing technology transfer processes within petrochemical joint venture companies in the Kingdom

### 6. Research Methodology

Based to the objectives of this work, the research methodology was descriptive using comprehensive survey of the literature. A quantitative research methodology was also used, with a questionnaire presented to and completed from top management, such as CEO's and whoever is involved in the decision-making process.

#### 6.1. Tools for Data Collection and Statistical Analysis

Based on several previous studies related to the study area, a first draft of survey tool "Questionnaire" was developed. The questionnaire was e-mailed to a number of academics and experts with experience in technology management. They were asked to evaluate the relevant contents of the questionnaire, its language, accuracy, completeness, clarity and reliability. The final form of questionnaires was distributed via E-mails in order to collect data from the respondents. The data were be collected from top management, such as CEO's and

whoever is involved in the decision-making process of both representative of joint venture through a structured questionnaire and direct interviews as appropriate, whereas no significant difference between the two parties. The collected data were then analyzed and conclusions were delivered. Statistical Product and Service Solution (SPSS) version 16.0 for windows was used for the statistical analysis of the data collected by questionnaires. Microsoft Excel 2007 software was used to manage, process, and present the data.

## 6.2. Research Population

The population in this research consists of petrochemicals companies located in Jubail Industrial City in Saudi Arabia, which are listed on the Saudi Arabian General Investment Authority and Chamber of Commerce and Industry. The population was taken as companies located in Jubail Industrial City, which are 31 companies, and some of them operate in different locations yet they have representative and/or support office at Jubail Industrial City.

## 6.3. Research Sample

28 questionnaires were sent via E-mails to CEO's and planning directors, who were representing their joint ventures companies in Saudi Arabia. They were requested to participate by completing the questionnaire. However, the final retrieved number of responses was 17 out of 28 with percentage of (60.7%).

## 6.4. Statistical Test for the Tool

### 6.4.1. Reliability Analysis for Cause and Effect of Technology Transfer

A reliability analysis procedure was applied to make sure that the implemented tool was reliable in measuring the underlying elements. The reliability criterion (Cronbach alpha) of each section was calculated and presented in table (1). The analysis indicates that all factors have coefficients alpha ranged from (0.75) to (0.92). Therefore, values of calculated alpha in this research work indicate high levels of reliability.

### 6.4.2. Statistical Validity Analysis for Cause and Effect of Technology Transfer

To verify the validity of the study tool, the Pearson's Coefficient of Correlation between the main scale and the subscales are calculated as shown in table (2). Table (2) shows that the calculated Pearson's coefficient of correlation for the ten sub sections of this scale are between (0.499) for the fifth section and (0.910) for the ninth section. Since the correlation coefficient is ( $r > 0$ ), it shows that correlation coefficient is positive and significantly different from zero. These results show that there is a statistically linear significant relation between the variables. This indicates that the study tool has the validity to meet the research objectives.

Table (1) Values of Cronbach's alpha for Cause and Effect of Technology Transfer

| Number | Sub Scale   | Cronbach's alpha |
|--------|---|------------------|
| 1      | Technology(s) that the company has transferred to Saudi Arabia                              | 0.75             |
| 2      | How the company attained technology transfer  | 0.79             |
| 3      | Abandoning or delaying projects due to non feasibility or lack of resources and information | 0.78             |
| 6      | Potential aspects that facilitate easiness in acceptance of Technology Transfer             | 0.87             |
| 7      | Potential aspects that facilitate easiness in implementation of Technology Transfer         | 0.92             |
| 8      | Potential sources of information which contribute in Technology Transfer process            | 0.86             |
| 9      | Factors influencing the Technology Transfer success within the firm                         | 0.85             |
| 10     | Incentives that play a main role to increase the profit for the company                     | 0.88             |

Table (2) Pearson's Coefficient Correlation for "Cause and Effect of Technology Transfer Process" and its subscales

| Number | Sub Scale  | Pearson's Correlation |
|--------|--|-----------------------|
| 1      | Technology(s) that the company has transferred to Saudi Arabia                                 | 0.936(**)             |
| 2      | How the company attained technology transfer   | 0.708(**)             |
| 3      | Abandoning or delaying projects due to non feasibility or lack of resources and information    | 0.818(**)             |
| 4      | Effectiveness in receiving transfer technology   | 0.508(*)              |
| 5      | Saudi government policies revolving around joint venture agreements favour technology transfer | 0.499(*)              |
| 6      | Potential aspects that facilitate easiness in acceptance of Technology Transfer                | 0.710(**)             |
| 7      | Potential aspects that facilitate easiness in implementation of Technology Transfer            | 0.596(*)              |
| 8      | Potential sources of information which contribute in Technology Transfer process flow          | 0.673(**)             |
| 9      | Factors influencing the Technology Transfer success within the firm                            | 0.910(**)             |
| 10     | Incentives that play a main role to increase the profit for the company                        | 0.695(**)             |

## 7. Results and Discussion

### 7.1 Cause and Effect of Technology Transfer Process

#### 7.1.1 Types of technologies that the joint venture company has transferred to Saudi Arabia

To determine the technologies that the joint venture company has transferred to Saudi Arabia, the frequencies and percentages for the responses of the sample on the question "What is (are) the technology(s) that the joint venture company has transferred to Saudi Arabia" are calculated as shown in table (3).

Table (3) Technologies that the Joint Venture Company has transferred to Saudi Arabia

| No | Technology                         | Yes   |         | No    |         | Chi-Square | Df | Sig.  |
|----|------------------------------------|-------|---------|-------|---------|------------|----|-------|
|    |                                    | Freq. | Percent | Freq. | Percent |            |    |       |
| 1  | Product Technology Transfer        | 5     | 29.4%   | 12    | 70.6%   | 2.882      | 1  | 0.090 |
| 2  | Process Technology Transfer        | 7     | 41.2%   | 10    | 58.8%   | .529       | 1  | 0.467 |
| 3  | Marketing Technology Transfer      | 9     | 52.9%   | 8     | 47.1%   | .059       | 1  | 0.808 |
| 4  | Organizational Technology Transfer | 11    | 64.7%   | 6     | 35.3%   | 1.471      | 1  | 0.225 |
| 5  | Strategic Technology Transfer      | 12    | 70.6%   | 5     | 29.4%   | 2.882      | 1  | 0.090 |
| 6  | Systematic Technology Transfer     | 11    | 64.7%   | 6     | 35.3%   | 1.471      | 1  | 0.225 |

The results in table (3) show that the "Strategic Technology Transfer" is the most kind of technology that has been transferred to Saudi Arabia through the surveyed companies with a percentage of (70.6%) of the sample. Jabar and other (2011), said that this element usually get the highest percentage due to the direction that the companies have adopted, that help to modify the way of thinking from technology transfer philosophy into organizational learning philosophy, which is an antecedent of technology transfer and new product development. This is followed by "Organizational Technology Transfer" and "Systematic Technology Transfer" with the same percentage (64.7%) of the sample. The researchers think that Joint Ventures companies are clearly targeting to transfer new management methods more than transferring processes, products or else, and that might be for the weakness in the training programs, research and development, or the ability to start producing new products and new processes.

#### 7.1.2 The Mechanism of Attaining Technology Transfer in the Joint Venture Company

To define the mechanism of attaining technology transfer in the Joint Venture Company, the researchers calculated frequencies and percentages for the responses of the sample as shown in table (4). It can be concluded from the table that most of the companies investigated in the study have attained technology transfer in collaboration with another enterprise with a percentage of (70.6%). Lichtenthaler (2010), justified that most of

the companies, especially who are in industrial market, always tend to head for open innovation and inter-organizational technology transfer, in other words alliances and licensing with technological firms. The results show significant differences at ( $\alpha=0.05$ ) in the responses for the benefit of the companies who attained technology transfer by themselves as shown in table (4).

Table (4) Methods of technology transfer

| No | Phrase                                   | Yes   |         | No    |         | Chi-Square | df | Sig.  |
|----|--|-------|---------|-------|---------|------------|----|-------|
|    |  | Freq. | Percent | Freq. | Percent |            |    |       |
| 1  | Mainly by your Organization              | 1     | 5.9%    | 16    | 94.1%   | 13.235     | 1  | 0.000 |
| 2  | In collaboration with another enterprise | 12    | 70.6%   | 5     | 29.4%   | 2.882      | 1  | 0.090 |
| 3  | Mainly by another Organization           | 5     | 29.4%   | 12    | 70.6%   | 2.882      | 1  | 0.090 |

### 7.1.3 Effectiveness of Saudi Manpower in Receiving Technology Transfer

The results show that six companies of the respondents said they are strongly agree that the Saudi technical manpower are effective in receiving transfer technology with the highest percentage (35.3%) and (23.5%) of the sample agreed with the statement. Ahmad (2007) said that the oil companies worldwide are looking for ways to improve operations in order to stimulating production increasing and costs reduction. Therefore, companies focused on addressing the technical quality of the local manpower and started to improve it through several English, American, Canadian, and Australian expertise. Then, by the end of 2004, the technical manpower efficiency in Saudi Aramco was improved up to 64% while the costs were reduced to 39%. Table (5) shows the results.

Table (5) The effectiveness of Saudi technical manpower in technology transfer

| Strongly Disagree |         | Disagree |         | Uncertain |         | Agree |         | Strongly Agree |         | Chi-Square | df | Sig. |
|-------------------|---------|----------|---------|-----------|---------|-------|---------|----------------|---------|------------|----|------|
| Freq.             | Percent | Freq.    | Percent | Freq.     | Percent | Freq. | Percent | Freq.          | Percent |            |    |      |
| 0                 | 0       | 2        | 11.8    | 5         | 29.4    | 4     | 23.5    | 6              | 35.3    | 2.059      | 3  | .560 |

### 7.1.4 The Saudi Government policies around Joint Venture Agreements favor Technology Transfer

The results show that six companies said that the Saudi Government policies revolving around joint venture agreements favor technology transfer with a percentage of (35.3%) of the sample, whereas eleven companies (64.7%) didn't agree with this statement, as shown in table (6). Aldridge and Audrestch (2010) said that, several references since the 21<sup>st</sup> century began, Saudi Arabia had set many policies that concerning technology transfer mechanisms and processes, but it was obviously that those policies are not even closely related to oil, gas, and petrochemicals sectors. In addition, there were policies that control and confined the foreign investment in Saudi, which makes the Kingdom unhealthy environment to attract the investors to deploy new technologies and develop them.

Table (6) The Saudi Government's policies revolving around joint venture agreements

| Yes   |         | No    |         | Chi-Square | df | Sig. |
|-------|---------|-------|---------|------------|----|------|
| Freq. | Percent | Freq. | Percent |            |    |      |
| 6     | 35.3    | 11    | 64.7    | 1.471      | 1  | .225 |

### 7.1.5 The Potential Aspects that Facilitate Acceptance of Technology Transfer

To determine the potential aspects that facilitate acceptance of technology transfer, the means and standard deviations for the responses of sample on the question: "What are the potential aspects that facilitate acceptance of technology transfer?" are calculated as shown in table (7). The results revealed that the first potential aspect that facilitate acceptance of technology transfer is collaborating with suitable external partners (Means=4.824,

SD=0.393). In fact, this factor came in the beginning due to the partnership parties most likely tend to understand each business philosophy and cultural perspectives, and these could be considered essential elements to achieve a successful cooperation, especially if both parties are from different cultural background; then the trust and transparency are playing very important role to make technology transfer process done successfully. In the second place came the aspect “Management Commitment and Support” (Means=4.353, SD=0.606) followed by the aspect “Education and training” (Means=4.235, SD=1.201). “Flexible Organizational Culture” came in the fourth potential aspect that facilitate acceptance of technology transfer (Means=4.176, SD=0.529).

Table (7) The potential aspects that facilitate acceptance of technology transfer

| No | Phrase   | Means (5) | SD    | Sort |
|----|--|-----------|-------|------|
| 1  | Management Commitment and Support                                    | 4.353     | 0.606 | 2    |
| 2  | Flexible Organizational Culture                                      | 4.176     | 0.529 | 4    |
| 3  | Focus on long term gains when compared to short term profits         | 4.125     | 0.719 | 5r   |
| 4  | Collaborating with suitable external partners.                       | 4.824     | 0.393 | 1    |
| 5  | Intra-Organization Coordination                                      | 3.625     | 0.619 | 9    |
| 6  | Use of Information and Communication Technology 'ICT'                | 3.438     | 1.031 | 10   |
| 7  | Having clear objectives and criteria for technology transfer.        | 4.118     | 1.111 | 7    |
| 8  | Recruiting compatible talent and securing the required competencies. | 4.125     | 1.204 | 5r   |
| 9  | Education and training.  | 4.235     | 1.201 | 3    |
| 10 | Competitors and other Organizations in your sector.                  | 3.882     | 1.166 | 8    |
|    | Total  | 4.090     |       |      |

#### 7.1.6 The Potential Aspects that Facilitate Implementation of Technology Transfer

To determine the potential aspects that facilitate implementation of Technology Transfer, the means and standard deviations for the response of sample are calculated as shown in table (8). The results show that three potential aspects “Focus on long term gains when compared to short term profits”, “Flexible Organizational Culture” and “Collaborating with suitable external partners” are chosen as the first aspect that facilitate implementation of technology transfer, and here we can see that both partners of the Joint Venture are looking for their long and short term benefits, considering that the culture they are going to deal with as a major factor, too. Where choosing the convenient partner is an essential factor to make the success for this process. These three aspects had the same means (M=4.353). In the fourth place came the aspect “Management Commitment and Support”.

Table (8) The potential aspects that facilitate implementation of technology transfer

| No | Phrase  | Means (5) | SD    | Sort |
|----|---|-----------|-------|------|
| 1  | Management Commitment and Support                             | 4.294     | 0.470 | 4    |
| 2  | Flexible Organizational Culture                               | 4.353     | 0.702 | 1r   |
| 3  | Focus on long term gains when compared to short term profits. | 4.353     | 0.702 | 1r   |
| 4  | Collaborating with suitable external partners.                | 4.353     | 0.862 | 1r   |
| 5  | Intra Organization Coordination                               | 3.588     | 1.004 | 5r   |
| 6  | Use of Information and Communication Technology 'ICT'         | 3.588     | 0.795 | 5r   |
|    | Total   | 4.088     |       |      |

#### 7.1.7 The Sources of Information which Contribute in Technology Transfer Process

Means and standard deviations for the responses of the sample are calculated to determine their opinion about the potential sources of information which contribute in technology transfer process as shown in table (9). The results show that the study sample thinks that the first potential source of information which contributes in Technology Transfer process is “Market sources such as Suppliers, Customers, Competitors, Consultants and Commercial lab/R&D canter” (M= 4.353. SD=0.862). This is followed by two statements in the second place which are “Intra Organizational information and use of 'ICT'” and “Government or public research institutes” (M=4.235). The fourth source was “Universities and Higher education and institutions” (M=3.938, SD=1.237).

Table (9) The sources of information which contribute in technology transfer

| No | Phrase  | Means (5) | SD    | Sort |
|----|---|-----------|-------|------|
| 1  | Intra Organizational information and use of 'ICT'.  | 4.235     | 0.437 | 2r   |
| 2  | Market sources such as Suppliers, Customers, Competitors, Consultants and Commercial lab/R&D centers. | 4.353     | 0.862 | 1    |
| 3  | Universities and Higher education and institutions.   | 3.938     | 1.237 | 4    |
| 4  | Government or public research institutes.   | 4.235     | 1.348 | 2r   |
| 5  | Professional Conferences, Journals and Meetings.  | 3.529     | 0.875 | 5    |
| 6  | Fairs and Exhibitions.  | 3.412     | 0.939 | 6r   |
| 7  | Professional or Industry Associations.  | 3.412     | 0.939 | 6r   |
|    | Total   | 3.873     |       |      |

### 7.1.8 The Factors Influencing the technology transfer success within the Joint Venture Company

To identify the level of the respondents agreement on some potential factors influencing the technology transfer success within the firm, means and standard deviations for the responses of the sample are calculated. As shown in table (10), "Training and development programs" is the first potential factor influencing the technology transfer success ( $M=4.235$ ,  $SD=0.903$ ). The training might be the most important element that influences technology transfer positively, only if it is been conducted continuously for constant improvement to the manpower and ongoing technology development opportunities. The second factor is "Market awareness of Technology Transfer" ( $M=4.188$ ,  $SD=0.911$ ). Two factors came in the third place with the same Means (4.176) and SD (0.883 and 1.015). These factors are "Inclination towards creative behaviour and idea generation." and "Improvement of decision-making, communication, working environment, frame work". This was followed by the factors "Value of the product and productivity efficiency" and "Emphasis on in-house and extramural research and development" with means of (4.133 and 4.059) respectively.

Table (10) The factors influencing the technology transfer success within the joint venture

| No | Phrase   | Means (5) | SD    | Sort |
|----|--|-----------|-------|------|
| 1  | Entrepreneur's commitment.   | 3.882     | 0.858 | 7    |
| 2  | Inclination towards creative behaviour and idea generation.                  | 4.176     | 0.883 | 3r   |
| 3  | Improvement of decision-making/communication/working environment/frame work. | 4.176     | 1.015 | 3r   |
| 4  | Competitive advantage.   | 3.625     | 1.088 | 10   |
| 5  | Training and development programs.   | 4.235     | 0.903 | 1    |
| 6  | Emphasis on in-house and extramural research and development.                | 4.059     | 1.088 | 6    |
| 7  | Market awareness of Technology Transfer.                                     | 4.188     | 0.911 | 2    |
| 8  | High sale potential.   | 3.250     | 1.065 | 12   |
| 9  | Value of the product and productivity efficiency.                            | 4.133     | 0.990 | 5    |
| 10 | Effecting the development of the economy                                     | 3.647     | 0.996 | 9    |
| 11 | Create new industries or expand the existing.                                | 3.706     | 0.772 | 8    |
| 12 | Investment returns increment.  | 3.294     | 1.047 | 11   |
| 13 | Product quality increment.   | 2.941     | 1.029 | 16   |
| 14 | Customer satisfaction increment.   | 3.000     | 1.061 | 15   |
| 15 | Potential of learning.   | 3.176     | 0.883 | 14   |
| 16 | Overcomes ownership restrictions and cultural distance.                      | 3.235     | 0.903 | 13   |
|    | Total  | 3.670     |       |      |

### 7.1.9 The Incentives for Increasing the Profit of the Joint Venture Company.

To determine these incentives, the means and standard deviations for the responses of the sample on the question about the role of these incentives in increasing the profit for the joint venture company are calculated as shown in table (11). The results show that "patents" came in the first place ( $M=4.353$ ,  $SD=0.606$ ) as an incentive that can play a main role in increasing the profit for the joint venture company. Ramady (2010) said that Saudi government is funding and supporting all the concerned institutions that have research and development or strategic alliances with technological providers. The government is also playing an essential role

to commercialize new patents within the Kingdom, as this was one of the requirements for Saudi Arabia to join the trade world organization (WTO). The second place was taken by the incentive “Design Registration” (M=3.882, SD=0.993). “Trade Marks” came in the third place with a means of (3.875) and SD (1.204).

Table (11) The incentives for increasing the profit for the joint venture company

| No | Phrase                             | Means (5) | SD    | Sort |
|----|------------------------------------|-----------|-------|------|
| 1  | Patents                            | 4.353     | 0.606 | 1    |
| 2  | Design Registration                | 3.882     | 0.993 | 2    |
| 3  | Trade Marks                        | 3.875     | 1.204 | 3    |
| 4  | Copy Right                         | 2.400     | 0.986 | 7    |
| 5  | Secrecy/Confidentiality Agreements | 3.412     | 1.326 | 6    |
| 6  | First Mover Advantage              | 3.588     | 0.795 | 4r   |
| 7  | Complexity of Design               | 3.588     | 0.795 | 4r   |
|    | Total                              | 3.585     |       |      |

## 7.2 Technology Transfer Barriers in The Kingdom of Saudi Arabia

The respondents were asked to indicate the level of their agreement on some factors that are considered barriers to technology transfer to Saudi Arabia. The means and standard deviations for the responses of the sample are calculated as shown in the table (12). The results show that amongst sixteen chosen factors, the respondents thought that the culture and language factors are the first potential factors that considered barriers to technology transfer to Saudi Arabia (Means= 4.647 SD= 0.606). The second factor is the “Differences in policies and procedures” with a means of (4.235) and SD (1.252). The factor “Lack of appropriate contractual terms and conditions” is categorized as the third barrier (M=4.118, SD=1.166). The two factors “Absence of National Plans for Science and Technology Development” and “Governmental Policies” came in the fourth place with the same means (4.059). This was followed by “Market Domination by Established Enterprises” and “Lack of Communications and Coordination” with the same means (M=4.000).

Table (12) Technology Transfer Barriers in The Kingdom of Saudi Arabia

| No | Phrase   | Means (5) | SD    | Sort |
|----|--|-----------|-------|------|
| 1  | Culture/Language Barriers  | 4.647     | 0.606 | 1    |
| 2  | Lack of time   | 3.353     | 1.057 | 13   |
| 3  | Inadequate training  | 3.471     | 1.231 | 12   |
| 4  | Lack of funding provisions                                       | 3.250     | 1.183 | 14   |
| 5  | Differences in policies and procedures                           | 4.235     | 1.252 | 2    |
| 6  | Market Domination by Established Enterprises                     | 4.000     | 1.323 | 6r   |
| 7  | Geographical differences   | 3.941     | 1.144 | 8    |
| 8  | Lack of appropriate contractual terms and conditions             | 4.118     | 1.166 | 3    |
| 9  | Lack of Information and Technology                               | 3.235     | 1.252 | 15   |
| 10 | Weak and/or Lack of Infrastructure                               | 2.471     | 0.943 | 16   |
| 11 | Lack of Qualified Personnel                                      | 3.500     | 1.095 | 11   |
| 12 | Lack of Communications and Coordination                          | 4.000     | 0.791 | 6r   |
| 13 | Difficulty in Finding Suitable Partner for JV                    | 3.765     | 0.970 | 9    |
| 14 | Lack of Market Information                                       | 3.529     | 1.125 | 10   |
| 15 | Absence of National Plans for Science And Technology Development | 4.059     | 0.966 | 4r   |
| 16 | Governmental Policies  | 4.059     | 1.249 | 4r   |
|    | Total  | 3.727     |       |      |

### **7.3 Analysis of Variance and T-Test**

Analysis of variance was carried out to identify any significant differences at ( $\alpha=0.05$ ) in the role of joint venture for technology transfer in petrochemicals industry at Jubail Industrial City, Kingdom Of Saudi Arabia considering the six independent variables namely: the nature of business, the joint venture company's market, the capital of the company, the annual revenue, the total number of employees and the percentage of Saudi nationals working in the company.

#### **7.3.1 The Nature of Business**

According to the nature of business whether it is manufacturing or trading, the results show that there are significant differences at ( $\alpha=0.05$ ) in the effectiveness in receiving technology transfer and in favouring technology transfer by the Saudi government policies revolving around joint venture agreements. It could be that the policies which facilitate transferring technologies need to be more discussed in terms of technology transfer in petrochemical sector. However, results didn't reveal any significant differences ( $\alpha=0.05$ ) in the other causes that are assumed to affect the technology transfer process.

#### **7.3.2 The Joint Venture Company's Market**

The results show that there are significant differences at ( $\alpha=0.05$ ) in the incentives that play a main role to increase the profit for the company ascribed to the joint venture company's market, and this might be because the patent is always an attractive factor to the investors for joint venture and to commercialize it into the international market. But there are no significant differences in the cause and effect of technology transfer process according to the other subscales.

#### **7.3.3 The Capital of the Company**

The results show that there are no significant differences at ( $\alpha=0.05$ ) in the cause and effect of technology transfer process according to the capital of the company.

#### **7.3.4 The annual revenue of the company.**

The results show that there are no significant differences at ( $\alpha=0.05$ ) in the cause and effect of technology transfer process according to the annual revenue of the company.

#### **7.3.5 The Total Number of Employees**

The results show that there are no significant differences at ( $\alpha=0.05$ ) in the cause and effect of technology transfer process according to the total number of employees in the company.

#### **7.3.6 The Percentage of Saudi Nationals Working in the Company**

The results show that there are significant differences at ( $\alpha=0.05$ ) in the potential aspects that facilitate implementation of technology transfer according to the percentage of Saudi Nationals working in the company, and this might be because setting plans and procedures is mostly more easier than executing them. But there are no significant differences in the cause and effect of technology transfer process according to the other subscales.

## **8. Summary and Conclusions**

Technology transfer is a crucial and a dynamic factor in social and economic development. The industry's adopted business model, therefore, has entailed setting up joint ventures with leading global players. Al-Ghamdi (1987) illustrated that joint venture transfers more technology than direct foreign investment. With the exception of SABIC projects, almost all the current petrochemical projects in Saudi Arabia about 70% are joint ventures with major chemical companies (Al-Sa'doun, 2006). The technology transfer, as much as it seems to be simple in words, as much as it is quite complex and full of much opposition such as advantages, impacts, income, barriers, knowledge and difficulties. It might be because it is a rapidly changing process and may face several factors that block it or slow it down.

In the Petrochemical industry, several technologies including product, process, marketing, organizational, strategic, and systematic have been successfully transferred to Saudi Arabia mainly through joint venture companies. Joint venture companies consider and control many internal and external aspects to assure a successful technology transfer. The conclusion can be summarized in:

1. "Strategic Technology Transfer" is the most kind of technology that has been transferred to Saudi Arabia.
2. The majority of the petrochemical companies in Saudi Arabia have attained technology transfer in collaboration with another enterprise.
3. "Collaborating with suitable external partners", "Management Commitment and Support", "Education and training", "Flexible Organizational Culture", "Competitors and other organizations", "Intra-Organization Coordination" and "Use of Information and Communication Technology" sequentially ordered as the factors that facilitate in acceptance of technology transfer.
4. "Focus on long term gains when compared to short term profits", "Flexible Organizational Culture" and "Collaborating with suitable external partners", "Management Commitment and Support", "Organization Coordination" and "Use of Information and Communication Technology" are major factors that facilitate in implementation of technology transfer.
5. "Market sources such as Suppliers, Customers, Competitors, Consultants and Commercial lab/R&D centers", "Intra Organizational information and use of ICT", "Government or public research institutes", "Universities and Higher education and institutions" and "Professional Conferences, Journals and Meetings" are major sources of information which contribute to technology transfer process.
6. "Training and development programs", "Market awareness of Technology Transfer", "Inclination towards creative behavior and idea generation", "Improvement of decision-making, communication, working environment, frame work" and "Value of the product and productivity efficiency" are major factors in influencing the technology transfer success within a firm.
7. Patents, as an incentive, play a main role in increasing profits for the joint venture companies.
8. The majority of the joint ventures consider "Culture" "Language", "Differences in policies and procedures", "Lack of appropriate contractual terms and conditions", "Absence of National Plans for Science and Technology Development" as the top barriers to technology transfer to Saudi Arabia.

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# EVALUATION OF ZINC-RICH EPOXY PAINT PERFORMANCE BY ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

Nadia HAMMOUDA<sup>a,\*</sup>, H. Chadli<sup>b</sup>, G. Guillemot<sup>c</sup>, K. Belmokre<sup>a</sup>

<sup>a</sup> *Laboratoire de Corrosion et Traitements de Surface, Dép. Sci. De la Matière, Université du 20 août 1955, Route d'El-Hadaiek, B.P.26, Skikda, Algérie. e-mail: hammoudanad@yahoo.fr*

<sup>b</sup> *Laboratoire de Métallurgie et Génie des Matériaux, Université de Badji Mokhtar, B.P 12-Sidi Ammar, Annaba, 23.000-Algérie*

<sup>c</sup> *Laboratoire de Métallurgie Physique et Génie des Matériaux, école Nationale Supérieure d'Arts et Métiers de Lille, 8, boulevard Louis XIV 59046 Lille Cedex - France*

**Abstract:** Electrochemical impedance spectroscopy (EIS) in the 100 kHz-10 mHz frequency range was employed as the main electrochemical technique to study the corrosion protection behaviour of zinc rich epoxy paint in 3% NaCl solution. The EIS results obtained at the open-circuit corrosion potential have been interpreted using a model involving the impedance of particle to particle contact to account for the increasing resistance between zinc particles with immersion period, in addition to the impedance due to the zinc surface oxide layer and the electrical resistivity of the binder. Galvanic current and *dc* potential measurements allowed us to conclude that the cathodic protection effect of the paint takes some time to be achieved. The loss of cathodic protection is due to a double effect: the decrease of the Zn/Fe area ratio due to Zn corrosion and the loss of electric contact between Zn to Zn particles. Even when the cathodic protection effect by Zn dust become weak, the substrate steel is still protected against corrosion due to the barrier nature of the ZRP film reinforced by Zn.

**Keywords:** zinc-rich epoxy paints, cathodic protection, electrochemical impedance spectroscopy, corrosion mechanisms.

## Introduction

The application of zinc-rich primers on ferrous substrates is a very efficient method of anticorrosion protection. They are used in many aggressive media: sea water, marine and industrial environments. It is a common fact that in order to achieve a long-life coating system, a zinc primer needs to be applied as the first coat. For solvent-based zinc-rich paints (ZRPs), it seems to be established that, at least at the beginning of immersion, zinc particles provide a cathodic protection of the steel substrate [1,2]. Then, a long term protection develops due to the formation of zinc corrosion products, reinforcing the barrier effect of the paint [1,3].

The metallic zinc content in the dry film is a very important parameter to be emphasized in the technical specifications of zinc-rich paints. However, as observed by Lindquist *et al.*, [4] this parameter is not the only factor determining the performance of this kind of paint. For example, Fragata [5] Del Amo [6] and Pereira [7] verified that the chemical nature of the binder and the zinc particle size are also very important.

The zinc dust (spherical or lamellar shape, or a combination of both) is dispersed in an inorganic (usually orthosilicates) or organic binder (usually epoxies) [8]. These particles must be in electrical contact between themselves and the metallic substrate in order to ensure a well-established electrical conduction within the coating. In such conditions of percolation, a galvanic coupling is created between zinc and the substrate (steel) which is nobler than the zinc. Then, zinc can preferentially dissolve, acting as a sacrificial pigment, and allowing a cathodic protection of the substrate. Many studies [9–19] exist in literature and relate the protection mechanisms and degradation processes of such coatings.

Physico-chemical properties and corrosion resistance of solvent-based zinc-rich paints ZRPs strongly depend on pigment volume concentration (PVC), shape and size of zinc dust [19, 20]. In common liquid ZRP, zinc is usually introduced as spherical pigments with a mean diameter ranging from 5 to 10  $\mu\text{m}$ . To ensure good electrical contacts between zinc pigments and the steel substrate, a high pigment concentration is required (usually above 60 % by volume in solvent-based zinc-rich paints ZRPs) [19]. A major drawback of classic solvent-based paint is the emission of volatile organic compounds (VOC), which contribute to atmospheric pollution. Since the 1970s, powder coatings are often preferred, because they are composed of dry thermosetting powders (without organic solvent) and more environmental abiding.

The aim of this work was to study the protective mechanisms of a single coat solvent-based zinc-rich paints ZRPs. Primer coating panels were applied on sandblasting steel and were studied when immersed in artificial 3% NaCl solution. Open circuit potential and electrochemical impedance spectroscopy measurements were recorded

to study changes in the coating properties with the exposure time. The distribution of the zinc particles in the epoxy binder – which controls the porosity – is considered as the main factor affecting the electrolyte penetration within the coating. Moreover, Raman spectroscopy was used to analyze zinc corrosion products. This study reveals that the behavior of solvent-based zinc-rich paints ZRPs is different from powder coating. This is mainly attributed to the high porosity of solvent-based zinc-rich paints ZRPs, due to their low wetting ability, which insulates some of the zinc particles. However, cathodic protection is active and provides the sealing of the coating pores. Finally, it is found that the barrier effect is lower than the one usually observed with powder coating. S.E.M. observations have also been employed to illustrate the non-homogeneity of our paints. The main objective is to propose a model of EIS results accounting for the zinc particles distribution and mechanisms of water entrance within the coating.

## Experimental part

### Sample material and preparation

The metallic substrate was A283C steel (according to NF10027 standard) in conformity with the norm API (American Petroleum Industry), used in the storage reservoirs of the Algerian crude oil, the chemical composition of the tested steel is given in Table 1. Before coating application, the metallic substrate was sandblasted to Sa 2.5 (Swedish Standard SIS 05 59 00/67) (roughness Ra 6.2  $\mu\text{m}$ ) or polished with emery paper up to G 400. Commercial epoxy-ZRPs were immediately applied onto steel panels using a brush or a roller (Fig. 1). Once cured, the samples were stocked in a desiccator until the moment of testing. The coating thickness was measured using an Elcometer gauge and was found around 80  $\mu\text{m}$  for all panels, the composition of the coating is proprietary information.

Table 1. Chemical composition of A283C steel (% in weight)

| C    | Mn  | S    | P     | Cu  | Si  |
|------|-----|------|-------|-----|-----|
| 0.24 | 0.9 | 0.04 | 0.035 | 0.2 | 0.4 |

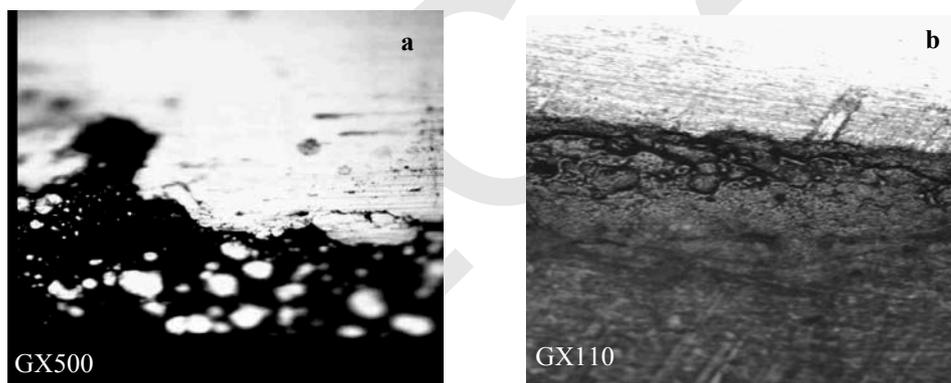


Figure 1: Cross-section of the studied ZRP. (a) Prior to exposition. The observed white particles are due to the spherical zinc particles. (b) After 360 days of immersion in NaCl 3%. Substrate steel is seen as the white region at the top of micrography.

Coated panels were cut out (100 cm $\times$ 60 cm $\times$ 4 cm) and an electrical wire was added in order to allow electrochemical measurements. With the aim to achieve the electrochemical measures in the best conditions it has been suited that the areas of about 15 cm<sup>2</sup> exposed to the electrolytic solution were sufficient. It seemed necessary to use a surface of paint relatively big in contact with electrolytic solution in order to compensate the insulating role of the sample as the thickness of the film grows. Mansfeld reports in a technical document [21] a study of Kendig and Scully suggesting the use of samples covered with a ratio area / thickness of the coating of at least 10<sup>4</sup> to assure satisfactory electrochemical measurement.

Samples were exposed under open circuit potential conditions in NaCl aqueous solution normally aired and none agitated whose concentration is 30 g/l for electrochemical impedance.

## Electrochemical impedance spectroscopy measurements

The Electrochemical Impedance Spectroscopy (EIS) measurement is carried out in a 3% NaCl solution, using a potentiostat/galvanostat EG&G A273. A frequency response analyser Solartron FRA 1260 connected to an electrochemical interface Solartron SI 1287 was used to perform EIS measurements. A filter (Kemo VBF 8) was also employed to improve the signal to noise ratio. The frequency domain covered was 100 kHz to 10 mHz with the frequency values spaced logarithmically (five per decade). The width of the sinusoidal voltage signal applied to the system was 10 mV. All the measurements were performed at the open circuit potential and at different immersion times. The electrolyte was confined in a glass tube which was fixed to the painted surface by an O-shaped ring. The total tested area was 15 cm<sup>2</sup>. Platinum gauze of large area was used as a counter electrode. All the potentials in the current article are referred to saturated calomel electrode (SCE). During the intervals between EIS measurements, the painted specimen was kept in the electrolyte cell without reference electrode. The cell design for EIS measurement was described in detail in a previous work [22].

## Characterization of wash primer coatings

### FTIR analysis

The FTIR spectra of zinc rich epoxy paint were taken with SHIMATZU 8000 *série* + FTIR Spectrometer using ATR attachment in the range 4000–450 cm<sup>-1</sup>.

### Micro-Raman spectroscopy

Cross sections of the zinc-rich epoxy paint were polished and analyzed *ex situ* by micro-Raman spectroscopy after immersion. Fresh polishing with 1 μm diamond paste was performed just before Raman analysis. Fig.2 shows cross-section obtained by scanning electron microscopy of the ZRP. Only zinc particles (spherical) are observable. This figure shows that the distribution of the spherical pigments is quite inhomogeneous while zinc plates are uniformly distributed. Raman spectrophotometer (Labram from Jobin Yvon with an optical microscope from Horiba) was equipped with a HeNe laser (632.81 nm); the output power was 0.97 mW at the sample. A confocal hole set at 200 μm allowed an analyzed depth lower than 10 μm on transparent products. A 80 ULWD objective from Olympus was used to select the analyzed area. Raman spectra were only acquired on spherical zinc particle frontier.

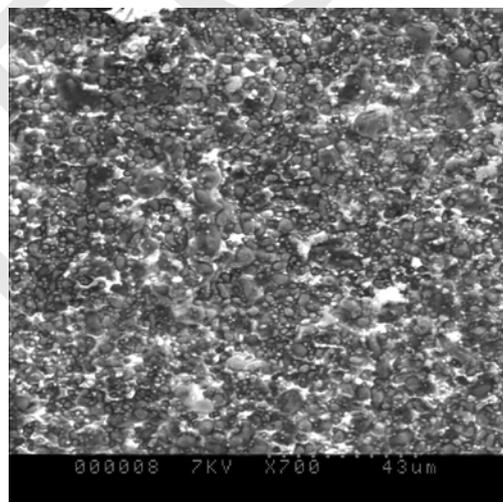


Figure 2 :Cross section SEM micrography of the coating where spherical zinc particle are visible.

## Results and discussion

### Electrochemical properties of sandblasted steel ( $Sa 2\frac{1}{2}$ )

To the analysis of the curves (Fig 3), we note a continuous deterioration of the sandblasted steel to Sa 2.5 provoking a change in the state of the metallic surface. It can for example, to cover of corrosion products, weakly adhesive which provoke a stability of the free corrosion potential, the value was around -0.684 V/SCE. The diagrams of Nyquist determined to different time of immersion, in the 3% NaCl solution normally aired and non agitated are represented on the Fig. 3, the values of the different parameters are gathered in the table 2.

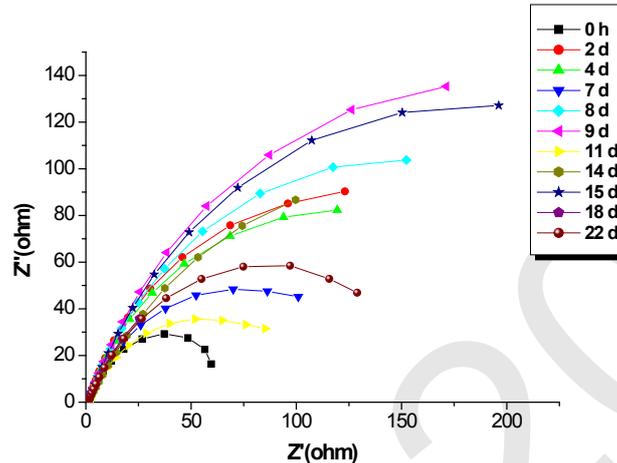


Figure 3: Evolution of Nyquist diagrams as a function of immersion time in 3% NaCl solution for the sandblasted steel (Sa 2.5).

The values of the electrolyte resistance  $R_e$  are very weak, of the order of  $14 \Omega cm^2$ , what shows that the middle is very conductive.

To the analysis of the impedance diagrams, since the first hours of immersion of the metallic substrate, we register a rapid evolution of the charge transfer resistance  $R_{ct}$  of the sandblasted steel, we note that at the beginning of the immersion the value of the charge transfer resistance  $R_{ct}$  only makes increase until to the fourth days of immersion (96 hours), it means that the process governing the kinetics is under control of load transfer. According to the Fig. 4 we notes that the charge transfer resistance  $R_{ct}$  evolves cyclically with time of immersion (growth then decrease) this state of fact to been signalled already by certain author [23, 24-25].

The tracing of the double layer capacitance  $C_{dl}$  curve as a function of exposure time from the values arranged in the Fig. 4, show an increase of the capacity of double layer  $C_{dl}$  since the first hours of exposure. This growth is more or less important ( $3.810$  to  $4.505 \text{ mF.cm}^{-2}$ ) translating the deterioration of steel thus, but beyond the seventh day (168 hours) of immersion it decreases suddenly ( $2.892 \text{ mF.cm}^{-2}$ ), we think that the slowing of the decrease of the double layer capacitance  $C_{dl}$  would be due to the formation of corrosion products (Fig.4) forming a film more or less adhesive to the substrat playing the role of a gate, beyond 216 hours the capacity of double layer fluctuates weakly that we can consider like steady.

Table 2. Parameters values extracted from the fitting procedure.

| Time (days) | $R_e (\Omega.cm^2)$ | $R_{ct} (K\Omega.cm^2)$ | $C_{dl} (mF/cm^2)$ |
|-------------|---------------------|-------------------------|--------------------|
| 0 h         | 17.97               | 1.044                   | 3.810              |
| 2           | 13.53               | 3.804                   | 4.183              |
| 4           | 13.14               | 3.532                   | 4.505              |
| 7           | 13.77               | 2.201                   | 2.892              |
| 8           | 14.53               | 4.460                   | 3.568              |
| 9           | 14.51               | 5.877                   | 2.707              |
| 11          | 13.65               | 1.706                   | 2.331              |
| 14          | 14.67               | 2.991                   | 2.218              |
| 15          | 14.95               | 5.532                   | 2.876              |
| 18          | 14.28               | 2.597                   | 2.450              |
| 22          | 16.02               | 2.546                   | 2.500              |

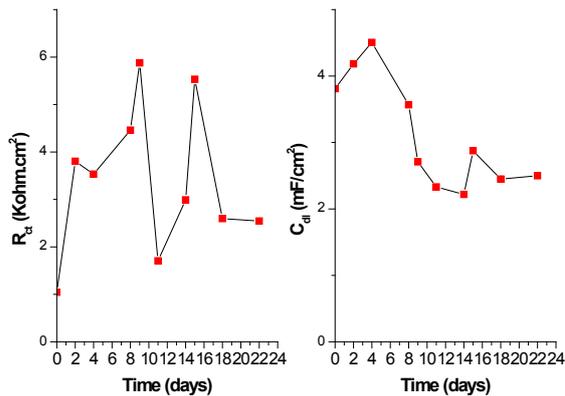


Figure 4: Variation of  $R_{ct}$  and  $C_{dl}$  with time of exposure.

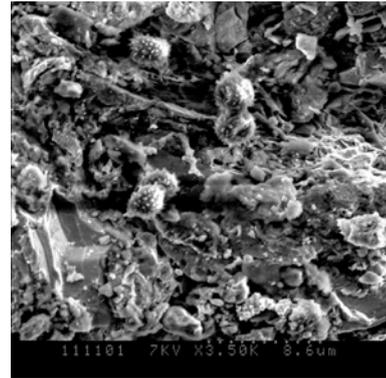


Figure 5: Cross section SEM micrograph on sandblasted steel (Sa2.5).

This situation has already been met, at the time of our survey with the different states of naked surface. This phenomenon observed by Duprat [26], has been assigned to the porous nature of corrosion products formed at the free corrosion potential and present at the metallic interface (Fig.5).

The model of equivalent circuit proposed and presented in Fig.6 could be used to represent the electrochemical behaviour of our samples after immersion in 3% NaCl solution, in this circuit  $R_e$  is the resistance of electrolyte ( $\Omega.cm^2$ ),  $R_{ct}$  the charge transfer resistance ( $\Omega.cm^2$ )  $C_{dl}$  the double layer capacitance ( $F.cm^2$ ).

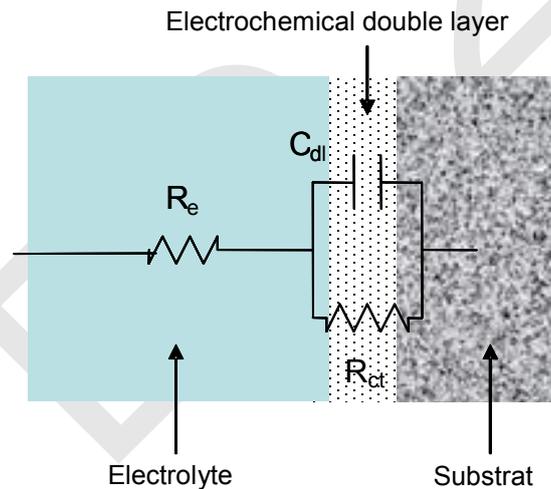


Figure 6: Equivalent circuit used to model sandblasted steel (Sa 2.5) during immersion in 3% NaCl solution.

### EIS behavior of zinc rich epoxy paint

Zinc-rich primers can only protect the steel cathodically when the zinc particles in the primer have electric contact to the steel substrate. Only the zinc particles in direct contact with the steel substrate, or connected through other zinc particles, will contribute to the cathodic protection. It is therefore necessary to have a large amount of zinc dust in the coating.

The potential of ZRP is approximately  $-1.160$  V/SCE, while the steel substrate used here has a potential of approximately  $-0.65$  V/SCE. The measured potentials are mixed potentials between the steel substrate and the "active" zinc-pigments, and will depend on the area ratio between the two. If only few zinc-pigments are active, the anode area will be small, and the potential will be close to that of the steel. On the other hand, if the area of active zinc particles is large, the potential will be close to that of zinc.

The Nyquist impedance diagrams for the ZRP coated panels obtained in the aerated 3% NaCl solution as a function of immersion time are shown in Fig. 7a. Two time constants (two loops) were clearly defined at the beginning of the exposure, that become more and more distinct as the immersion time increases, which corresponds well with the model shown in Fig.10 one in the high frequency range (Fig. 7b) which is related to the coating properties followed by a second one at lower frequencies which is related to the corrosion process

[27, 28]. At high frequencies, the impedance reduces to one or two semicircles with diameters of charge transfer resistance and pore resistance. At lower frequencies, a Warburg impedance develops on the Nyquist plot by a straight line superimposed at 45° to both axes, which shows a shielding effect on mass transport of reactants and products. The shape of the impedance plot suggests that the ZRP corrosion changes from charge transfer control process to diffusion control process during time of immersion. By considering the morphology and the EIS of the ZRP, the impedance first decreased for few days showing the zinc particles activation before an increase related to the zinc corrosion products formation.

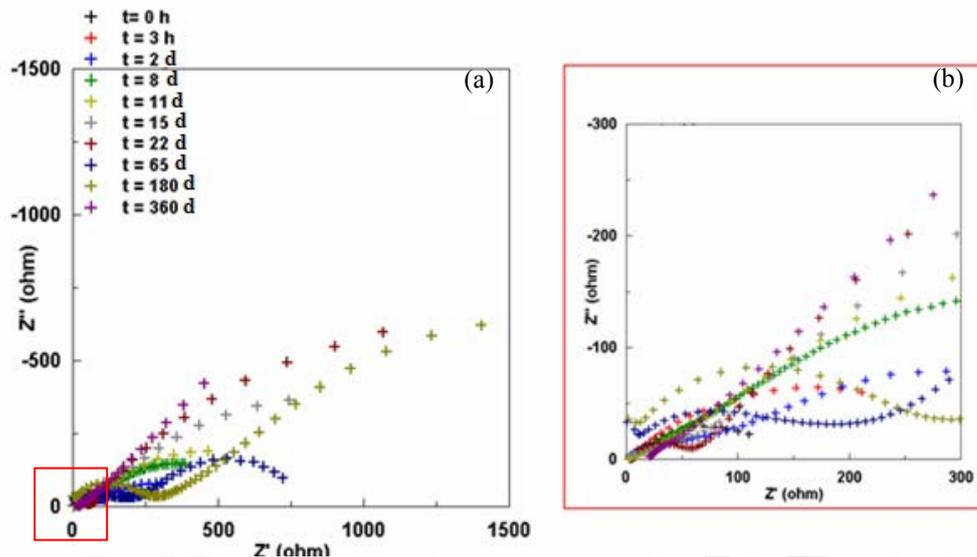


Figure 7: Electrochemical impedance spectroscopy diagrams for ZRP as a function of immersion time in aerated 3% NaCl solution.

The fitting of EIS data was performed by Zview software (Scribners Associates, USA) using different electrical equivalent circuits which include two time constants [29,30].

Another difference with previous studies on ZRPs was found in the visual observation of panels during immersion. Usually, zinc corrosion products are clearly observed as white scale at the ZRP panel surfaces [31] (Fig. 8a). These new products would be maintained within the coating at the neighbourhood of the corroded zinc particles. Moreover, they could also contribute to the isolation of zinc particles as a protective barrier which reduces the corrosion rate of zinc and the coating porosity. Fig. 8b shows the visual appearance of zinc rich epoxy paint coated panel after 180 days (six months) of immersion where the whiteness related to the zinc corrosion products was not observed. It means that after zinc corroded, zinc corrosion products were not able to reach the coating/electrolyte interface, the surface appears damaged with the presence of the red rust due to a progressive attack informing on the state of steel substrat, at this stage of deterioration, the coating lost all its protective properties.

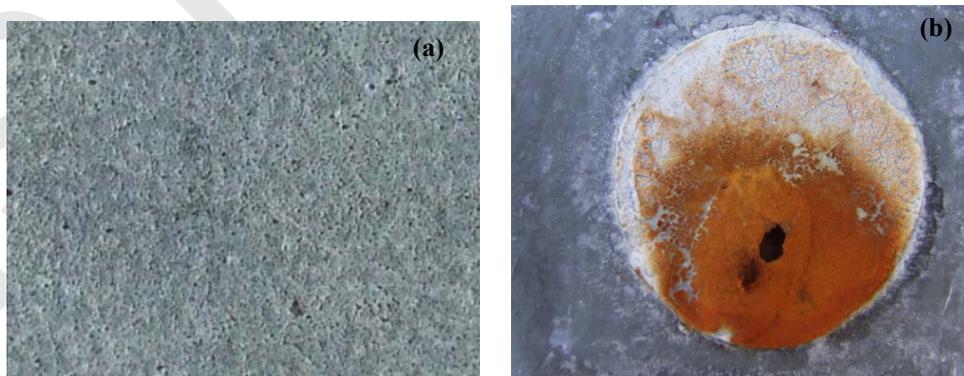


Figure 8: Visual aspect of zinc rich epoxy paint after six months of immersion in 3% NaCl solution.

## $E_{\text{cor}}$ evolution

According to Abreu *et al.* [2], the evolution of the free corrosion potential  $E_{\text{cor}}$  allows to follow the electrochemical activity of the ZRP. It is believed that the electrochemical processes occurring in such systems are the oxidation of zinc particles ( $\text{Zn} \rightarrow \text{Zn}^{2+} + 2e^-$ ) and the reduction of dissolved oxygen ( $\text{O}_2 + 2\text{H}_2\text{O} + 4e^- \rightarrow 4\text{OH}^-$ ). The authors reported that the  $E_{\text{cor}}$  evolution for liquid ZRP coated samples is in close relationship with the ratio of active areas (zinc/steel) and allows to define the cathodic protection (CP) duration which is the period where  $E_{\text{cor}}$  remains lower than  $-0.86$  V/SCE, a value corresponding to the commonly accepted criterion of a maximum  $\text{Fe}^{2+}$  concentration of  $10^{-6}$  M. In other words, the increase in this potential corresponds to the decrease of the electroactive zinc area which means the decrease of the cathodic protection intensity. This is generally attributed to the isolation of the zinc particles by the zinc corrosion products in the coating.

Fig.9 shows the  $E_{\text{cor}}$  evolution with time of coated steel substrates with Zinc rich epoxy paint. It can be seen that  $E_{\text{cor}}$  was cathodic between  $-1.0$  and  $-0.8$  V<sub>SCE</sub> during the six months of entire immersion, this result could be due to a high zinc particles amount. This shows that the zinc particles in the primers were electrochemically active with a high number of electrical contacts between zinc particles. This high percolation means that zinc pigments improve a good electrical contact which implies that the steel substrate was under a good CP. That means that a higher part of the zinc particles was involved in a percolation process.

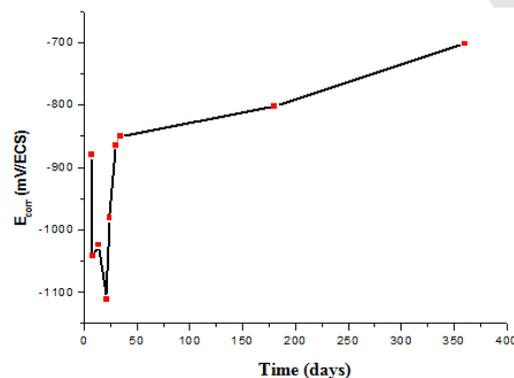


Figure 9: Variations in corrosion potential with time for ZRP exposed in 3% NaCl solution at ambient temperature.

However, as the CP duration is due to the activation of zinc particles by the electrolyte penetration, it also means that the zinc dissolution is reduced or that galvanic contact was lost after six months of immersion in 3% NaCl solution, some small spots of iron rust are detected on the film surface, indicating that the iron corrosion process started some days before. For our zinc-rich primers, it has been observed that zinc corrosion products precipitate inside the coating, around the zinc particles that originated them, blocking the pores of the coating and therefore increasing its barrier resistance [32]. After the test the latter sample was covered with red rust in a limited area. Probably the primer was very thin there, so that the zinc particles were consumed and the steel started to corrode.

## Equivalent circuit for the EIS simulation

The electrical circuits that are used to simulate the EIS results are shown in Fig. 10. By considering the morphology and the EIS of the ZRP, the corrosion process and its equivalent circuit are proposed. At the beginning of the immersion, the model circuit was proposed by the combination of Randles type equivalent circuits for a porous paint film [33] and an intact paint film [34], as shown in Fig. 10a.

In the case of Fig. 10a, the nature of the zinc rich epoxy paint enables the coating to be modelled as an ideal capacitance  $C_f$  in parallel with the ionic resistance  $R_f$  through the coating.

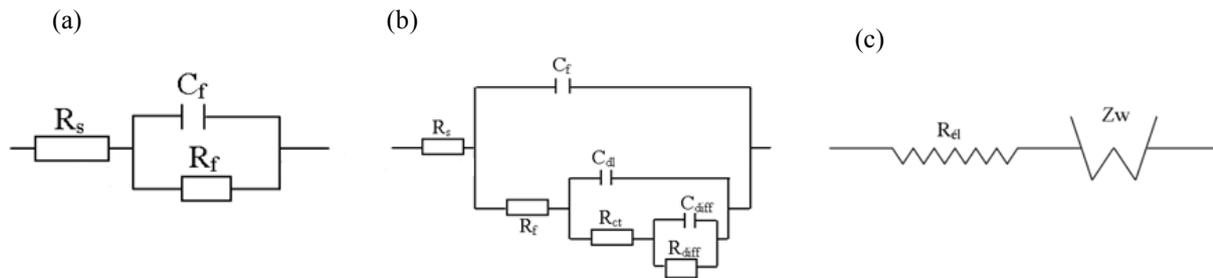


Figure 10: Electrical circuits used to simulate the EIS results.

In the same way the presence of a metal surface without chemical pretreatment together with the iron electrochemical dissolution reaction which involves a single time constant, enables the metal-paint interface to be considered as a resistance (the charge transfer resistance  $R_{ct}$ ) in parallel with the double layer capacitance  $C_{dl}$  (the double layer capacitance on quite a rough surface). In this example the suggested model is simple but it is in good agreement with the experimental result (Fig.10b). Moreover, after about 180 days of immersion we can observe the appearance of a diffusion tail at the lowest frequencies (Fig.10c). In most of the cases, a circuit including diffusion impedance through a layer of finite thickness [2] gave the best agreement between experimental and calculated curves. This circuit describes a degraded coating with a weak charge transfer [35].

### Micro-Raman spectroscopy

In order to understand the behaviour of zinc rich epoxy paint, complementary analyzes were carried out. Raman spectroscopy analyzes were performed after 180 days (6 months) of immersion of the zinc rich epoxy paint. This technique allows to identify locally zinc corrosion products inside the coatings. Representative spectra obtained for our sample are shown in Fig. 11(a) and (b). In fig. 11(a), a characteristic peak was observed at  $543\text{ cm}^{-1}$  which was attributed to a non-stoichiometric oxide  $\text{Zn}_{1+x}\text{O}$  [36, 37], which is detected on some particles of zinc to some micrometers of the electrolyte/coating interface whereas only the metallic zinc is detected on the other particles. This shape of the non-stoichiometric zinc oxide  $\text{Zn}_{1+x}\text{O}$ , where zinc ion is in interstitial position had been observed by Tzolov and *alli* [38].

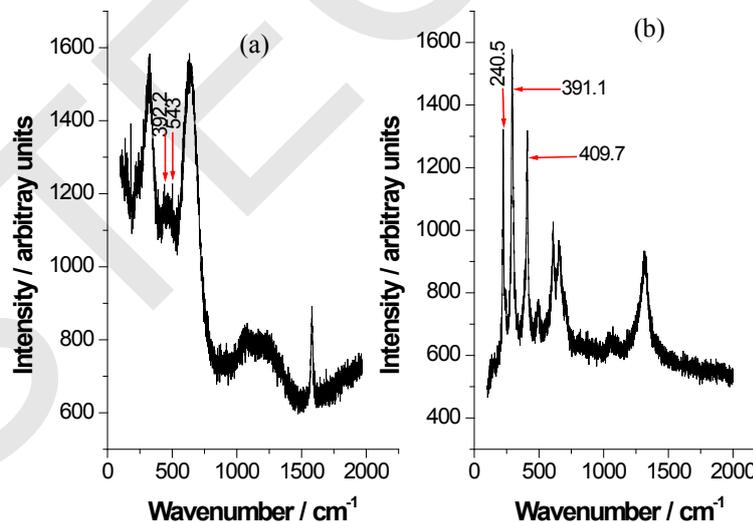


Figure 11: Raman spectrum of zinc particles near the interface film/electrolyte after six months of immersion in 3% NaCl solution.

Other corrosion products were detected inside the coatings and their characteristic wavenumbers (Fig. 11b). We detected additional peaks at  $240.5$ ,  $392.2$  and  $409.7\text{ cm}^{-1}$  attributed to simonkolleite [ $4\text{Zn}(\text{OH})_2 \cdot \text{ZnCl}_2 \cdot \text{H}_2\text{O}$ ] a kind of zinc corrosion products, we detected also additional peak at  $1340\text{ cm}^{-1}$ . The oxidized forms were first observed at the solution/ coating interface and progressed towards the steel substrate as the immersion duration increased.

## FTIR spectral characterization

The FTIR spectrum of the zinc rich epoxy paint is shown in Fig. 12. The peaks around  $850\text{ cm}^{-1}$ ,  $1250\text{ cm}^{-1}$ ,  $1510\text{ cm}^{-1}$ ,  $1600\text{ cm}^{-1}$  and  $1460\text{ cm}^{-1}$  are due to the resin epoxy. The film is found to be hydrated by the presence of peak at  $3400\text{ cm}^{-1}$  due to O–H absorption band.

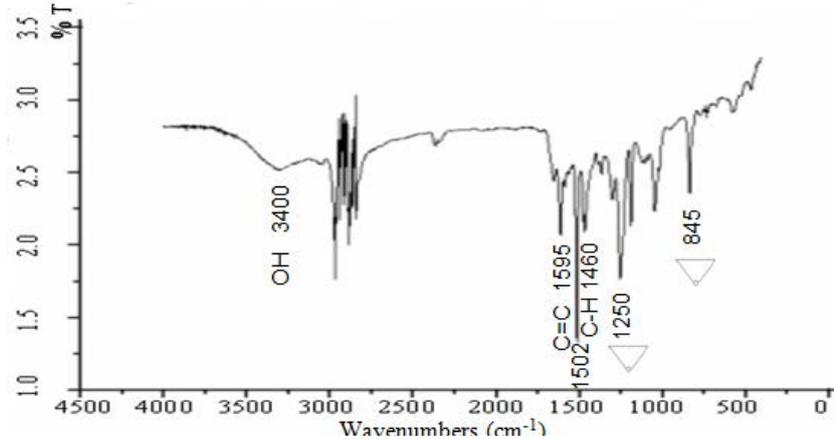


Figure 12: FTIR spectra of zinc rich epoxy paint (ZRP).

From FTIR spectra result, it can be concluded that the synthesised zinc rich epoxy paint was under a conductive form, which is represented in the Fig.13.

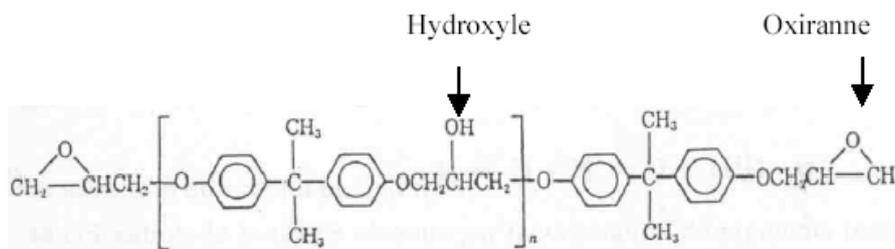


Figure 13: Structural formula of the zinc rich epoxy paint.

## SEM analysis

Cross section S.E.M. micrographs of several ZRP samples exposed to the electrolyte for different time are shown in Fig.14. It was clearly observed that the coating presented zones which did not contain zinc particles. Moreover, it can be seen that the zinc particle shape varied significantly from spherical to elongated forms. Most of the zinc particles were not in direct contact with the substrate. These observations about the zinc particles distribution were considered to analyse EIS spectra.

Fig .14a and b represents a testing panel covered with the oxidation products after exposure to 3% NaCl solution. The oxidation of zinc in the coating creates the so-called “white corrosion”; the shapes of damage were under Cracks and scaling damage. Sealing of pores in a spherical zinc-pigmented coating. Which is necessary to secure the barrier protection of the substrate. The scheme outlines the possible reactions at the appearance of oxidation zinc products; these products are of alkaline nature and can manifest themselves in the neutralization protection mechanism [39,40].

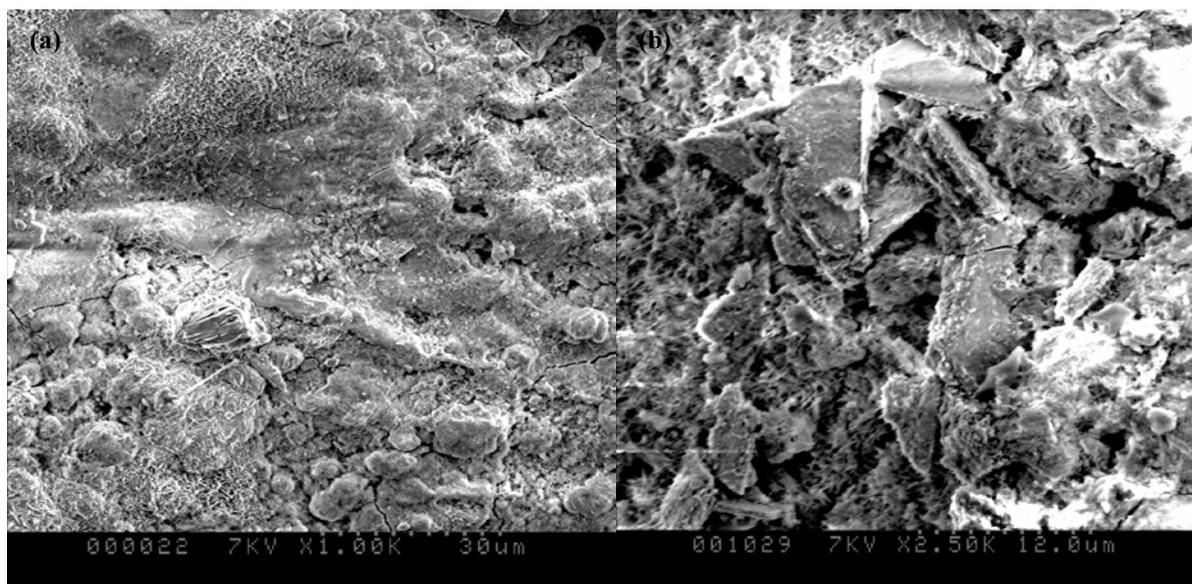


Figure 14: SEM pictures of zinc rich epoxy paint in 3% NaCl solution.

## Conclusion

- There is no doubt that zinc-rich primers offer a very efficient method of anticorrosion protection. Zinc offers threefold protection since it seals the underlying metal from contact with its corrosive environment, provides galvanic protection and “repairs” minor damage in a coating forming a barrier to further electrochemical action.
- Corrosion protection properties of zinc-rich epoxy primer coated carbon steel was studied and characterised in 3% NaCl solution. The EIS diagrams showed clearly two capacitive loops, however, classical equivalent circuits used to monitor coating degradation were unable to provide satisfying fitting results. It was found that the cathodic protection was maintained for six months, due to a low percolation process combined to a low porosity, the reason is high zinc content and poor weldability.
- The good performance of ZRP coatings during immersion can also be explained by the retention of zinc corrosion products into the coating which allow improving barrier properties. However, it is important to remember that the zinc-rich paint effectiveness does not depend solely on electrochemical factors. There are other factors such as mechanical properties (cohesion, adhesion to Sa 2.5, flexibility, etc) that are very important. So, the addition of auxiliary pigments should be controlled carefully in order not to impair the film’s physical and chemical characteristics.

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# FACTORS AFFECTING LEISURE TIME ACTIVITIES ACCORDING TO VOCATIONAL HIGH SCHOOL STUDENTS

Secil OKAY<sup>1</sup>

Omer F TUTKUN<sup>2</sup>

## Abstract

The main problem of this study is to prove the reasons why vocational high school students cannot spend their leisure time. In the direction of this main problem, sub-problems of the study is to prove the reasons why vocational high school students cannot spend their leisure time with an activity "according to the variables such as class level, gender, region that parents live, economic conditions of the parents, educational background of mother and father. In this research, descriptive research method has been used in general screening model. The population of the study comprises of 50.539 Vocational High School students who are still attending. The sample of the study comprises of 1380 students. The reasons why they cannot spend their leisure time with an activity according to Vocational High School students are put in order from high to low: I do not have enough time, my achievement is decreasing, we are not instructed by the school, activities are not organized in my school, we are not instructed by our teachers, my parents do not allow me and my parents do not have enough income.

**Key words:** Leisure Time, Out-of-School Time, Free Time, Vocational High School, Education, Student.

## 1. Introduction

It may be said that since the early ages one the most important affairs of human life is spending their leisure time with useful activities. In contrast to past, controlling of children by both parents and schools is getting harder. Factors such as social environment and internet, written-visual media have started to be much more dominant than parents and the schools. In this context, the foundations of making a habit of spending their leisure time with useful activities and turning into attitudes as from person's school age must be one of the basic functions of formal education. It is explicit that students' spending their leisure time with useful activities will make a great contribution to students' canalizing individual and academic success by improving themselves. It is apparent that this kind of activities has contribution intended for the students' assuming responsibility, having positive interpersonal relations, creativities, academic successes and self-actualizations. On the other side, in the education of youths who are taking a step towards adulthood, evaluating their out-of-school time with activities for their not heading for bad habits to be formed their personalities, in their heaths' being protected and their preparing a better future is quite important (Demir & Demir, 2006; Terzioğlu & Yazıcı, 2003; Tezcan, 1976).

\*\* This study has been generated from one part of post graduate thesis supervised by second author.

<sup>1</sup>Teacher, MA, okay.secil@hotmail.com

<sup>2</sup>Assoc. Prof. Sakarya University Faculty of Education, Turkey, oftutkun@hotmail.com

Spending free time has become an important subject in many countries of the world. Free time has some advantages such as; creativity, pleasure, satisfactory, enhancing personal satisfaction, developing physical-mental-psychological capacity and leading entertainment (Demirel & Harmandar, 2009; Sağlam Saföz, 2008; Demir & Demir, 2006). The main aim of education is to train good people, good citizens. In this context, the primary function of educational institutions is to train youths as competent adults of the future, to provide their compatibility to the social life and to gain them democratic and moral (Özer, Gelen & Öcal, 2009; Yetiş, 2008).

The most important factors for programming the students' out-of-school time are schools and parents. Parents should know that social activities are useful for their children and school works cannot supersede these activities alone. If the child has been given enough time to study, habit of preparing their weekly program should be gained by giving permission to his/her sparing enough time to play (have a good time). Schools, however, should be the place where the students can spend their out-of-school time. At the end of the school hours, with social events and recreational activities, students should be encouraged to spend their free time efficiently and the students should be in the habit of these activities and should reflect their youths and adulthoods period (Kırkpınar, 2004; Tezcan, 1976). For these reasons, in the future in order to be the students' being individuals who have completed their personalities, be able to take social responsibilities, spend time efficiently, are away from harmful habits, they should learn to use their out-of-school time accurately (Ministry of National Education, 2012). In this framework, it is thought that this study will provide contributions in terms of knowledge as a source to the school administrators, teachers, parents, civil society institutions, local administrators and other relevants.

The main problem of the study "According to Vocational High School students, the determination of the reasons of their out-of-school time." Sub-problems of the research, however, are these; how are the reasons of the Vocational High School students' not being able to spend their out-of-school time according to "class level, gender, the place where the parents live, economic situation of the parents, educational level of father and mother variables?"

## 2. Methodology

In this research, descriptive research method in general screening model has been used. Target population of the study has consisted of 50.539 students, attending the Vocational High Schools. Sample of the study, %99 confidence %1 margin of error accuracy, has consisted of 1800 students determined by ratio sampling from these schools. But, data analysis have been made through (over) the rest 1380 surveys after the ones which were filled inappropriately.

In research, the 5<sup>th</sup> section of the survey "Forms of the students' spending their out-of-school time and the factors affecting these forms" has been used in order to determine the forms of the Vocational High School students' out-of-school time and the factors affecting these forms as data collection tools. The 1<sup>st</sup> section of the survey comprises personal information. In 2<sup>nd</sup> section, 7 cases have been given the reasons why the students cannot take part in the activities in their out of school time. As this section (5<sup>th</sup> section) has the classification property, reliability work has not been studied.

### 3. Findings

#### 3.1. What are the reasons of the Vocational High School students' not being able to spend their out-of-school time with any activities? findings relating to this basic problem

Table 1. The reasons of the Vocational High School students' not being able to spend their out-of-school time

|   | n   | %    |
|---|-----|------|
| I don't have enough time                  | 746 | 54,1 |
| My achievement is decreasing              | 383 | 27,8 |
| We are not instructed by the school       | 298 | 21,6 |
| Activities are not organized in my school | 273 | 19,8 |
| We are not instructed by our teachers     | 214 | 15,5 |
| My parents don't allow                    | 188 | 13,6 |
| My parents don't have enough money        | 176 | 12,8 |

According to Table 1, the reasons of not being able to spend their out-of-school time in regard to Vocational High School students are like these from top to least (maximum to minimum): "I don't have enough time (% 54,1), my achievement is decreasing (% 27,8), we are not instructed by the school (% 21,6), activities are not organized in my school (% 19,8), we are not instructed by our teachers (% 15,5), My parents don't allow (% 13,6) and My parents don't have enough money (% 12,8).

#### 3.2. "How are the reasons of the Vocational High School students' not being able to spend their out-of-school time with any activities" according to gender?

Table 2. The reasons of not being able to spend time according to "gender" variable

| Reasons of not taking part in activity    | Gender | Yes |        | No  |        |
|---|--------|-----|--------|-----|--------|
|   |        | n   | %      | n   | %      |
| I don't have enough time                  | Girl   | 251 | % 33,6 | 205 | % 32,3 |
|   | Boy    | 495 | % 66,4 | 429 | % 67,7 |
| My parents don't allow                    | Girl   | 79  | % 42,0 | 377 | % 31,6 |
|   | Boy    | 109 | % 58,0 | 815 | % 68,4 |
| My parents don't have enough money        | Girl   | 44  | % 25,0 | 412 | % 34,2 |
|   | Boy    | 132 | % 75,0 | 792 | % 65,8 |
| Activities are not organized in my school | Girl   | 80  | % 29,3 | 376 | % 34,0 |
|   | Boy    | 193 | % 70,7 | 731 | % 66,0 |
| My achievement is decreasing              | Girl   | 133 | % 34,7 | 323 | % 32,4 |
|   | Boy    | 250 | % 65,3 | 674 | % 67,6 |
| We are not instructed by our teachers     | Girl   | 48  | % 22,4 | 408 | % 35,0 |
|   | Boy    | 166 | % 77,6 | 758 | % 65,0 |
| We are not instructed by the school       | Girl   | 78  | % 26,2 | 378 | % 34,9 |
|   | Boy    | 220 | % 73,8 | 704 | % 65,1 |

According to the gender variable, the reasons of the Vocational High School students' not being able to take part in an activity are like these: at most school boys, I don't have enough time (66,4%), my parents don't allow (58,0%), my parents don't have enough money (75,0%), activities are not organized in my school (70,7%), my achievement is decreasing (65,3%), we are not instructed by our teachers (77,6%) and we are not instructed by the school (73,8%).

### 3.3. How are “The reasons of the Vocational High School students’ not being able to spend their out-of-school time with any activities” according to class level?

Table 3. The reasons of not being able to spend time according to “class level” variable

| Reasons of not taking part in activity    | Class Level | Yes |        | No  |        |
|---|-------------|-----|--------|-----|--------|
|   |             | n   | %      | n   | %      |
| I don't have enough time                  | 9           | 109 | % 14,6 | 81  | % 12,8 |
|   | 10          | 394 | % 52,8 | 298 | % 47,0 |
|   | 11          | 196 | % 26,3 | 202 | % 31,9 |
|   | 12          | 47  | % 6,3  | 53  | % 8,4  |
| My parents don't allow                    | 9           | 19  | % 10,1 | 171 | % 14,3 |
|   | 10          | 90  | % 47,9 | 602 | % 50,5 |
|   | 11          | 68  | % 36,2 | 330 | % 27,7 |
|   | 12          | 11  | % 5,9  | 89  | % 7,5  |
| My parents don't have enough money        | 9           | 21  | % 11,9 | 169 | % 14,0 |
|   | 10          | 93  | % 52,8 | 599 | % 49,8 |
|   | 11          | 50  | % 28,4 | 348 | % 28,9 |
|   | 12          | 12  | % 6,8  | 88  | % 7,3  |
| Activities are not organized in my school | 9           | 45  | % 16,5 | 145 | % 13,1 |
|   | 10          | 141 | % 51,6 | 551 | % 49,8 |
|   | 11          | 72  | % 26,4 | 326 | % 29,4 |
|   | 12          | 15  | % 5,5  | 85  | % 7,7  |
| My achievement is decreasing              | 9           | 65  | % 17,0 | 125 | % 12,5 |
|   | 10          | 191 | % 49,9 | 501 | % 50,3 |
|   | 11          | 112 | % 29,2 | 286 | % 28,7 |
|   | 12          | 15  | % 3,9  | 85  | % 8,5  |
| We are not instructed by our teachers     | 9           | 24  | % 11,2 | 166 | % 14,2 |
|   | 10          | 76  | % 35,5 | 616 | % 52,8 |
|   | 11          | 92  | % 43,0 | 306 | % 26,2 |
|   | 12          | 22  | % 10,3 | 78  | % 6,7  |
| We are not instructed by the school       | 9           | 35  | % 11,7 | 155 | % 14,3 |
|   | 10          | 142 | % 47,7 | 550 | % 50,8 |
|   | 11          | 101 | % 33,9 | 297 | % 27,4 |
|   | 12          | 20  | % 6,7  | 80  | % 7,4  |

According to the class level variable, the reasons of the Vocational High School students’ not being able to take part in an activity are like these: at most 10<sup>th</sup> grade students, I don't have enough time (52,8%), my parents don't allow (47,9%), my parents don't have enough money (52,8%), activities are not organized in my school (51,6%), my achievement is decreasing (49,9%), we are not instructed by the school (47,7%); 11<sup>th</sup> grade, we are not instructed by our teachers (43,0%).

### 3.4. “How are the reasons of the Vocational High School students’ not being able to spend their out-of-school time with any activities” according to the place where parents live?

Table 4. The reasons of not being able to spend time according to “the place where parents live” variable

| Reasons of not taking part in activity | The place where the parents live | Yes |        | No  |        |
|--|----------------------------------|-----|--------|-----|--------|
|  |                                  | n   | %      | n   | %      |
| I don't have enough time               | City                             | 443 | % 59,4 | 327 | % 51,6 |

|   |         |     |        |     |        |
|---|---------|-----|--------|-----|--------|
|   | County  | 234 | % 31,4 | 231 | % 36,4 |
|   | Town    | 8   | % 1,1  | 19  | % 3,0  |
|   | Village | 61  | % 8,2  | 57  | % 9,0  |
|   | City    | 80  | % 42,6 | 690 | % 57,9 |
| My parents don't allow                    | County  | 93  | % 49,5 | 372 | % 31,2 |
|   | Town    | 2   | % 1,1  | 25  | % 2,1  |
|   | Village | 13  | % 6,9  | 105 | % 8,8  |
| My parents don't have enough money        | City    | 91  | % 51,7 | 679 | % 56,4 |
|   | County  | 56  | % 31,8 | 409 | % 34,0 |
|   | Town    | 2   | % 1,1  | 25  | % 2,1  |
| Activities are not organized in my school | Village | 27  | % 15,3 | 91  | % 7,6  |
|   | City    | 144 | % 52,7 | 626 | % 56,5 |
|   | County  | 99  | % 36,3 | 366 | % 33,1 |
| My achievement is decreasing              | Town    | 4   | % 1,5  | 23  | % 2,1  |
|   | Village | 26  | % 9,5  | 92  | % 8,3  |
|   | City    | 214 | % 55,9 | 556 | % 55,8 |
| We are not instructed by our teachers     | County  | 136 | % 35,5 | 329 | % 33,0 |
|   | Town    | 4   | % 1,0  | 23  | % 2,3  |
|   | Village | 29  | % 7,6  | 89  | % 8,9  |
| We are not instructed by the school       | City    | 113 | % 52,8 | 657 | % 56,3 |
|   | County  | 76  | % 35,5 | 389 | % 33,4 |
|   | Town    | 5   | % 2,3  | 22  | % 1,9  |
| We are not instructed by the school       | Village | 20  | % 9,3  | 98  | % 8,4  |
|   | City    | 170 | % 57,0 | 600 | % 55,5 |
|   | County  | 94  | % 31,5 | 371 | % 34,3 |
| We are not instructed by the school       | Town    | 7   | % 2,3  | 20  | % 1,8  |
|   | Village | 27  | % 9,1  | 91  | % 8,4  |

According to the place where the parents live variable, the reasons of the Vocational High School students' not being able to take part in an activity are like these: at most students living in cities, I don't have enough time (59,4%), My parents don't have enough money (51,7%), activities are not organized in my school (52,7%), my achievement is decreasing (55,9%), we are not instructed by our teachers (52,8%) and we are not instructed by the school (57,0%); students living in counties, My parents don't allow (49,5%).

### 3.5. "How are the reasons of the Vocational High School students' not being able to spend their out-of-school time with any activities" according to the economic situation of the parents?"

Table 5. The reasons of not being able to spend time according to "the economic situation of the parents" variable

| Reasons of not taking part in activity | The economic situation of the parents | Yes |        | No  |        |
|--|---------------------------------------|-----|--------|-----|--------|
|  |                                       | n   | %      | n   | %      |
| I don't have enough time               | Good                                  | 149 | % 20,0 | 164 | % 25,9 |
|  | Medium                                | 544 | % 72,9 | 420 | % 66,2 |
|  | Poor                                  | 53  | % 7,1  | 50  | % 7,9  |
| My parents don't allow                 | Good                                  | 33  | % 17,6 | 280 | % 23,5 |
|  | Medium                                | 136 | % 72,3 | 828 | % 69,5 |
|  | Poor                                  | 19  | % 10,1 | 84  | % 7,0  |
| My parents don't have                  | Good                                  | 9   | % 5,1  | 304 | % 25,2 |

|   |        |     |        |     |        |
|---|--------|-----|--------|-----|--------|
| enough money                              | Medium | 114 | % 64,8 | 850 | % 70,6 |
|   | Poor   | 53  | % 30,1 | 50  | % 4,2  |
| Activities are not organized in my school | Good   | 57  | % 20,9 | 256 | % 23,1 |
|   | Medium | 198 | % 72,5 | 766 | % 69,2 |
|   | Poor   | 18  | % 6,6  | 85  | % 7,7  |
| My achievement is decreasing              | Good   | 66  | % 17,2 | 247 | % 24,8 |
|   | Medium | 300 | % 78,3 | 664 | % 66,6 |
|   | Poor   | 17  | % 4,4  | 86  | % 8,6  |
| We are not instructed by our teachers     | Good   | 31  | % 14,5 | 282 | % 24,2 |
|   | Medium | 169 | % 79,0 | 795 | % 68,2 |
|   | Poor   | 14  | % 6,5  | 89  | % 7,6  |
| We are not instructed by the school       | Good   | 56  | % 18,8 | 257 | % 23,8 |
|   | Medium | 228 | % 76,5 | 736 | % 68,0 |
|   | Poor   | 14  | % 4,7  | 89  | % 8,2  |

According to the economic situation of the parents variable, the reasons of the Vocational High School students' not being able to take part in an activity are like these: students who are perceived their parents' economic situations as medium, I don't have enough time (72,9%), My parents don't allow (72,3%), My parents don't have enough money (64,8%), activities are not organized in my school (72,5%), my achievement is decreasing (78,3%), we are not instructed by our teachers (79,0%) and we are not instructed by the school (76,5%).

### 3.6. "How are the reasons of the Vocational High School students' not being able to spend their out-of-school time with any activities" according to the educational level of mother?

Table 6. The reasons of not being able to spend time according to "the educational level of mother" variable

| Reasons of not taking part in activity    | The educational level of mother | Yes |        | No  |        |
|---|---------------------------------|-----|--------|-----|--------|
|   |                                 | n   | %      | n   | %      |
| I don't have enough time                  | Not educated                    | 23  | % 3,1  | 22  | % 3,5  |
|   | Primary school graduate         | 404 | % 54,2 | 346 | % 54,6 |
|   | Secondary school graduate       | 135 | % 18,1 | 116 | % 18,3 |
|   | High school graduate            | 155 | % 20,8 | 132 | % 20,8 |
|   | University graduate             | 23  | % 3,1  | 15  | % 2,4  |
|   | Other                           | 6   | % 0,8  | 3   | % 0,5  |
| My parents don't allow                    | Not educated                    | 8   | % 4,3  | 37  | % 3,1  |
|   | Primary school graduate         | 112 | % 59,6 | 638 | % 53,5 |
|   | Secondary school graduate       | 21  | % 11,2 | 230 | % 19,3 |
|   | High school graduate            | 42  | % 22,3 | 245 | % 20,6 |
|   | University graduate             | 4   | % 2,1  | 34  | % 2,9  |
|   | Other                           | 1   | % 0,5  | 8   | % 0,7  |
| My parents don't have enough money        | Not educated                    | 7   | % 4,0  | 38  | % 3,2  |
|   | Primary school graduate         | 118 | % 67,0 | 632 | % 52,5 |
|   | Secondary school graduate       | 27  | % 15,3 | 224 | % 18,6 |
|   | High school graduate            | 19  | % 10,8 | 268 | % 22,3 |
|   | University graduate             | 4   | % 2,3  | 34  | % 2,8  |
|   | Other                           | 1   | % 0,6  | 8   | % 0,7  |
| Activities are not organized in my school | Not educated                    | 8   | % 2,9  | 37  | % 3,3  |
|   | Primary school graduate         | 127 | % 46,5 | 623 | % 56,3 |
|   | Secondary school graduate       | 55  | % 20,1 | 196 | % 17,7 |
|   | High school graduate            | 68  | % 24,9 | 219 | % 19,8 |
|   | University graduate             | 11  | % 4,0  | 27  | % 2,4  |

|                                       |                           |     |        |     |        |
|---------------------------------------|---------------------------|-----|--------|-----|--------|
|                                       | Other                     | 4   | % 1,5  | 5   | % 0,5  |
| My achievement is decreasing          | Not educated              | 19  | % 5,0  | 26  | % 2,6  |
|                                       | Primary school graduate   | 218 | % 56,9 | 532 | % 53,4 |
|                                       | Secondary school graduate | 63  | % 16,4 | 188 | % 18,9 |
|                                       | High school graduate      | 67  | % 17,5 | 220 | % 22,1 |
|                                       | University graduate       | 13  | % 3,4  | 25  | % 2,5  |
|                                       | Other                     | 3   | % 0,8  | 6   | % 0,6  |
| We are not instructed by our teachers | Not educated              | 7   | % 3,3  | 38  | % 3,3  |
|                                       | Primary school graduate   | 111 | % 51,9 | 639 | % 54,8 |
|                                       | Secondary school graduate | 48  | % 22,4 | 203 | % 17,4 |
|                                       | High school graduate      | 42  | % 19,6 | 245 | % 21,0 |
|                                       | University graduate       | 5   | % 2,3  | 33  | % 2,8  |
|                                       | Other                     | 1   | % 0,5  | 8   | % 0,7  |
| We are not instructed by the school   | Not educated              | 4   | % 1,3  | 41  | % 3,8  |
|                                       | Primary school graduate   | 152 | % 51,0 | 598 | % 55,3 |
|                                       | Secondary school graduate | 66  | % 22,1 | 185 | % 17,1 |
|                                       | High school graduate      | 65  | % 21,8 | 222 | % 20,5 |
|                                       | University graduate       | 7   | % 2,3  | 31  | % 2,9  |
|                                       | Other                     | 4   | % 1,3  | 5   | % 0,5  |

According to the educational level of mother variable, the reasons of the Vocational High School students' not being able to take part in an activity are like these: students whose mothers are primary school graduate, I don't have enough time (54,2%), My parents don't allow (59,6%), My parents don't have enough money (67,0%), activities are not organized in my school (46,5%), my achievement is decreasing (59,9%), we are not instructed by our teachers (51,9%) and we are not instructed by the school (51,05%).

### 3.7. "How are the reasons of the Vocational High School students' not being able to spend their out-of-school time with any activities" according to the educational level of father?

According to the educational level of father variable, the reasons of the Vocational High School students' not being able to take part in an activity are like these: students whose fathers are primary school graduate, I don't have enough time (44,92%), My parents don't allow (52,7%), My parents don't have enough money (56,80%), activities are not organized in my school (35,9%), my achievement is decreasing (45,4%), we are not instructed by our teachers (39,3%) and we are not instructed by the school (35,2%).

Table 7. The reasons of not being able to spend time according to “the educational level of father” variable

| Reasons of not taking part in activity    | The educational level of father | Yes |        | No  |        |
|---|---------------------------------|-----|--------|-----|--------|
|   |                                 | n   | %      | n   | %      |
| I don't have enough time                  | Not educated                    | 5   | % 0,7  | 10  | % 1,6  |
|   | Primary school graduate         | 335 | % 44,9 | 249 | % 39,3 |
|   | Secondary school graduate       | 159 | % 21,3 | 143 | % 22,6 |
|   | High school graduate            | 189 | % 25,3 | 195 | % 30,8 |
|   | University graduate             | 55  | % 7,4  | 37  | % 5,8  |
|   | Other                           | 3   | % 0,4  | 0   | % 0,0  |
| My parents don't allow                    | Not educated                    | 0   | % 0,0  | 15  | % 1,3  |
|   | Primary school graduate         | 99  | % 52,7 | 485 | % 40,7 |
|   | Secondary school graduate       | 46  | % 24,5 | 256 | % 21,5 |
|   | High school graduate            | 29  | % 15,4 | 355 | % 29,8 |
|   | University graduate             | 14  | % 7,4  | 78  | % 6,5  |
|   | Other                           | 0   | % 0,0  | 3   | % 0,3  |
| My parents don't have enough money        | Not educated                    | 3   | % 1,7  | 12  | % 1,0  |
|   | Primary school graduate         | 100 | % 56,8 | 484 | % 40,2 |
|   | Secondary school graduate       | 24  | % 13,6 | 278 | % 23,1 |
|   | High school graduate            | 39  | % 22,2 | 345 | % 28,7 |
|   | University graduate             | 10  | % 5,7  | 82  | % 6,8  |
|   | Other                           | 0   | % 0,0  | 3   | % 0,2  |
| Activities are not organized in my school | Not educated                    | 0   | % 0,0  | 15  | % 1,4  |
|   | Primary school graduate         | 98  | % 35,9 | 486 | % 43,9 |
|   | Secondary school graduate       | 53  | % 19,4 | 249 | % 22,5 |
|   | High school graduate            | 97  | % 35,5 | 287 | % 25,9 |
|   | University graduate             | 25  | % 9,2  | 67  | % 6,1  |
|   | Other                           | 0   | % 0,0  | 3   | % 0,3  |
| My achievement is decreasing              | Not educated                    | 6   | % 1,6  | 9   | % 0,9  |
|   | Primary school graduate         | 174 | % 45,4 | 410 | % 41,1 |
|   | Secondary school graduate       | 81  | % 21,1 | 221 | % 22,2 |
|   | High school graduate            | 91  | % 23,8 | 293 | % 29,4 |
|   | University graduate             | 28  | % 7,3  | 64  | % 6,4  |
|   | Other                           | 3   | % 0,8  | 0   | % 0,0  |
| We are not instructed by our teachers     | Not educated                    | 2   | % 0,9  | 13  | % 1,1  |
|   | Primary school graduate         | 84  | % 39,3 | 500 | % 42,9 |
|   | Secondary school graduate       | 49  | % 22,9 | 253 | % 21,7 |
|   | High school graduate            | 66  | % 30,8 | 318 | % 27,3 |
|   | University graduate             | 12  | % 5,6  | 80  | % 6,9  |
|   | Other                           | 1   | % 0,5  | 2   | % 0,2  |
| We are not instructed by the school       | Not educated                    | 0   | % 0,0  | 15  | % 1,4  |
|   | Primary school graduate         | 105 | % 35,2 | 479 | % 44,3 |
|   | Secondary school graduate       | 67  | % 22,5 | 235 | % 21,7 |
|   | High school graduate            | 100 | % 33,6 | 284 | % 26,2 |
|   | University graduate             | 25  | % 8,4  | 67  | % 6,2  |
|   | Other                           | 1   | % 0,3  | 2   | % 0,2  |

#### 4. Conclusion, Discussion and Suggestions

In this research, it has been aimed to reveal the reasons of the Vocational High School students' not being able to spend their out-of-school time. “I don't have enough time and my achievement is decreasing” are the basic reasons of the Vocational High School students' not being able to spend their out-of-school time with any activities. This outcome proves that students take the best part of their free time to study because of testing system in Turkey and academic success.

In terms of research outcomes, these are the suggestions: 1- Activities should be included in curriculum (instructional program) in order for the students to spend their out-of-school time efficiently. 2- Parents administrators and teachers should be raised awareness of this subject. 3- Testing system should be restructured.

The suggestions that are for the future research depending on the research outcomes might be these: 1- This research can be applied to other high schools and youths out of school. 2- Researches should be done in order to provide awareness for the term “out-of-school time” being perceived.

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## FEATURE EXTRACTION OF ECG SIGNALS USING WAVEFORM SHAPE

Ziynet Yılmaz

Department of Electrical and Electronics Engineering  
Sakarya University Turkey  
ziynet@sakarya.edu.tr

Mehmet Recep Bozkurt

Department of Electrical and Electronics Engineering  
Sakarya University Turkey  
mbozkurt@sakarya.edu.tr

**Abstract:** This paper presents feature extraction of the electrocardiogram (ECG) for the detection of normal (N), atrial premature contraction (APC), ventricular bigeminy (B), ventricular trigeminy (T), left bundle brunch block (LBBB), right bundle brunch block (RBBB) and supraventricular tachyarrhythmia (SVTA) types. Data was attained from the MIT-BIH arrhythmia database. In feature extraction was used Pan-Tompkins algorithm and was written code. Features based on the ECG waveform shape such as RR intervals, QRS amplitude, QRS area, QRS width was obtained from of the electrocardiogram.

**Key words:** Feature extraction, Pan-Tompkins algorithm, and arrhythmia.

### Introduction

Electrocardiogram (ECG) is one of the most widely used methods for diagnosis of heart disease. Emerging signs and ECG rhythm is called arrhythmia, and heart malformations provide important information about the disease. The recording produced by this noninvasive procedure is termed as ECG. (<http://en.wikipedia.org/wiki/Electrocardiography>).

ECG is electrical manifestation of the contractile activity of the heart. It was recorded with surface electrodes on the limbs or chest. ECG: most commonly known & used biomedical signal. The rhythm of the heart in terms of beats per minute (bpm) may be estimated by counting the readily identifiable waves. ECG wave shape is altered by cardiovascular diseases and abnormalities: myocardial ischemia and infarction, ventricular hypertrophy, and conduction problems (Rangayyan, R. M,2002)

An ECG records the electrical activity of the heart ([http://www.heartsite.com/html/electrical\\_activity.html](http://www.heartsite.com/html/electrical_activity.html)). ECG records consist of external noise due to the patient's movements (muscle contraction, breathing...) change the relative positions of the electrodes, for that the baseline has a wavy path. Therefore variation in the baseline, the detection of QRS complexes will be more difficult.

An arrhythmia is an irregular heartbeat - the heart may beat too fast (tachycardia), too slowly (bradycardia), too early (premature contraction) or too irregularly (fibrillation). Arrhythmias are heart-rhythm problems - they occur when the electrical impulses to the heart that coordinate heartbeats are not working properly, making the heart beat too fast/slow or inconsistently. Many heart arrhythmias are harmless. We all occasionally experience irregular heartbeats, which may feel like a racing heart or fluttering. Some arrhythmias, however, especially if they veer too far from a normal heartbeat or result from a weak or damaged heart, may cause troublesome and even potentially fatal symptoms (<http://www.medicalnewstoday.com/articles/8887.php>)

Therefore variation in the baseline, the detection of QRS complexes will be more difficult. Arrhythmia types which N, APC, B, T, LBBB, RBBB and SVTA types are difficult to detection. Therefore The Pan - Tompkins algorithm is the most widely used and the often cited algorithm for the extraction of QRS complexes from the ECG signal (C. Pavlatos,2004).

Recognition of Electrocardiogram (ECG) heartbeat arrhythmias is an important area in biomedical signal processing. In the past few years, many algorithms have been proposed for the automated classification of the ECG signals (S. Palreddy,1997, J. Rodriguez,2005).

## Method

### Data Source

In the 1970s Beth Israel Hospital (BIH) and Massachusetts Institute of Technology (MIT) collaborated in research into arrhythmia. From hospital record twenty three recording were picked at random from a set of 4000. Twenty five record with abnormal ECG was also collect for the same data. This is done on purpose for research, as out of forty eight records you would not usually get twenty five abnormal records. Each record was independently noted with an explanation, to include background information on the subjects, including their medications. Each record is thirty minutes long and was digitized at 360 samples per second: this gives 648,000samples in a 30 minute record (www.physionet.org)

In this study, records include 11 men aged 41 to 73 years and 14 women aged 23 to 83 years totally 25 patients data. The records numbers of arrhythmias are given in Table1.

| Arrhythmias | Records   |
|-------------|---|
| APC         | 232   |
| B           | 106,119,223,233                                 |
| LBBB        | 109,111   |
| Normal      | 100,101,103,106,112,114,115,116,121,122,231,222 |
| RBBB        | 118,124,212,231                                 |
| SVTA        | 223   |
| T           | 106,119,223,201,208,233                         |

**Table1.** Records of arrhythmias.

MIH\_BIH database records were sampled at 360 hz.

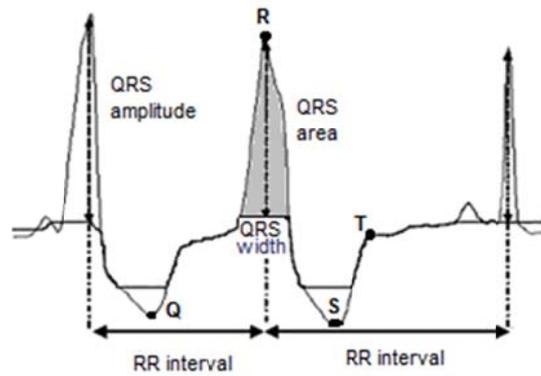
### Pan Tompkins Algorithms

Pan - Tompkins algorithm was developed in 1985 by Jiapu Pan and Willis J.Tompkins. Algorithm was developed a real-time algorithm for detection of the QRS complexes of ECG signals. It reliably recognizes QRS complexes based upon digital analyses of slope, amplitude, and width. In Pan-Tompkins algorithms sample rate of 200 samples/s, the window is 30 samples wide (150ms). The width of the window is determined empirically ( Jiapu P., W. J. Tompkins,1985).

The threshold value is determined between 0.1 and 0.2. In this study, data required to sample at 200 hz or window width select to 54 (150ms) owing to MIH\_BIH database records 360 hz sample.

In this study, instead of sample 200hz sample frequency 360 hz was taken and change windows width. 30 or 54 of windows width empirical and don't appears to very important. But it is a very important change in the threshold was observed. Arrhythmia types morphologic attributes different. Depend upon arrhythmia type threshold change to determination R point was very important.

In ECG signal identified qualifications are given in Figure1.

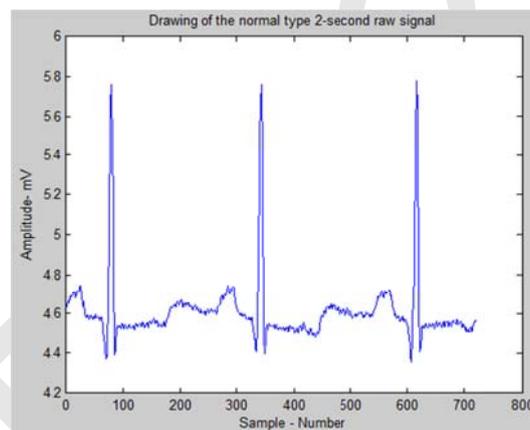


**Figure1.** ECG signal qualification

It represents QRS amplitude; the distance between R point with baseline, QRS area; area of QRS complex, RR interval; distance point R between two consecutive and QRS width; width of QRS complex.

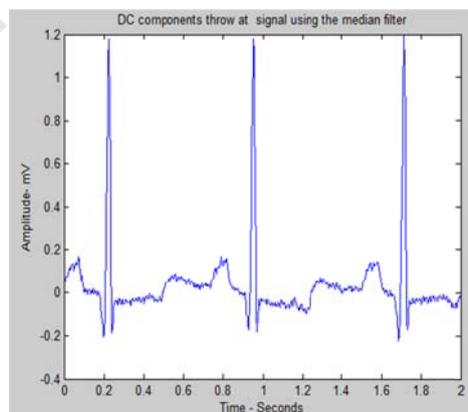
Through the Pan-Tompkins algorithm important points such as R were estimated. Then to determination qualifications as QRS amplitude, QRS width, QRS area and RR interval was written require code. To analyses records a MATLAB program was used.

In terms of being visually comfortable consist of 720 sample normal raw signal are given in Figure2.



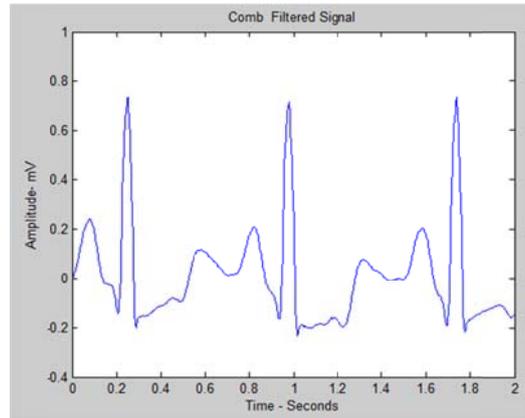
**Figure2.** Raw Signal

In this study, in the first step mean filter is used the data was taken to zero. Then to appear as amplitude (mV), time (seconds) was written require code.



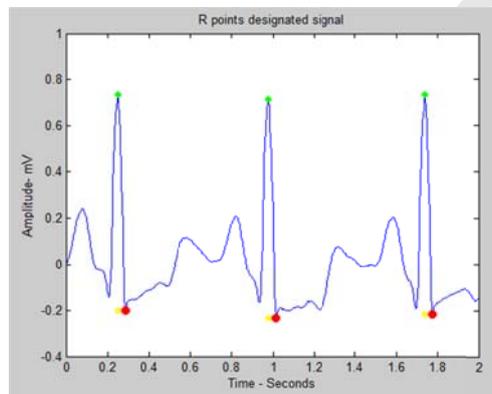
**Figure3.** Mean filtered raw signal

Pan-Tompkins algorithms occurs band pass filter, derivative, squaring function, moving-window integrations and adjusting the thresholds. Low pass filter, high pass filter and comb filtered signal is given in Figure4.



**Figure4.** Filtered signal

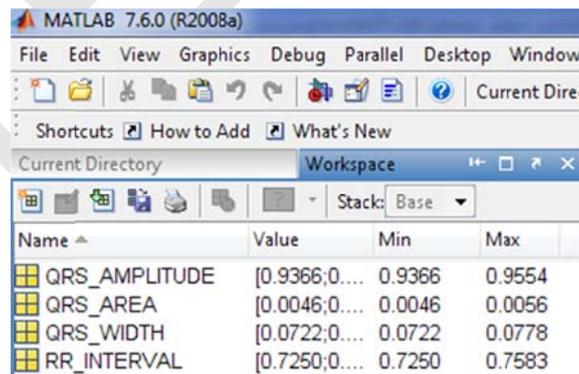
R point's green, S points were marked red and given in Figure5.



**Figure5.** Low Pass filtered signal

Important points were determined as R point later qualifications were calculated.

The application is written in Matlab. In Normal signal identified qualifications are given in Figure6.



**Figure6.** Qualifications to 720 sample normal signal [8].

## Results

Important qualifications of the time domain were determined by using the Pan-Tompkins algorithm. Depend on the amount was used records of arrhythmias appears normal beat numbers differences. The number of beats to arrhythmia show as Table 2.

| Arrhythmias | Beats |
|-------------|-------|
| APC         | 788   |
| B           | 524   |
| LBBB        | 3351  |
| Normal      | 12157 |
| RBBB        | 5964  |
| SVTA        | 189   |
| T           | 640   |

**Table2.** Qualification numbers

| Name ^               | Value            | Min    | Max    |
|----------------------|------------------|--------|--------|
| APC_QRS_AMPLITUDE    | <788x1 double>   | 0.7003 | 1.6242 |
| APC_QRS_AREA         | <788x1 double>   | 0.0047 | 0.0204 |
| APC_QRS_WIDTH        | <788x1 double>   | 0.0889 | 0.1111 |
| APC_RR_INTERVAL      | <788x1 double>   | 0.4528 | 0.8333 |
| B_QRS_AMPLITUDE      | <524x1 double>   | 0.3192 | 6.6256 |
| B_QRS_AREA           | <524x1 double>   | 0      | 0.1242 |
| B_QRS_WIDTH          | <524x1 double>   | 0.0278 | 0.2111 |
| B_RR_INTERVAL        | <524x1 double>   | 0.3639 | 1.7194 |
| LBBB_QRS_AMPLITUDE   | <3351x1 double>  | 0.6518 | 7.2186 |
| LBBB_QRS_AREA        | <3351x1 double>  | 0      | 0.0331 |
| LBBB_QRS_WIDTH       | <3351x1 double>  | 0.0444 | 0.1611 |
| LBBB_RR_INTERVAL     | <3351x1 double>  | 0.5833 | 1.7472 |
| NORMAL_QRS_AMPLITUDE | <12157x1 double> | 0.4763 | 5.0693 |
| NORMAL_QRS_AREA      | <12157x1 double> | 0      | 0.0574 |
| NORMAL_QRS_WIDTH     | <12157x1 double> | 0.0278 | 0.1667 |
| NORMAL_RR_INTERVAL   | <12157x1 double> | 0.2917 | 1.5111 |
| RBBB_QRS_AMPLITUDE   | <5964x1 double>  | 1.0207 | 4.6589 |
| RBBB_QRS_AREA        | <5964x1 double>  | 0      | 0.1091 |
| RBBB_QRS_WIDTH       | <5964x1 double>  | 0.0500 | 0.1500 |
| RBBB_RR_INTERVAL     | <5964x1 double>  | 0.5389 | 2.0583 |
| SVTA_QRS_AMPLITUDE   | <189x1 double>   | 0.8982 | 1.7670 |
| SVTA_QRS_AREA        | <189x1 double>   | 0      | 0.0140 |
| SVTA_QRS_WIDTH       | <189x1 double>   | 0.0722 | 0.1500 |
| SVTA_RR_INTERVAL     | <189x1 double>   | 0.3222 | 0.5833 |
| T_QRS_AMPLITUDE      | <640x1 double>   | 0.7208 | 6.6027 |
| T_QRS_AREA           | <640x1 double>   | 0      | 0.1049 |
| T_QRS_WIDTH          | <640x1 double>   | 0.0778 | 0.2556 |
| T_RR_INTERVAL        | <640x1 double>   | 0.2667 | 1.5806 |

**Figure7.** Qualifications to all arrhythmias type signal [8].

In future studies, obtained from to time domain data such as QRS amplitude, QRS width, QRS area and RR interval may be taken classification with classifiers as Artificial Neural Networks, Artificial Immune System.

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# FİBER TAKVİYELİ PLASTİK (FRP) ÇUBUKLARLA GÜÇLENDİRİLMİŞ AHŞAP BOY BİRLEŞİMLERİNİN ÇEKME MUKAVEMETİNİN İNCELENMESİ

Tahir Akgül<sup>1\*</sup>, Ahmet APAY<sup>2</sup>, Mehmet SARIBIYIK<sup>2</sup>

<sup>1</sup>Teknik Eğitim Fakültesi, Sakarya Üniversitesi, Türkiye, takgul@sakarya.edu.tr

<sup>2</sup>Teknoloji Fakültesi, Sakarya Üniversitesi, Türkiye, aapay@sakarya.edu.tr, mehmet@sakarya.edu.tr

**Özet;** Ahşap yapılar tarihsel süreç içerisinde doğal etkenlerle yıpranmaktadır. Bu çalışmada; ahşap yapı konstrüksiyon sisteminde, çekmeye çalışan yapı elemanlarının birleştirme bölgelerinde lif sürekliliğinin sağlanması hedeflenmektedir. Bu amaçla, cam ve karbon fiberlerle güçlendirilmiş kertmeli boy birleştirmelerin, birleşim bölgelerinin mekanik performansları incelenmiştir. Deneysel numuneleri doğada bol miktarda bulunan ve ahşap yapı uygulamalarında yaygın olarak kullanılan sarıçamdan hazırlanmıştır. Yapılan deney numunelerinin performans değerlendirilmelerinin yapılabilmesi için şahit numunelerle birlikte, yapıştırılmalı birleştirme, Cam elyaf takviyeli plastiklerle (GFRP) birleştirme ve Karbon elyaf takviyeli plastiklerle (CFRP) birleştirme şeklinde, 6 farklı tipte deneysel numuneleri hazırlanmış ve çekme testine tabi tutularak, elde edilen sonuçlar karşılaştırılmıştır. Çalışma sonucunda, kertmeli boy birleştirmede cam ve karbon elyaflar la güçlendirilmiş numunelerde, yapıştırılmış birleştirme numunelerinden yaklaşık olarak % 300 daha yüksek çekme dayanımına ulaşılmıştır.

**Anahtar Kelimeler:** Ahşap Yapı, Çekme Dayanımı, Kertmeli Boy Birleştirme, Cam Elyaf Takviyeli Plastik (GFRP), Karbon Elyaf Takviyeli Plastik (CFRP), Güçlendirme

## 1. Giriş

Türkiye’de eski yapıların büyük kısmını oluşturan ahşap yapıların tarihsel süreç içerisinde doğal etkenlerden kaynaklanan yıpranmalar kaçınılmazdır. Gerek mevcut tarihi dokunun korunması gerekse yeni inşa edilecek ahşap yapılarda durabilenin sağlanması amacıyla ahşabın zayıf bölgelerinde, özellikle birleşim bölgelerinde güçlendirme yapılmasına ihtiyaç duyulmaktadır.

Günümüzde ahşap yapı tasarımında, masif ahşap malzemenin büyük boyutlu elemanlarda tek parça olarak kullanılması, gerek ekonomik ve gerekse teknik açıdan elverişli değildir. Bu nedenle ahşapta boy birleştirmeler yapılması kaçınılmazdır. Ancak birleştirmeler liflerin sürekliliğini ortadan kaldırdığı için ahşap yapının güvenliğini olumsuz etkilemektedir. Bu olumsuz etkiyi ortadan kaldırmak amacıyla birleşim bölgelerinde güçlendirme ile ilgili çalışmalar yapılmaktadır [1].

Ahşap yapı tasarımında eleman boyutları uygun birleştirme detaylarına bağlı olarak değişmektedir. Bu nedenle tasarlanan ahşap yapıların taşıyıcı elemanlarının istenen boyutlarda olması ve daha özgün yapı tasarımının mümkün kılınması ancak birleştirme bölgelerinin eğilme ve çekme yüklerine karşı yüksek dayanım sergilemesi ile mümkün olabilmektedir. Bu nedenden dolayı tüm ahşap tasarım evrelerinde farklı birleşim detayları geliştirilmiş ve zamana bağlı olarak değişim göstermiştir. Son yıllarda söz konusu birleşim bölgelerinin güçlendirilmesi amacı ile de farklı materyaller kullanılmıştır. Günümüzde çelik ve betonarme binaların güçlendirmesinde olduğu gibi ahşap yapıların güçlendirilmesinde de fiber takviyeli plastik (FRP) kullanımı yaygınlaşmaktadır [2]. Güçlendirme amacıyla kullanılan elyaf takviyeli plastiklerle yüksek dayanıma sahip, korozyona uğramayan, hafif, uygulanması kolay, görünümü bozmayan bir güçlendirme yapılması mümkündür [3].

Ahşap yapıların ve birleşim bölgelerinin güçlendirilmesindeki temel amaçlar özgün tasarımlar ortaya koymanın yanı sıra zamanla dış etkenler ve depremler sonucu oluşan hasarları giderilmek, restorasyon yoluyla yapı elemanlarının yük taşıma kapasitesini arttırmak, yetersiz detaylandırmaya bağlı ortaya çıkan erken yorulma ve kırılmaları önlemek, yaşlanmayla oluşan deformelere bağlı yük taşıma kapasitesinde meydana gelen kayıpları bertaraf etmek gibi etkenler olarak sayılabilir [4]. Ülkemizin uzun yıllar önce yapılmış ahşap yapılarda tarihsel süreç içerisinde doğal etkenlerden kaynaklanan yıpranmalar ve özellikle birleşim bölgelerinde oluşan çürümeler restorasyon çalışmalarında güçlendirme ihtiyacını ortaya koymaktadır. Yapılacak bu restorasyon çalışmaları öncesinde deneysel çalışmalarla geliştirilecek olan uygun bir güçlendirme modelinin çıkarılması, ahşap yapıların daha titiz bir şekilde restore edilmesini, tarihi dokunun korunmasını ve kültürel değerlerimizin ileri nesillere taşınmasını sağlayacaktır.

Ayrıca restorasyon ve güçlendirme çalışmalarında, zamanla ahşap taşıyıcı sistemlerin bazı bölgelerinde oluşan kurtlanma, mantarlanma, çürüme vb. sebeplerden dolayı değişmesi gereken yapı elemanının tamamının sistemden ayrılması tarihi dokunun kaybolması, yapının stabilitesinin bozulması, maliyet ve işçiliklerin artmasına neden olmaktadır. Bu durumda yapı elemanının tamamını değiştirmek yerine mümkünse elemanlarda lokal değişikliğe gidilmesi daha uygun görülmektedir [5,6]. Ancak yapılacak bu lokal değişiklikler sonucu oluşacak yeni birleşim bölgelerinin statik açıdan yüksek performans sergilemesi istenir. Geleneksel güçlendirme tekniklerinde ahşap yapılarda

birleştirme yerlerinin metal levhalarla güçlendirilmesi uygulanan bir çözümdür. Ancak metal levhalarla yapılan güçlendirmelerde zamanla bakıma ihtiyaç duyulması, güçlendirilen bölgelerde görüntü kirliliği oluşturması ve yapıya ekstra yük getirmesi gibi göz ardı edilemeyecek dezavantajlar sıralanabilir [7,8]. Teknolojik gelişmelerle bu dezavantajların tamamının veya bir kısmının giderilmesini sağlayacak ürünler arasında fiber takviyeli plastikler yer almaktadır. Literatürde FRP'lerle ahşap güçlendirme konusunda birçok çalışma yapılmış ayrıca yapılan bu çalışmalar sonucunda tavsiye edilen bu teknikler uygulamada da yerini bulmuştur (Şekil 1).



Şekil 1. FRP ile ahşap güçlendirme uygulaması örneği [6]

Daha önce yaptığımız çalışmalarda eğilmeye çalışan ve kertmeli boy birleştirmelerle birleştirilmiş elemanların güçlendirmesinde cam ve karbon elyaf takviyeli plastikler kullanılmış ve birleştirme bölgelerinin güçlendirilmesinde başarılı sonuçlar elde edilmiştir [9,10]. Bu çalışmada da, ahşap yapılarda çekmeye çalışan elemanlar Cam ve karbon takviyeli plastik çubuklarla güçlendirilmiştir.

Çekmeye çalışan elemanların güçlendirilmesi, boyut sorunu olan yani istenilen ebatlarda temin edilmesi zor olan ahşap yapı elemanlarının daha küçük boyutlarla daha özgün tasarımlara kavuşmasını sağlayacaktır. Ancak gerekli uzunluk ve ebatlardaki elemanların üretiminde yapılacak güçlendirmelerin uygulama sahasında, hem yapımı kolay, hem çap değişikliği oluşturmadan istenen dayanımı sağlayabilecek hem de ahşap estetiğini ve sıcaklığını koruyacak bir güçlendirme detayı tasarımı gerekmektedir. Bu nedenle güçlendirme, uygulama alanlarında sıkça kullanılan kertmeli boy birleştirmeler üzerinde ahşap görünümü bozmayacak şekilde yapı elemanı üzerine açılan kanallara cam ve karbon elyaf takviyeli plastikler yerleştirilerek uygulanmıştır.

Yapılan çalışmada öncelikli olarak masif ahşap çekme mukavemeti değerleri tespit edilmiş daha sonra diğer deney tipi sonuçları masif ahşap numunelerle karşılaştırılmıştır. Deneysel çalışmalarda asıl olarak uç uca eklenerek yapılan kertmeli boy birleştirmede oluşan lif süreksizliği ortadan kaldırılarak birleştirilme yapılmamış masif ahşapta elde edilen çekme dayanımı değerlerine ulaşılması hedeflenmiştir.

## 2. Materyal ve Metot

### 2.1. Ahşap

Deney örneklerinin hazırlanmasında kullanılan masif ağaç malzeme, Sakarya bölgesindeki kereste işletmelerinden rastgele seçim yöntemi ile temin edilmiştir. Deneysel çalışmalarda kullanılacak ahşap malzeme seçiminde, 1. sınıf sarı çam kerestenin, normal büyüme göstermiş, kurutulmuş, kusursuz, lifleri düzgün, budaksız, ardaksız, mantar ve böcek zararlarına uğramamış olmasına özen gösterilmiştir [11].

### 2.2. Epoksi

Gerek ahşap yüzeylerin birleştirilmesinde gerekse CFRP çubukların ahşap yüzeylere yapıştırılmasında İnce uygulamalar için özel olarak geliştirilmiş, çift bileşenli yapıştırma ve montaj malzemesi olarak üretilen Teknobond 300 tipi epoksi kullanılmıştır.

Teknobond 300 epoksi reçinesi; ince tip uygulamalarda, katı malzemelerin parlak yüzeylere yapıştırılmasında kullanılan, kimyasallara karşı dayanıklı, betona, ahşaba, çeliğe ve plastik malzemelere mükemmel yapışma sağlayan, istenen mekanik mukavemete çok hızlı ulaşan bir epoksidir. Çift bileşenli olarak üretilen Teknobond 300 epoksi uygulanırken, orantılı olarak hazırlanmış A ve B bileşeni, yavaş devirli karıştırıcıyla birbirine karıştırılır. Karıştırmaya homojen gri bir renk alana kadar devam edilir. Kullanabilecek kadar malzeme uygulama ömrü göz önünde bulundurularak ve oranlarına göre hazırlanır. Hazırlanan karışım spatula ile yapıştırılacak yüzeye çok ince şekilde sürülür. Yüzey uygulamalarında malzemenin bir müddet kendini çekmesi beklendikten sonra hava boşluğu kalmayacak şekilde ve mümkünse preslenerek yapıştırılır [12].

### 2.3. Cam Elyaf Takviyeli Plastik (GFRP)

GFRP malzemenin üstün mekanik dayanımının yanı sıra, hafifliği, korozyon dayanımı, düşük yoğunluk ve dayanım/yoğunluk oranının yüksekliği, düşük ısı iletkenliğine sahip olması, uzun yıllar bakım ve boya gibi ek bir hizmete ihtiyaç duymaması, üretimin düşük iş gücü ile yapılabilir olması, kolay kesilebilir ve işlenebilir olması, karmaşık geometriye sahip şekillerin kolaylıkla üretilebilir olması, farklı mekanik özellikler elde etmek için, farklı elyaf katmanları ve kombinasyonları ile üretilebilir olması gibi özelliklerinden dolayı GFRP profilleri inşaat sektöründe özellikle güçlendirme çalışmalarında birçok malzemenin alternatifi olma yönünde hızla ilerlemektedir [13].

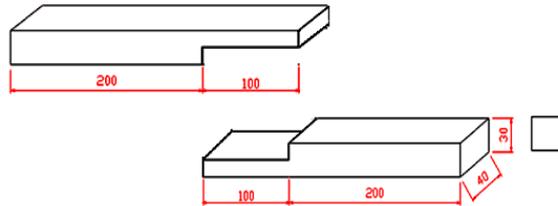
Piyasada farklı şekil ve ebatlarda üretilen GFRP profiller içerisinde yapılacak güçlendirme çalışmasına uygun ebat ve form araştırılmış sonuç olarak 0,4 cm çapında daire kesitli GFRP numuneleri, ülkemizde kompozit malzeme üretimi yapan Esa Kimya Metal Sanayi ve Ticaret Ltd. Şti. firmasından temin edilmiştir.

#### 2.4. Karbon Elyaf Takviyeli Plastik (CFRP)

Güçlendirme çalışmalarında kullanılan fiber takviyeli plastiklerin seçiminde genellikle üstün dayanım özelliklerinden dolayı karbon elyaf takviyeli plastikler tercih edilmektedir [14]. Bu nedenle çalışmamızda piyasada farklı şekil ve ebatlarda üretilen CFRP profiller içerisinde yapılacak güçlendirme çalışmasına uygun ebat ve formda ve cam elyaf takviyeli plastiklerle aynı boyutta olacak şekilde, ülkemizde kompozit malzeme üretimi yapan Esa Kimya Metal Sanayi ve Ticaret Ltd. Şti. firmasından temin edilmiştir.

#### 2.5. Deney Numunelerinin Hazırlanması

Ahşap birleştirme bölgelerinin güçlendirilmesinde kullanılan 4 mm çapındaki GFRP ve CFRP çubuklar 30 cm uzunluğunda kesilmiştir. Eleman boylarının eşit olması ve malzemelerin kesimi esnasında zarar görmemesine dikkat edilmiştir. Şahit numuneler, 30x40 mm boyutlarında ve 500 mm uzunluğunda 1. Sınıf kurutulmuş, çatlaqsız ve budaksız sarıçamdan lif yönlerine paralel olacak şekilde hazırlanmıştır. Bu numunelerle, birleştirme yapılmış numunelerin çekme mukavemeti kıyaslamasında şahit numuneyi oluşturacak masif ahşap deneyi yapılmıştır. Masif ahşap numuneler tek parçadan oluşan ve herhangi bir birleştirme söz konusu olmayan numunelerdir. İkinci aşamada masif ahşapla aynı boyutlarda, ancak ortadan kertmeli boy birleştirme yöntemi ile birleştirilmiş iki parça ahşaptan oluşan numuneler hazırlanmıştır (Şekil 2). Hazırlanan numunelerin birleştirme yüzeyleri çift birleşimli Teknobond 300 epoksi ile birleştirilerek 72 saat pres altında tutulmuştur.



Şekil 2. Kertmeli boy birleştirmeli ahşap numune

Üçüncü aşamada kertmeli boy birleştirme yapılmış numunelerin her iki yüzeyine tek ve çift kanallar açarak bu kanallara epoksi ile cam ve karbon elyaf takviyeli çubuklar yapıştırılmış 2 farklı malzemeden 2 farklı tipte numuneler hazırlanmıştır (Şekil 3). Numune isimlendirmeleri ve sembolleri aşağıdaki tabloda verilmiştir (Tablo 1).



Şekil 3. FRP çubuklarla oluşturulmuş deney numuneleri

Tablo 1. Numune isimleri ve sembolleri

| Numune Adı | Sembol |
|------------|--------|
|------------|--------|

|   |     |
|---|-----|
| Masif Ahşap Numuneler                           | ST1 |
| Kertmeli Boy Birleştirmeli Numuneler            | ST2 |
| Tek Çubuk Cam Elyaf Yapıştırılmış Numuneler     | ST3 |
| Çift Çubuk Cam Elyaf Yapıştırılmış Numuneler    | ST4 |
| Tek Çubuk Karbon Elyaf Yapıştırılmış Numuneler  | ST5 |
| Çift Çubuk Karbon Elyaf Yapıştırılmış Numuneler | ST6 |

Hazırlanan tüm numuneler ilgili Türk standartlarına [15,16,17,18] uygun olarak hazırlanmış olup her bir deney numune tipinden 5'er adet numune hazırlanarak deneye tabi tutulmuştur.

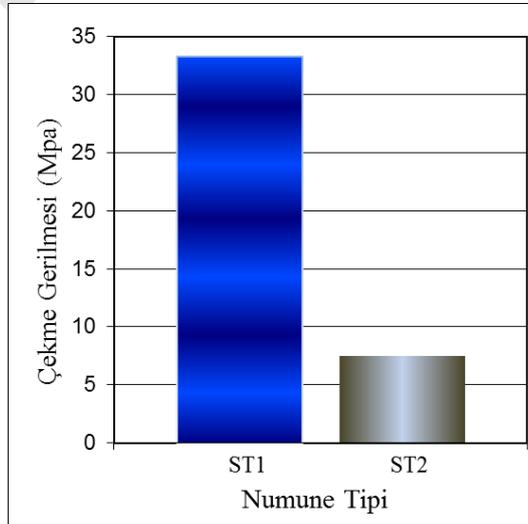
### 3. Bulgular

Deneyel çalışmalarda 40 tonluk çekme deneyi cihazı kullanılmıştır. Çekme deneyi düzeneği şekil 4'te verilmiştir. Yapılan deneylerde çekme hızı 1 mm/dk olarak alınmıştır. Yapılan çalışmada ilk olarak masif ahşap numune çekme mukavemeti değerleri tespit edilmiş daha sonra farklı deney tipi sonuçları masif ahşap numunelerle kıyaslanmış ve her numune çeşidi için ortalama gerime değerleri tespit edilmiştir. Uç uca yapılan kertmeli boy birleştirmesinde oluşan lif süreksizliği ortadan kaldırılarak masif ahşapta elde edilen çekme gerilmesi dayanıma ulaşılma hedeflenmiştir.



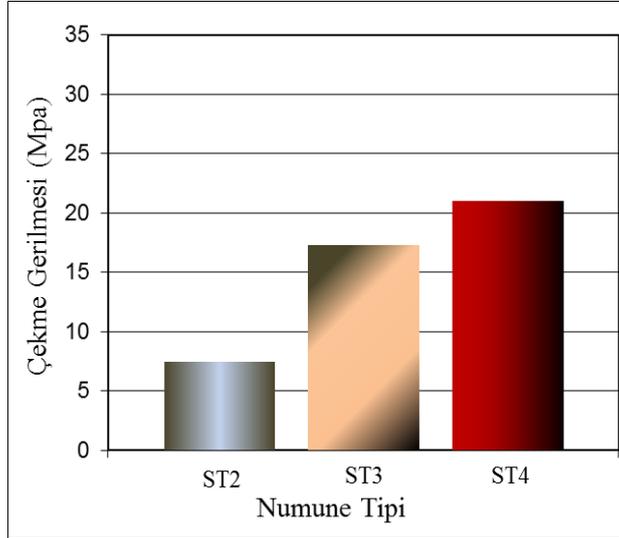
Şekil 4. Çekme Deneyi Düzeneği

Gerek birleştirilmiş numune deney sonuçları gerekse güçlendirilmiş ahşap numunelerin çekme gerilmelerini kıyaslamak amacıyla, (şahit numune) birleştirme yapılmamış masif ahşap (ST1) numunelerle yapılan 5 adet çekme deneylerinde ortalama çekme gerilmesi  $33,2 \text{ N/mm}^2$  olarak tespit edilmiştir. Ahşap yapı elemanlarının birleştirilmesinde sıklıkla kullanılan, geleneksel birleştirme yöntemlerinden biri olan ve yapımı diğer birleştirme tekniklerine göre daha kolay uygulanan kertmeli boy birleştirme ile güçlendirme yapılmaksızın epoksi ile yapıştırılarak birleştirilmiş numunelere (ST2) çekme testi uygulanmıştır. Bu deneyler sonucunda elde edilen gerilme değeri, masif ahşap gerilmesi ile kıyaslandığında 4,5 kat daha küçük olan  $7,5 \text{ N/mm}^2$  olarak elde edilmiştir (Şekil 5). İster yapıda kullanılacak yeni ahşap elemanlarının boyut yetersizliği ister restorasyon çalışmalarında yapılacak parça değişiminde boy birleştirmelerin yapılması kaçınılmazdır ve iki numune arasındaki dayanım farkı göz önüne alındığında da söz konusu olan boy birleştirmede birleştirme bölgelerinin güçlendirilmesi gerekliliği ortaya çıkmaktadır.



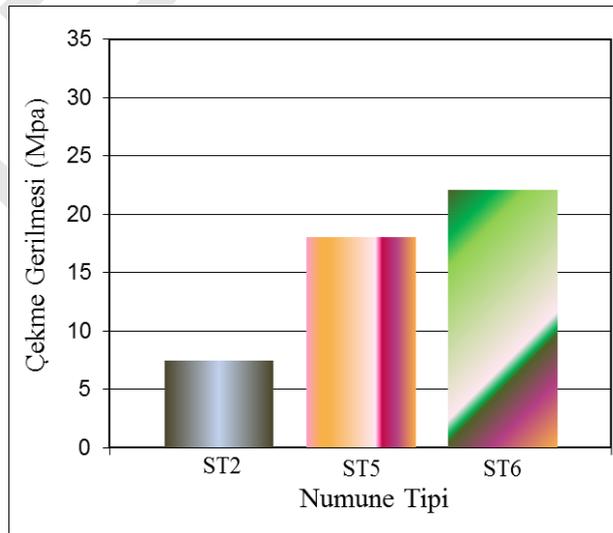
Şekil 5. Masif ahşap numuneleri ile yapıştırılarak birleştirilmiş ahşap numunelerin çekme gerilmeleri

Günümüzde ahşap yapı elemanlarının güçlendirilmesinde sıklıkla kullanılan ve teknolojik yöntemlerinden biri olan fiber takviyeli plastiklerle ahşap güçlendirme tekniklerinin birleşim bölgelerindeki performansının kıyaslanması amacıyla piyasada en yaygın kullanılan cam ve karbon takviyeli plastikler kullanılmıştır. Öncelikle cam elyaf takviyeli plastiklerle birleşim yüzeyini ortalayacak şekilde her yüzeye tek ve çift GFRP çubuk kullanılarak hazırlanan numuneler üzerinde yapılan çekme deneyi sonucunda; tek çubuklu numunelerin (ST3) çekme mukavemeti  $17,3 \text{ N/mm}^2$ , çift çubuklu numunelerin (ST4) çekme mukavemeti  $21 \text{ N/mm}^2$  olduğu tespit edilmiştir. Bu değerler yapıştırılarak birleştirilmiş numunelere göre kıyaslandığında çekme direnci dayanımının tek çubuklu GFRP güçlendirmesinde 2,3 kat, çift çubuklu GFRP güçlendirmesinde ise 2,8 kat çekme gerilmesi artışı elde edilmiştir (Şekil 6).



Şekil 6. Birleştirilmiş ahşap ile tek ve çift GFRP ile güçlendirilmiş numunelerin çekme gerilmeleri

Son olarak karbon elyaf takviyeli plastiklerle güçlendirilmiş numunelerde, birleşim yüzeyini ortalayacak şekilde her yüzeye tek ve çift CFRP çubuk yapıştırılmıştır. Numuneler üzerinde yapılan çekme deneyi sonucunda; tek çubuklu numunelerin (ST5) çekme mukavemeti  $18 \text{ N/mm}^2$ , çift çubuklu numunelerin (ST6) çekme mukavemeti  $22,1 \text{ N/mm}^2$  olduğu tespit edilmiştir. Bu değerler de yapıştırılarak birleştirilmiş numunelere göre kıyaslandığında çekme direnci dayanımının tek çubuklu CFRP güçlendirmesinde 2,4 kat, çift çubuklu CFRP güçlendirmesinde ise 3 kat daha yüksek bir çekme gerilmesi elde edilmiştir (Şekil 7).

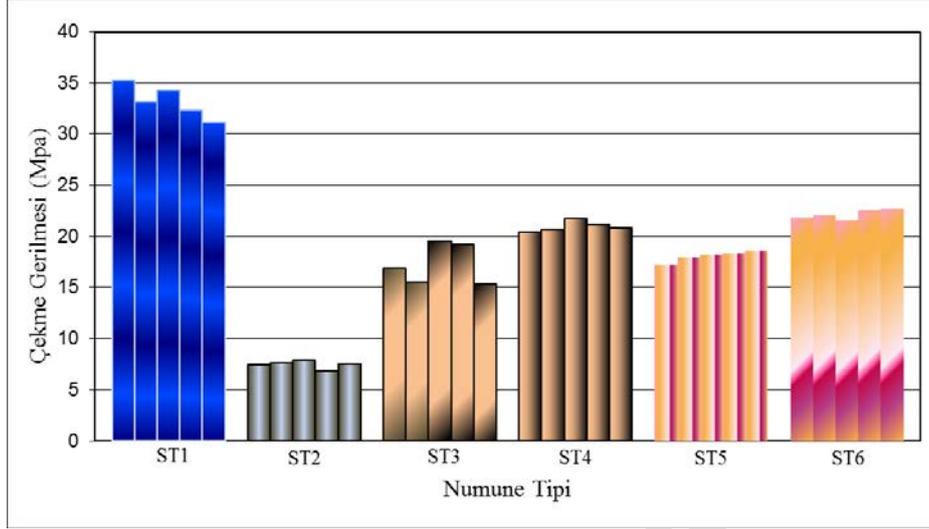


Şekil 7. Birleştirilmiş ahşap ile tek ve çift CFRP ile güçlendirilmiş numunelerin çekme gerilmeleri

Sonuçların daha iyi irdelenebilmesi açısından Yapılan her deney gurubu için, numunelerin ayrı ayrı çekme gerilmesi değerleri alınarak tüm numuneler için ortak bir çekme gerilme grafiği oluşturulmuştur (Şekil 8). Ayrıca tüm numunelere ait ortalama gerilme değerleri tablo 2’de verilmiştir.

**Tablo 2.** Deneye tabi tutulan tüm numunelerin ortalama çekme gerilmesi değerleri

| Numune Adı   | Sembol | Çekme Dayanımı (N/mm <sup>2</sup> ) |
|--|--------|-------------------------------------|
| Masif Ahşap Numuneler                                | ST1    | 33,2                                |
| Kertmeli Boy Birleştirme ile Yapıştırılmış Numuneler | ST2    | 7,5                                 |
| Tek Çubuk Cam Elyaf Yapıştırılmış Numuneler          | ST3    | 17,3                                |
| Çift Çubuk Cam Elyaf Yapıştırılmış Numuneler         | ST4    | 21                                  |
| Tek Çubuk Karbon Elyaf Yapıştırılmış Numuneler       | ST5    | 18                                  |
| Çift Çubuk Karbon Elyaf Yapıştırılmış Numuneler      | ST6    | 22,1                                |


**Şekil 8.** Deneye tabi tutulan tüm ahşap numunelerinin çekme gerilmeleri

#### 4. Sonuç ve Değerlendirme

Ahşap birleşim bölgelerinin güçlendirilmesi amacıyla yapılan bu çalışmada; Ahşap elemanların birleşim detaylarının GFRP ve CFRP ile güçlendirilmesi amaçlanmıştır. Birinci aşamada şahit numuneler ile birleştirme yapılmış numuneler karşılaştırılmış ve birleşim bölgelerinin çekme dayanımı üzerindeki olumsuz etkinin boyutu ortaya çıkarılmıştır. İkinci aşamada bu olumsuzluğu giderebilmek adına cam ve karbon elyaf çubuklar kullanılarak ahşap birleşim bölgelerinin güçlendirilmesi ve birleştirme yapılmamış masif bütün ahşabın çekme dayanımına ulaşılması üzerinde çalışılmıştır.

Yapılan bu deneysel çalışmalar sonucuna göre;

- Hazırlanan farklı deney numunelerinde masif ahşap numunelere göre çekme gerilmesi bakımından en düşük olanı hiç güçlendirme yapılmamış epoksi ile yapıştırılarak birleştirilmiş numunelerdir. Güçlendirme yapılmamış, epoksi ile birleştirilmiş numuneler ile masif ahşabın çekme gerilmesinin ancak %22'sine ulaşılabilmiştir.
- Masif ahşap dayanımı göz önüne alındığında;
  - GFRP çubuklarla yapılan güçlendirmede, tek çubuk kullanımında, % 52 oranında iyileştirme sağlanmış, çift çubuk kullanımında ise, % 63 oranında iyileştirme sağlanmıştır.
  - CFRP çubuklarla yapılan güçlendirmede, tek çubuk kullanımında, % 54 oranında iyileştirme sağlanmış, çift çubuk kullanımında ise, % 67 oranında iyileştirme sağlanmıştır.
- Güçlendirilme yapılmamış yapıştırılmalı birleştirmelere göre GFRP kullanımında % 180'lik çekme gerilmesi artışı, CFRP kullanımında ise %185'lik çekme gerilmesi artışı elde edilmiştir.
- GFRP ile CFRP çubuklarla yapılan güçlendirmeler birbiriyle kıyaslandığında her ne kadar karbon elyaf çekme mukavemeti cam elyaf çekme mukavemetinden çok daha yüksek olsa da numuneler incelendiğinde her iki grupta da elyaf çubuklar zarar görmemekte ve epoksiden sıyrılmaktadır. Bu nedenle kullanılan malzemenin cam veya karbon elyaf olması çekme dayanımına çok fazla etki etmemiş, ortaya çıkan küçük dayanım artışının epoksinin karbon elyafa daha iyi yapışması sonucu oluşan aderans farkı olduğu anlaşılmıştır.
- GFRP ve CFRP kullanımı ile ilgili değerlendirme yapıldığında, günümüzde karbon elyafın kg fiyatı 30 Euro iken cam elyafın birim fiyatı ise 4,5 Euro'dur. Deneyler sonucunda karbon elyaf kullanımında elde edilen sınırlı orandaki artış birim fiyatla karşılaştırıldığında cam elyaf kullanımının daha uygun olduğu, öte yandan cam elyafın doğal rengi karbon elyafa göre ahşaba daha yakın olması ayrıca cam elyafın üretim aşamasında renklendirilebilme özelliğinden dolayı ahşap güçlendirmelerde cam elyaf kullanımının daha uygun görülmüştür.

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## FIBROUS CONCRETE SUBJECTED TO SULPHATE ATTACK

Abeer Tayseer Andrawes  
Architecture collage  
Jordan University of Science and Technology  
Jordan  
[atandrawes7@just.edu.jo](mailto:atandrawes7@just.edu.jo)

**Abstract:** Concrete is the most widely used structural material in the world. For a variety of reasons, much of this concrete is cracked. The reason for concrete cracking may be attributed to structural, environmental or economic factors, but most of the cracks are formed due to the inherent weakness of the material to resist tensile forces. It is now well established that steel fibre reinforcement offers a solution to the problem of cracking by making concrete tougher and more ductile. An experimental investigation was undertaken to evaluate the potential of fibers in controlling expansion and damage for concrete subjected to sulfate attack. Cylindrical (100X200mm) and prism concrete specimens (70X70X300mm) were prepared at w/c of 0.4 with and without different percentage of hooked steel (0.5-2%), brass coated steel (0.5-2%), and a blend of both at 1% each. Specimens were subjected to cyclic sulfate treatment in 5% Na<sub>2</sub>SO<sub>4</sub>. During the immersion period for about 4 month, expansion measurements were acquired for prisms whereas compressive mechanical properties of the concrete cylinders were obtained and compared to those of controls. The results showed that concrete prepared with fibers had higher compressive strength, modulus of elasticity, and toughness compared to those of plain concrete.

**Key words:** Fiber, concrete, sulphate attack, expansion, damage

### Introduction

Concrete is the material of choice for the construction of structures exposed to extreme conditions whether it be offshore oil platforms in icy water or hazardous containment vessels buried in the earth. As demand for construction in harsh environments increases, so do the desired service lives of these structures. Typically, concrete structures are designed to perform, with minimal maintenance, 50 to 100 years. Concrete containment vessels, which may be hold chemical and radioactive waste, are designed for 500 year service lives and a desire exists to extend the expected service life to 1000 years. Sulfates present in soils, groundwater, sea water, decaying organic matter, and industrial effluent surrounding a concrete structure pose a major threat to the long term durability of the concrete exposed to these environments. Sulfate attack of concrete may lead to cracking, spalling, increased permeability, and strength loss. Thus, resistance of concrete to sulfate attack is integral to ensure satisfactory performance over long periods. (Paulo J.M. Monteiro, Kimberly E. Kurtis, 2003).

Recently, fibers (steel or synthetic) have been used on a wide scale in concrete and mortar. Fields of using fiber reinforced concrete include highways and airfield pavement, hydraulic structures, tunnel lining and more. The addition of the steel fibers significantly improves many of the engineering properties of mortar and concrete, notably impact strength and toughness. Tensile strength, flexural strength, fatigue strength and ability to spalling are also enhanced. Moreover, addition of the fibers makes concrete more homogeneous and isotropic and therefore it is transformed from a brittle to a more ductile material (Paul K, Polivka M, Metha M.K., 1981). Also the use of steel fibers in concrete helped reducing expansion or contraction of concrete due to creep or shrinkage and increased resistance to cracking (Houde J, Prezeau A, Roux R, 1987).

### Materials and Method

Different fiber reinforced concrete mixtures were prepared at w/c ratio of 0.40 using Type I ordinary cement with coarse limestone aggregate, a mixture of fine limestone and silica sand and different volumetric fractions of brass-coated steel (BCS), hooked steel (HS) and a mixture of both (HBCS) fibers. Cylindrical (100x200mm) and prism (70x70x300 mm) specimens were prepared from these mixtures, and cured in water for seven days at 23°C before treated in 5% Na<sub>2</sub>SO<sub>4</sub>. Specimens were divided into seven groups according to the type and content of fibers used, as shown in table 1 and 2. Control specimens from same mixtures were cured in lime water, and those which designated for sulfate attack treatment were subjected to cycles of immersion in 5% Na<sub>2</sub>SO<sub>4</sub> solution followed by drying using a special conditioning unit for about 4 month in three stages (Stage I (45days), Stage II (90days), Stage III (128days)). The unit consists of a treatment and a storage tanks that are connected by a two-way pumping system. The temperature

was set at 40°C during immersion and drying cycles of two days each. The compressive mechanical properties were evaluated for control cylinder specimens as well as for those subjected to different stages of sulfate treatment whereas length changes and cracking initiation and extent were monitored using the prisms specimens. The experimental results obtained for control and sulfate-treated concrete specimens were compared to determine the effectiveness of the fibers in controlling the expansion and preventing cracking; hence maintaining mechanical properties under sulfate attack.

Table 1: Testing Groups

| Group | Fiber Type | Fiber content |
|-------|------------|---------------|
| A     | -          | 0             |
| B     | BCS        | 0.5%          |
| C     | BCS        | 1%            |
| D     | BCS        | 2%            |
| E     | HS         | 0.5%          |
| F     | HS         | 1%            |
| G     | HS         | 2%            |
| H     | mixed      | 2%(1%+1%)     |

Table 2: The physical properties of fibers used in the experiment:

| Type of fiber | Geometrical configuration   | $F_y$ (Mpa) | Specific gravity (g/cm <sup>3</sup> ) | Fiber diameter (mm) | Fiber Length (mm) | Aspect ratio ( $L_f/L_D$ ) |
|---------------|---|-------------|---------------------------------------|---------------------|-------------------|----------------------------|
| BCS           |  | 2950        | 7.8                                   | 0.15                | 6                 | 40                         |
| HS            |  | 1172        | 7.8                                   | 0.5                 | 30                | 60                         |

## Results

### Evaluation of cracking and expansion in concrete prisms:

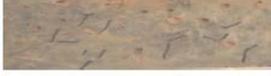
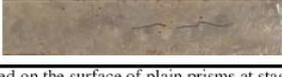
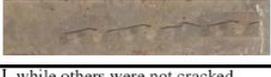
#### Time to cracking:

The results indicate that the specimens of plain concrete cracked after only 40 days of immersion in the sulfate solution. Longer immersion times were needed for the mixtures with fibers reaching as high as 95 days. The use of BCS fibers at contents of 0.5, 1, and 2% contributed more than corresponding contents of HS fibers to delaying the time to cracking. The blend of BCS and HS was less significant than BCS or HS fibers separately in delaying time to cracking.

#### Cracks: patterns and continuity:

Plain concrete experienced higher cracking extent than that of fibrous mixtures with BCS, HS, or the blend of BCS and HS fibers, as shown in the figure below. Also the results showed that cracks were observed to be short and randomly distributed in specimens with BCS fibers yet continuous and branched for those with plain concrete. The prisms with HS fibers experienced more continuity in their cracks as compared to those with BCS.

Figure 1: The cracking patterns for prisms specimen at the end of stage II and III

| Group               | Stage II (90) days  | Stage III (128)  |
|---------------------|---|--|
| A<br>Plain Concrete |  |  |
| B<br>0.5% BCS       |  |  |
| C<br>1% BCS         |  |  |
| D<br>2% BCS         | No cracking   |  |
| E<br>0.5% HS        |  |  |
| F<br>1% HS          |  |  |
| G<br>2% HS          |  |  |
| H<br>2% HBCS        |  |  |

\*Cracks appeared on the surface of plain prisms at stage I, while others were not cracked.  
BCS: Brass coated steel fiber; HS: Hooked steel fiber; HBCS: Hooked and brass coated steel fiber.

### Expansion-Time history

The expansion rate was the lowest during the period 0-16 days, the highest during 20-100 days, and almost negligible after 105 days. The results showed that plain concrete had higher expansion than fibrous concrete. It is seen that the expansion reduction for the mixtures with HS fibers at volumetric fractions of 0.5, 1, and 2 % was higher than other mixtures. The use of HS fibers at a volumetric fraction of 1.0 % was much more effective in reducing ultimate expansion, due to sulfate attack, than at that at 2 %.

### Effect of Sulfate Attack on the Mechanical Properties of Fiber Reinforced Concrete (stress -strain diagram):

The stress-strain diagrams for standard cylinders pertaining to groups A through H at the different stages of sulfate attack treatment are shown in figs (2-9), respectively. The curves showed a typical trend behavior represented in linear followed by non-linear trend behavior. The curves of the stress-strain diagrams representing control and sulfate treated specimens were matched until certain stress level and diverged thereafter. The stress level at divergence varied upon the fiber's type and content. For example, the stress level for plain concrete at stage I and II was at 10 MPa as compared to 30, 30, and 50 MPa for concrete with BCS fibers at volumetric fractions of 0.5, 1, and 2%, respectively. The corresponding values for concrete with HS were 10, 20, 20 MPa, respectively. The stress level for the concrete prepared using the blend of BCS and HS was about 10 MPa. As sulfate treated continued, the compressive strength (ultimate stress) was reduced while the strain at peak stress increased.

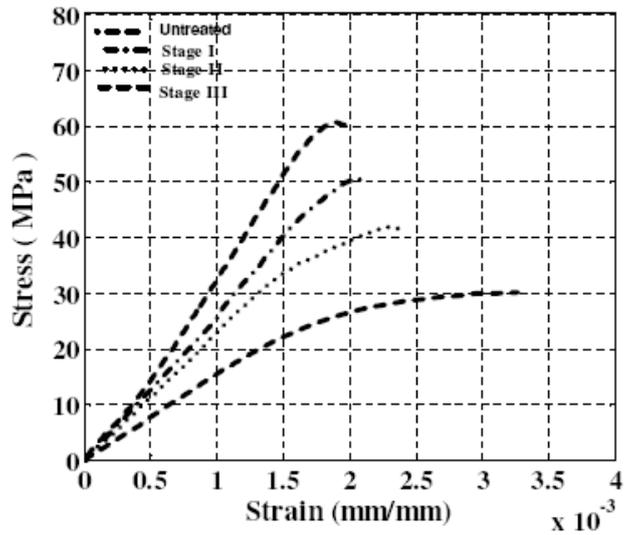


Figure 2: Stress strain curve: Group A

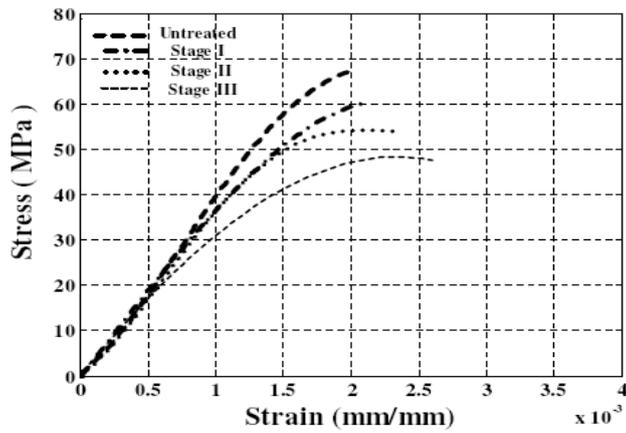


Figure 3: Stress strain curve: Group B (0.5% BCFS)

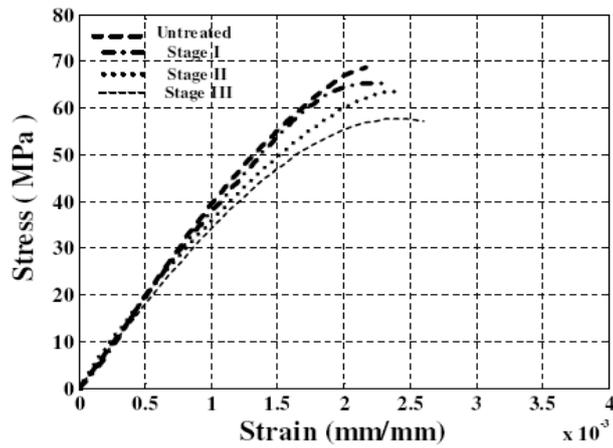


Figure 4: Stress strain curve: Group C (1% BCFS)

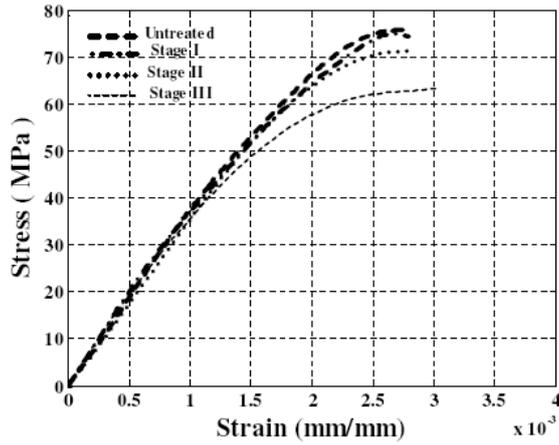


Figure 5: Stress strain curve: Group D (2% BCSF)

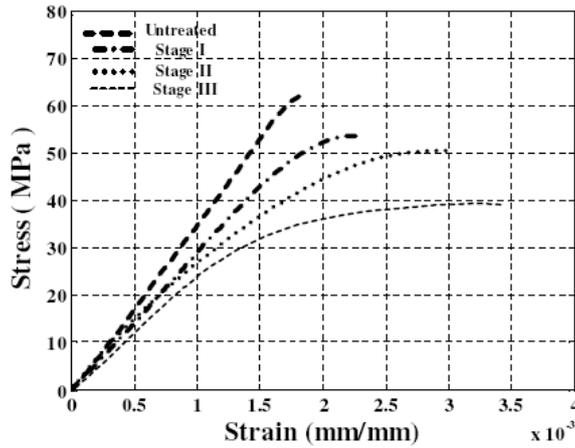


Figure 6: Stress strain curve: Group E (0.5% HS)

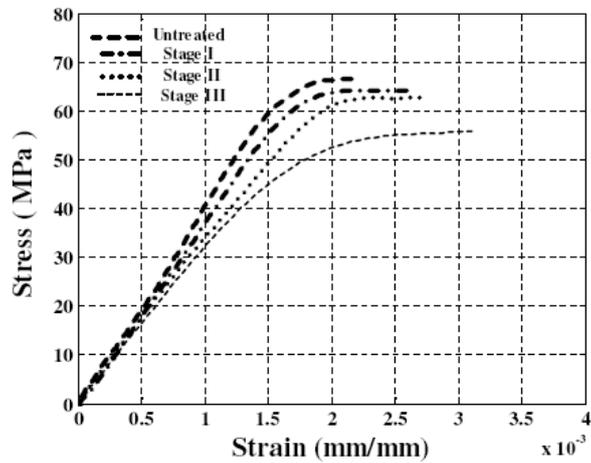


Figure 7: Stress strain curve: Group F (1% HS)

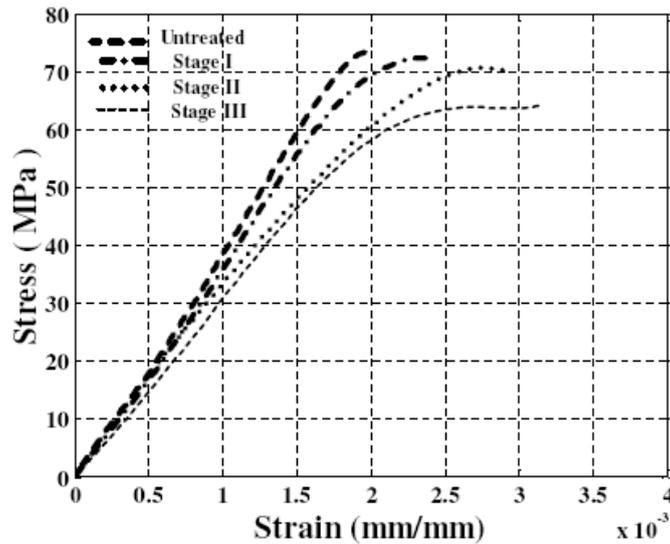


Figure 8: Stress strain curve: Group G (2% HS)

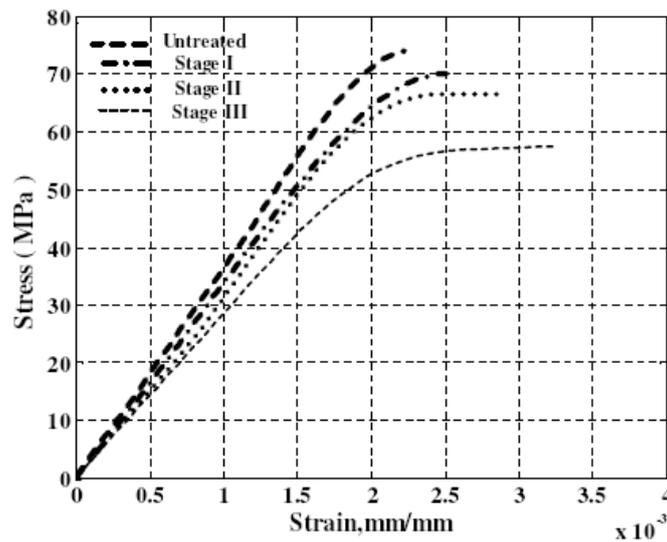


Figure 9: Stress strain curve: Group H (2% HBCS)

The characteristics of stress-strain diagrams of concern in this study are compressive strength (ultimate stress), secant modulus of elasticity. The secant modulus of elasticity is defined as slope of a line drawn from the origin to a point on the stress-strain curve corresponding to a 40% of ultimate strength. These characteristics are summarized in Table 3.

Table 3: Cylinders compressive strength (ultimate stress) and secant modulus of elasticity

| Group                       | Plain concrete | BCSF |      |      | HS   |      |      | HBCS |
|-----------------------------|----------------|------|------|------|------|------|------|------|
|                             | 0%             | 0.5% | 1%   | 2%   | 0.5% | 1%   | 2%   | 2%   |
| Compressive Strength (Mpa)  |                |      |      |      |      |      |      |      |
| Untreated                   | 61.0           | 67.5 | 69.0 | 76.0 | 62.4 | 67.4 | 73.7 | 72.0 |
| Stage I                     | 51.1           | 60.2 | 65.1 | 75.2 | 54.0 | 64.2 | 72.5 | 70.1 |
| Stage II                    | 41.9           | 54.3 | 63.4 | 71.2 | 50.4 | 62.8 | 70.7 | 66.7 |
| Stage III                   | 31.1           | 48.3 | 57.7 | 63.4 | 39.3 | 56   | 64.2 | 57.5 |
| Modulus of Elasticity (Gpa) |                |      |      |      |      |      |      |      |
| Untreated                   | 30.2           | 38.6 | 39.7 | 37.1 | 34.5 | 38.1 | 37.2 | 36.3 |
| Stage I                     | 24.3           | 36.6 | 38.2 | 36.7 | 28.9 | 37.0 | 35.7 | 33.8 |
| Stage II                    | 21.3           | 36.0 | 36.1 | 35.4 | 25.8 | 33.7 | 33.1 | 31.3 |
| Stage III                   | 16.5           | 31.4 | 34.2 | 34.3 | 22.6 | 31.4 | 31.1 | 28.5 |

## Discussion

### Cracking and expansion in concrete prisms:

**Time to cracking:** The longer immersion times that needed for the mixtures with fibers to crack is referred to the crack-arresting action of fibers. Those kept their properties in the concrete matrix and bond with concrete up to cracking.

**Cracks: patterns and continuity:** Resulting cracking on the surface of the specimens can be attributed to the formation of ettringite and conversion of calcium hydroxide and calcium silicate hydrates into gypsum that resulted in volume expansion. This led to cracking and reduction of strength and modulus of elasticity of concrete. Moreover, the wetting and drying cycles adopted in the sulfate treatment resulted in the accumulation and repetitive crystallization of sulfate in the pore system, which created additional internal pressure. The use of BCS fibers contributed to arresting cracking better than HS fibers because of the formers higher intensity in the concrete matrix.

**Expansion-Time history:** The significant reduction in expansion in the fibrous mixtures as compared to that of plain concrete may be attributed to the fibers arresting crack capability that was combined with the increased rigidity of the fibrous mixture. The higher reduction in expansion by HS fibers is due to higher anchorage of former fibers with the cement matrix.

### **Effect of Sulfate Attack on the Mechanical Proprieties of Fiber Reinforced Concrete (stress - strain diagram):**

Results of Table 3 indicated that concrete with and without fibers experienced a decrease in their compressive strength that was proportional to immersion period (stages I through III). The compressive strength was reduced after stage III by as much as 50% for plain concrete. Lower reductions were reported for the mixtures with HS and BCS fiber. The use of fibers in concrete was of great benefit in reducing loss of compressive strength of fibrous concrete under sulfate attack.

The immersion in the  $\text{Na}_2\text{SO}_4$  solution resulted in continuous loss of stiffness. The reduction in elastic modulus at the three stages of sulfate treatment was lower for BCS and HS fibers as compared to that for plain concrete due to the crack arresting capability of used fibers. The results indicated that increasing the fiber content up to a volumetric fraction of 1 % resulted in reducing damage in concrete significantly. However, raising the fiber volumetric fraction to 2 % had sometimes negative impact on the compressive strength and the modulus of elasticity of concrete under sulfate attack. This may be referred to the increase in fiber-fiber interaction, which weakened the contribution for fibers maintaining the fibrous mixtures rigidity and limiting cracking

The blend of HS and BCS fibers at 1% (by vol.) each showed similar contribution to maintaining the compressive strength as that of HS and BCS at 1% (by vol.).

### **Conclusions**

The following conclusions can be drawn from the experimental results:

1. Cracking intensity and continuity on the surfaces of prism specimens increased with the time of exposure. Those with plain concrete experienced higher expansion and cracking intensity under sulfate as compared to that of concrete with fibers.
2. The use of steel fibers contributed to delaying crack initiation in concrete proportional to fiber content. Brass coated steel fiber, although were more effective in delaying cracking as compared to Hooked steel fiber, was less effective in preventing cracking continuity.
- 3-The stress-strain diagram for plain and fiber reinforced concrete showed no change in its trend behavior after exposure to sulfate attack.
- 4-The reductions in compressive strength and modulus of elasticity were less for the mixtures with fibers as compared to those with plain concrete.
- 5- The results of this investigation indicated the advantages of using steel fibers in reducing concrete expansion, delaying crack initiation, and reducing result damage; hence allow maintaining high proportion of the mechanical properties of concern.

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# FLUORIDE CONTENT OF WATER AND SOME FOODS OF ENDEMIC FLUOROSIS REGION OF ALGERIA

SENATOR Abderrahmane

Department of Biochemistry, Faculty of SNV University of Ferhat Abbas Sétif 1, Algeria

E-mail [senatordz@yahoo.fr](mailto:senatordz@yahoo.fr)

Mobile: (+ 213) 7 74 99 17 00

## Abstract

At a small daily dose, fluoride is healthy and recommended to prevent dental caries, but at high levels it causes fluorosis. A large region in south-east of Algeria, represents an endemic fluorosis zone. The fluoride concentration was determined in water, some vegetables and some varieties of dates by the potentiometric method. Fluoride level in water was found to be (2.5 mg/ml) four fold higher than the content in water in the non-endemic regions (Setif city). This concentrations are not as high (2,5 mg/ml) as that reported in Uttar-Pradesh in India (13,5 mg/ml) for example. However, water is the major cause of fluorosis because of the hot and dry climate of this region. The locally cultivated vegetables are also very rich in fluoride, they accumulate variable but high rate of fluoride in their tissues, ranging from 8 mg in carrot to 22 mg in pepper per kg of dry matter (DM). Such concentrations are 2 to 6 fold higher than that of the non-endemic region. Dates contain approximately 2,5 mg/kgDM without any significant differences between varieties. According to these results, the daily intake can be estimated at 10 mg. However, this intake can be multiplied by a factor of 2 to 3 according to eating habits, work conditions, season, origin of foods and tea consumption. This intake is very high and represents a potential health hazard to bone and teeth. Calcium and magnesium contents of the same samples determined by Atomic Absorption Spectroscopy did not show any relationship with fluoride content.

# FRAKTAL BOYUT ve AŞIRI ÖĞRENME MAKİNELERİ ile DOKULU İMGELERİN SINIFLANDIRILMASI

## TEXTURE IMAGE CLASSIFICATION by USING FRACTAL DIMENSION and EXTREME LEARNING MACHINE

Mehmet ÜSTÜNDAĞ  
Elektronik ve Bilgisayar Eğitimi  
Fırat Üniversitesi, T. E. F.  
Elazığ / Türkiye  
[mustundag@firat.edu.tr](mailto:mustundag@firat.edu.tr)

Ömer F. ALÇIN  
Elektronik ve Bilgisayar Eğitimi  
Fırat Üniversitesi, T. E. F.  
Elazığ / Türkiye  
[ofalcin@firat.edu.tr](mailto:ofalcin@firat.edu.tr)

Abdulkadir ŞENGÜR  
Elektrik ve Elektronik Müh.  
Fırat Üniversitesi, Teknoloji Fak.  
Elazığ / Türkiye  
[ksengur@firat.edu.tr](mailto:ksengur@firat.edu.tr)

**Özet:** Bir imgedeki herhangi bir bölgenin istatistiksel özellikleri yavaş yavaş değişiyorsa veya yaklaşık olarak periyodikse, imgenin o bölgesi doku özelliği gösteriyor demektir. Doku, doğa imgeleri, uydu fotoğrafları ve biyomedikal imgeler gibi birçok imgenin analizinde kullanılan oldukça önemli bir karakteristiktir. Dokulu imgelerin sınıflandırılmasında karşılaşılan en büyük güçlük, bu tür imgelerin yeterince karakterize edilebilmesi için gerekli olan yöntemlerin geliştirilmesinde yaşanan güçlüklerdir. Bu çalışmada fraktal boyut ve aşırı öğrenme makineri ile dokulu imgelerin sınıflandırılması gerçekleştirilecektir. Önerilen sistemde fraktal boyut öznelik çıkarımı için, aşırı öğrenme makineleri ise sınıflandırıcı olarak kullanılacaktır. Gerçekleştirilen deneysel çalışmalarda önerilen yöntemin % 99 civarında bir başarımla elde ettiği görülmüştür. Ayrıca elde edilen sonuçlar dalgacık tabanlı ve diğer bir yöntem ile karşılaştırılmıştır.

**Anahtar Kelimeler:** Fraktal analiz, dokulu imgelerin sınıflandırılması, aşırı öğrenme makineleri

**Abstract:** If the statistical property of any region in an image varies slowly or almost periodic, that part of the image is said showing a textured property. Texture is an important characteristic, which is used in analysis of various images such as natural images, satellite photographs and biomedical images. The major difficulty encountered in the classification of textured images, such images are required to be sufficiently characterized by difficulties in the development of methods. In this study, we used the fractal dimension and extreme learning machine for classification of the gray scale texture images. In the proposed method, the fractal dimension is used for feature extraction and the extreme learning machine is used for classification purposes. Based on the experimental studies, the proposed scheme yielded almost 99 % success rate for gray level texture images. Moreover, we compared our method with a wavelet based methodology.

**Key words:** Fractal analysis, texture image classification, extreme learning machine

## 1.GİRİŞ

Bir imgedeki herhangi bir bölgenin istatistiksel özellikleri yavaş yavaş değişiyorsa veya yaklaşık olarak periyodikse, imgenin o bölgesi doku özelliği gösteriyor demektir (Tuceryan, 1993). Dokulu imgeler, doğa imgeleri, uydu fotoğrafları ve biyomedikal imgeler gibi birçok alanda kullanılan oldukça önemli bir karakteristiktir (Haralick, 1979). Doku tipi imgelerin analizi için çeşitli yöntemler geliştirilmiştir. İstatistiksel temelli yöntemler doku analizinde sıkça kullanılırlar (Zhaang, 2002). Diğer taraftan Markov Rassal Alanları (MRA) ve Gibbs Rassal Alanları (GRA) gibi olasılıksal yöntemler de bu amaçla kullanılmaktadır. Son zamanlarda doku tipi imgelerin analizinde fraktal analiz (Keller, 1989) ve dalgacık dönüşümü gibi çoklu çözünürlüklü zaman-frekans yöntemlerine olan ilgi artmıştır (Şengür, 2007, Şengür, 2008). Doku tipi imgeleri tam olarak analiz etmek, sınıflandırmak ve bölütleme için bu imgeleri yeterince karakterize edebilecek özneliklerin çıkarılması gerekmektedir.

Doku sınıflandırma probleminin çözümüne katkıda bulunacak pek çok yöntem literatürde mevcuttur. Weszka ve diğ., Fourier güç spektrumu öznelikleri ve ikinci dereceden gri seviyesi istatistiksel özellikleri ve ayrıca birinci dereceden istatistiksel özellikleri kullanarak doku sınıflandırma için karşılaştırmalı bir çalışma gerçekleştirmişlerdir (Weszka, 1976). Muneeswaran ve diğ., doku görüntüleri için döndürmeden ve ölçeklendirmeden bağımsız yeni öznelikler önermişlerdir (Muneeswaran, 2005). Önerilen yöntemde değişmez öznelik çıkarımı için Meksika şapkası, Gauss ve ortogonal dalgacık aileleri kullanılmıştır. Li ve diğ., doku sınıflandırma için diydik dalgacık, dalgacık çerçeve ve Gabor dalgacık özneliklerini hem bireysel hem de kombine olarak kullanmışlardır (Li, 2005). Sınıflandırıcı olarak ise Destek Vektör Makinelerini (DVM) kullanılmıştır. Yine doku sınıflandırma için DVM ve ayrık dalgacık çerçeve dönüşümü kullanılarak, döndürmeden bağımsız öznelik çıkarımı Kwok ve diğ., tarafından önerilmiştir (Li,

2003). Arivazhagan ve diğ., dalgacık dönüşümü istatistiksel öznitelikleri, dalgacık eş oluşum matrisi öznitelikleri ve bunların kombinasyonlarını kullanarak farklı öznitelik vektörleri ile doku sınıflandırmışlardır. Önerilen yöntemde basit bir mesafe sınıflandırıcısı kullanılmıştır (Arivazhagan, 2003). Mojsilovic ve diğ., dokuların karakterize edilmesinde kullanılan ayrışım filtresinin ne kadar önemli olduğunu ve dokuları karakterize edecek baskın öznitelik vektörünün tayin edilmesini araştırma makalelerinde göstermişlerdir (Mojsilovic, 2000). Çalışmada 23 adet Brodatz doku örneği kullanılmıştır. Uygulama sonuçları ile kullanılan ayrışım filtresinin dokuların özelliklerinin çıkarılmasındaki etkisi ortaya konmuştur. Çalışmada en uygun 19 adet ayrışım filtresi tespit edilmiştir. Chen ve diğ., doku sınıflandırma için önerilen filtreleme metodlarının performanslarını değerlendiren, karşılaştırmalı bir çalışma gerçekleştirmişlerdir (Chen, 1999). Çalışmada incelenen filtreleme yöntemleri, Fourier dönüşümü, uzamsal filtre, Gabor filtresi ve dalgacık dönüşümüdür. Çalışmanın deneysel sonuçları ile dalgacık dönüşümünün üstünlüğü gösterilmiştir. Wang ve Liu dokuları tanımlamak için çoklu çözünürlük bir MRA modeli önermişlerdir (Wang, 1999). Bu model hem MRA'nın avantajını hem de çoklu çözünürlüğün avantajını tek bir modelde birleştirerek, doku sınıflandırma için dayanıklı bir yapı oluşturmuştur. Bu model de ayrıca hem yüksek geçiren hem de alçak geçiren bileşenler kullanılmıştır.

Bu çalışmada fraktal boyut ve aşırı öğrenme makinesi ile dokuların sınıflandırılması gerçekleştirilecektir. Önerilen sistemde fraktal boyut öznitelik çıkarımı için, aşırı öğrenme makinesi ise sınıflandırıcı olarak kullanılacaktır. Fraktal analizin dokuların sınıflandırılması için etkili olduğu bildirilmiştir. Diğer taraftan aşırı öğrenme makinesi yeni önerilen bir sınıflandırıcı olup, yapay sinir ağları sınıflandırıcılarının parametre bağımlılığını ve iteratif yapısına etkili alternatif bir yapı olarak önerilmiştir. Deneysel çalışmalar için farklı veri tabanlarından alınan dokular kullanılacak ve önerilen yöntemin başarımı değişik parametreler ile değerlendirilecektir. Ayrıca elde edilen sonuçlar dalgacık tabanlı ve diğer birkaç yöntem ile karşılaştırılacaktır.

Bu çalışma şu şekilde özetlenebilir: Bölüm 2'de Fraktal analiz ve Aşırı Öğrenme Makinesi (AÖM) hakkında genel bilgiler verilmiştir. Bölüm 3'te bu çalışmada kullanılan Öznitelik Çıkarımı ve Sınıflandırma yöntemi açıklanmıştır. Bölüm 4'te dokuların sınıflandırma deneysel çalışma sonuçları verilmiştir. Bölüm 5'te ise elde edilen sonuçlar irdelenmiştir.

## 2. TEORİK BİLGİLER

### 2.1. Fraktal Analiz

Fraktallar, öklid geometrisinin karakterize edemediği doğal yapıları modellemek için kullanılan düzensiz geometrik yapılardır (Keller, 1989, Türkoğlu, 2007). Fraktal Boyut (FB), Fraktal geometrinin önemli bir matematiksel parametresidir. FB, ölçeklendirmeden ve bakış açısı bağımsız önemli bir özniteliktir. FB, biçim, doku, sayı, renk, tekrarlanma, benzerlik, rassallık, düzenlilik ve heterojenlik gibi bir imgenin özniteliklerini tanımlamakta kullanılan tanımlayıcı özellikleri nicelleştirir (Türkoğlu, 2007). Bu nedenle, FB birçok medikal doku özniteliklerini yorumlamakta kullanılan bir araç olmuştur (Türkoğlu, 2007). En yaygın FB hesaplama yöntemi olarak kutu sayma yöntemi kullanılmaktadır. Bu yöntemde şekil veya görüntü belirli bir büyüklükteki kutularla kaplanır. Kutuların farklı ölçekleri için her defasında şeklin bir parçasının bulunduğu kutu sayıları sayılır ve kutu ölçekleri ile dolu kutu sayılarına log-log en küçük kareler uygulanır. Bulunan denklemin eğimi FB olarak tanımlanır. Kutu sayma yöntemi, öz-benzeşim boyutları ile ilgilidir ve birçok durumda aynı sayıyı verir. Benzer yapılarda ölçeklendirme faktörü  $r$  ve kutu sayısı  $N(r)$  arasında Denklem 1'deki gibi bir ilişki vardır.

$$D_f = \frac{\log(N(r))}{\log(1/r)} \quad (1)$$

İmge,  $r$  ölçeklendirme faktörüne bölünür ve aynı özellikte olan kutu sayıları sayılır. Ölçeklendirme faktörü  $r$  küçültülerek işlem devam ettirilir. Bu süreçte her  $r$  değeri için, kutu sayıları belirlenir.  $R$  ölçeklendirme faktörünün kutu sayılarına göre grafiği çizdirilir. Grafikten elde edilen eğim, imgenin fraktal boyutunu ( $D_f$ ) verir (Türkoğlu, 2007).

### 2.2. Aşırı Öğrenme Makineleri

Huang ve ark., tarafından önerilen AÖM, Tek Gizli Katmanlı ve İleri Beslemeli (TGKIB) bir sinir ağı modeli için kullanılan basit bir öğrenme algoritmasıdır (Huang, 2006). AÖM hızlı öğrenme yeteneğinin yanı sıra geleneksel geri yayılım algoritması ile öğrenen ileri beslemeli ağlara göre daha iyi genelleme başarımına sahiptir. AÖM'nin öğrenme algoritması aşağıdaki gibi tanımlanır;

Belirli bir  $N$  girdi-çıkı ilişkisi  $x_i$  ve  $t_i$  parametreleri ile gösterilsin. Burada  $x_i, x_i = [x_{i1}, x_{i2}, \dots, x_{in}]^T \in R^n$  ve  $t_i$  ise  $t_i = [t_{i1}, t_{i2}, \dots, t_{in}]^T \in R^m$  şeklinde ifade edilir.  $\tilde{N}$  tane gizli sinir hücresi ve  $g(x)$  aktivasyon fonksiyonuna sahip standart TGKIB matematiksel olarak aşağıdaki gibi modellenir:

$$\sum_{i=1}^{\tilde{N}} w_{ij} (w_{ij} x_j + b_j) = t_i, \quad i = 1, \dots, \tilde{N} \quad (2)$$

Burada  $w_i = [\omega_{i1}, \omega_{i2}, \dots, \omega_{im}]^T$ ,  $i$ 'nci gizli sinir hücresine ve giriş sinir hücresine bağlı olan ağırlık vektörüdür,  $\beta_i = [\beta_{i1}, \beta_{i2}, \dots, \beta_{im}]^T$  ise  $i$ 'nci gizli sinir hücresine ve çıkış sinir hücrelerine bağlı olan ağırlık vektörüdür.  $b_i$  ise  $i$ 'nci gizli sinir hücresinin eşik değeridir.  $w_i \cdot x_j$  ise  $w_i$  ve  $x_j$ 'nin içsel çarpımını ifade eder. Bu makalede çıkış sinir hücrelerinin aktivasyon fonksiyonu doğrusal olarak seçilmiştir.

$\tilde{N}$  tane gizli sinir hücresine ve  $g(x)$  aktivasyon fonksiyonuna sahip standart TGKIB ortalama sıfır hataya yaklaşabilir,  $\sum_{j=1}^{\tilde{N}} \|o_j - t_j\| = 0$ ,  $\beta_i$ ,  $w_i$  ve  $b_i$  arasındaki ilişki aşağıdaki eşitlikte verilmiştir;

$$\sum_{j=1}^{\tilde{N}} \omega_{ij} (\omega_{ij} \cdot \omega_{ij} + \omega_{ij}) = \omega_{ij}, \quad i = 1, \dots, \tilde{N} \quad (3)$$

Denklem 3'de verilen  $\tilde{N}$  tane eşitlik, Denklem 4'deki gibi kısaltılabilir:

$$\omega_{ij} = \omega_{ij} \quad (4)$$

Burada;

$$\omega_{ij} (\omega_{ij}, \dots, \omega_{ij}, \omega_{ij}, \dots, \omega_{ij}, \omega_{ij}, \dots, \omega_{ij}) = \begin{bmatrix} \omega_{ij} (\omega_{ij} \cdot \omega_{ij} + \omega_{ij}) & \dots & \omega_{ij} (\omega_{ij} \cdot \omega_{ij} + \omega_{ij}) \\ \vdots & \dots & \vdots \\ \omega_{ij} (\omega_{ij} \cdot \omega_{ij} + \omega_{ij}) & \dots & \omega_{ij} (\omega_{ij} \cdot \omega_{ij} + \omega_{ij}) \end{bmatrix}_{\omega_{ij} \omega_{ij}} \quad (5)$$

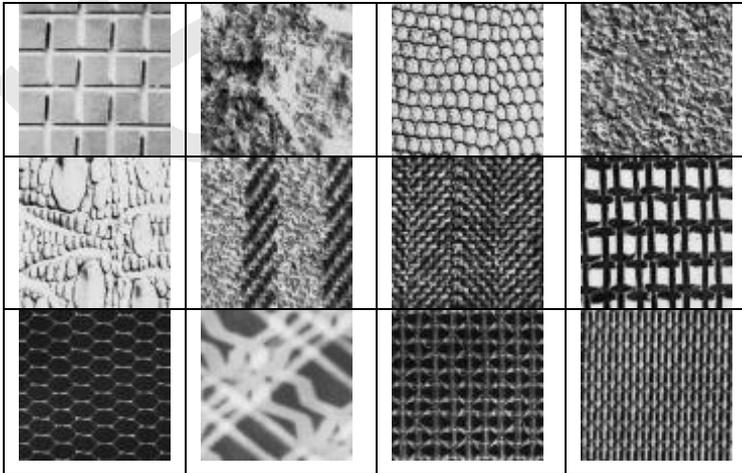
$$\omega_{ij} = \begin{bmatrix} \omega_{ij} \\ \vdots \\ \omega_{ij} \end{bmatrix}_{\omega_{ij} \omega_{ij}} \quad \text{ve} \quad \omega_{ij} = \begin{bmatrix} \omega_{ij} \\ \vdots \\ \omega_{ij} \end{bmatrix}_{\omega_{ij} \omega_{ij}} \quad (6)$$

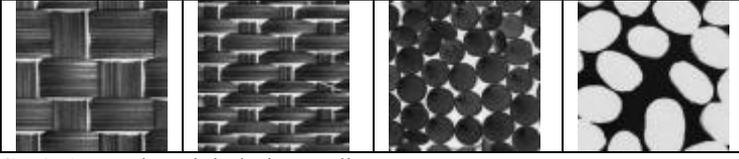
Sinir ağının gizli katmandaki çıkış matrisi  $H$  diye adlandırılır ve  $H$ 'in  $i$ 'nci sütünü  $x_1, x_2, \dots, x_N$  girişlerinin  $i$ 'nci gizli sinir hücrelerinin çıkış vektörüdür.

### 3. ÖZNETELİK ÇIKARIMI VE SINIFLANDIRMA

Bu çalışmada yapılan deneysel uygulamalarda kullanılan Brodatz albümünden (Brodatz Textures, 2012) elde edilmiş 16 adet doku tipi imge sıra ile Şekil 1'de verilmiştir. Bu çalışmada kullanılan öznetelik çıkarımı ve sınıflandırma yöntemleri iki aşamada ele alınabilir:

**Aşama-1:** Bu aşama öznetelik çıkarımı yapılmaktadır. Brodatz albümüne ait 16 adet  $75 \times 75$ 'lik doku imgeleri kullanılmıştır. Şekil 1'de bu imgeler gösterilmiştir. Bu imgelerin her biri için birbiriyle örtüşen rasgele 40 adet  $64 \times 64$ 'lük imge bölgesi oluşturulmuştur. Her bir imge için elde edilen bu  $64 \times 64$ 'lük imge bölgelerinin 20 adedi önerilen sistemin eğitiminde, geri kalan 20 adedi ise bu algoritmanın test aşamasında kullanılmıştır. FB özneteliklerinin çıkarılması için diferansiyel kutu sayma algoritması kullanılmıştır (Al-Kadi, 2009). Bu algoritma, FB öznetelikleri için değişken boyutlu kayan bir pencere kullanır. Pencerenin her bir pozisyonunda maksimum ve minimum gri seviyelerinin farkına bağlı lineer olmayan bir kernel fonksiyonu çalıştırılır. Daha sonra elde edilen imgelerim her bir pikseli için lineer regresyon kullanılarak FB imgesi hesaplanır. Son olarak FB imgesinin ortalama, standart sapma ve lakunarite öznetelikleri hesaplanarak öznetelik vektörü oluşturulur (Al-Kadi, 2009).





Şekil 1: Brodatz dokulu imge albümü.

**Aşama-2:** Bu aşama sınıflandırma safhasıdır. Burada, özellik çıkarım safhasında elde edilen  $320 \times 3$ 'lük özellik vektörü kullanılarak AÖM ile akıllı bir sınıflandırma yapılmıştır. Kullanılan AÖM gizli katmanlardaki hücre sayısı 50 seçilmiştir.

**Aşama-3:** Bu aşama ise 2. aşamada AÖM algoritması kullanılarak gerçekleştirilen sınıflandırma sonuçlarının doğruluğunu test etmektedir. Bu amaçla daha önceden belirtildiği gibi her bir imgeden elde edilen 40 adet rasgele oluşturulmuş  $75 \times 75$ 'lik parçalarının geriye kalan 20 adedi kullanılarak,  $320 \times 3$ 'lük öznitelik vektörü elde edilmiştir. Daha sonra bu  $320 \times 3$ 'lük özellik vektörü AÖM algoritmasının doğru sınıflandırma performansını değerlendirmek için test aşamasında kullanılmıştır.

#### 4. DENEYSEL SONUÇLAR

3. bölümde anlatıldığı gibi dokulu imgelerin her birinden 40 adet rasgele  $64 \times 64$ 'lik imge bölgeleri oluşturulmuş ve bu imge bölgelerinin 320 adedi AÖM algoritması ile eğitim ve geriye kalan 320 adedi ise bu algoritmanın test aşaması için kullanılmıştır. AÖM algoritması 25 kez çalıştırılmış ve ortalama % 99.21'lik bir başarımla elde edilmiştir. AÖM yapısının gizli katman hücre sayısı 17 olarak seçildiğinden de bu oran % 95.56 olmaktadır. Diğer taraftan eğitim ve test için kullanılan imge bölgesi boyutları  $64 \times 64$  den,  $48 \times 48$ 'e düşürüldüğünde, gizli katman hücre sayısı 25 iken, sistemin ortalama başarımları % 92.48 ve gizli katman hücre sayısı 17 iken, sistemin ortalama başarımları % 91.30 olmaktadır. Ayrıca, önerilen yöntemin, dalgacık paket enerji öznitelikleri karşılaştırılması da gerçekleştirilmiştir. Sınıflandırıcı olarak yapay sinir ağları kullanılmıştır (Şengür, 2007). Elde edilen başarımlar % 95.70'dir.

#### 5. SONUÇLAR

Bu çalışmada, AÖM tabanlı bir dokulu imge sınıflandırma sistemi önerilmiştir. Önerilen sistemin başarımları her bir imge için birbirinden farklı 40 adet rasgele seçilmiş  $64 \times 64$  ebatlarında imge bölgeleri kullanılarak test edilmiştir. Önerilen sistemin doğru sınıflandırma performansı farklı boyutlardaki imgeler ve farklı gizli katman hücre sayısına göre hesaplanmıştır. Yapılan değerlendirmelerde daha büyük boyutlardaki imge bölgeleri için sınıflandırma başarımının yüksek olduğudur. Bu durum büyük boyutlardaki imgelerden elde edilen özniteliklerin o imgeyi daha iyi karakterize ettiğini göstermektedir. Bundan başka önerilen yöntem dalgacık paket enerji öznitelikleri ve yapay sinir ağları kullanan başka bir sistem ile karşılaştırılmıştır. Bu karşılaştırma da önerilen sistemin daha iyi başarımlar gösterdiği görülmüştür.

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# FRAMEWORK OF A COLLABORATIVE RESEARCH AND DEVELOPMENT (CRD) INSTITUTE IN A DEVELOPING COUNTRY

S.M. Lutful Kabir\*

\* Professor, Institute of Information and Communication Technology,  
Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh.  
Email: lutfulkabar82@gmail.com

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**Abstract** For maintaining sustainable development of a country academia-industry collaboration is essential. Although this is an accepted and well-managed practice in almost all universities of developed countries, this is not simple and easy for a developing country. This paper highlights the challenges and opportunities of such initiative for the latter class. The framework of a collaborative research and development institute is outlined in this paper. The components of such institute and its implementation steps are also described here. The financial implications of establishing such an institute is also hinted in the paper.

**Keywords:** Collaborative Research, Research and Development, Innovative learning/Teaching ;

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## 1. Introduction

In order to increase efficiency, accuracy and transparency, advanced systems incorporating high-tech products of different nature are used in many sectors of a country. R.V. Engelan (2007) has illustrated few examples in this regard. Unfortunately, in almost all cases in developing countries like Bangladesh we have to depend on foreign products and experts to install and in some cases, to maintain the systems. Because of lack of research and development facilities for advanced system, we could not reach at that level at which we can develop the advanced systems on our own. Sometimes it is concluded that we are not capable of producing and developing high-tech product and advanced systems. This is not true because we have very meritorious young generation who has proved their talent through various activities.

Like developed countries, we need to establish a strong collaboration between the universities and the industries. The growth of Silicon Valley (2004) is an outcome of such initiative of collaboration between university and industries. In Bangladesh, we are lagging behind in establishing such collaboration. This is because of the fact that, in one hand, industrialists find it easy to import goods from abroad rather than producing them indigenously here. On the other hand, our academia has not been able to establish the confidence of the industrialist that industry-standard items can be produced in the country. But for last few years that idea, to a substantial extent, has been changed. At Institute of Information and Communication Technology (IICT) of BUET, a few products have been developed completely locally and finally marketed in the country. In the midst of limited scope and facilities, IICT of BUET has been carrying out research on advanced system development since 2001. It received momentum when a project on Prepaid Electricity Meter received first prize in an international industrial design competition. Industrial product development effort started with the development of commercial prepaid electricity meters [S.M.L. Kabir et al, (2003)], twenty thousands of which have been installed in Uttara area. Then, prepaid gas meters [T.H. Khan et al (2009)] have been developed and five thousands of them are being used in Lalmatia, Mohammadpur area. Finally Electronic Voting Machines [R. Laskar (2011)] were developed and they were used in Chittagong, Narayanganj and Comilla city corporation and Norshingdi municipality elections by Bangladesh Election Commission.

But, the path that IICT followed is not the ideal way of establishing academia-industry collaboration. In all three cases, the items were developed under turn-key projects of making final products. For that reason, separate R & D could not be carried out in proper way. In ideal case, there should be a research and development phase having some prototype production. But in these cases there was no such separate fund allocated for research. This was absent because of the fact that the concept of developing product through R & D was very new in our country. Although not ideal, the three product development attempts have moved us forward in establishing the confidence to our industrialist. It is now thought that if R&D is done even better products can be produced in our country. This proposal of establishing an Institute of Collaborative Research and Development (ICRD) is aimed at developing an institute of Research and Development that will allow researchers to work freely for making prototypes of hiTech products, having field tested and finally handing over to the industries for mass production.

The main objective of creating ICRD is to form a world class educational establishment for research and development on state-of-the-art technology. This will establish a platform not only to teach a large number of students on how to use the modern technology in carrying it out to the door-step of the people but also to create a great opportunity to directly contribute to this nation in particular and to the world in general. S. M. L. Kabir (2010) demonstrated how that can be achieved in Bangladesh.

In order to fulfil the objective, the first step would be to create infrastructural facilities for carrying out research for HiTech product development in the country. The second step is to hire very renowned researchers and associates for running the institute. The third step is to run different short and long term programs and projects. The final step is to take necessary steps for its sustainability.

## **2. Collaborative Research**

### *2.1 Collaboration between university and international & national industries*

The achievement of IICT, BUET shows that if attempted under a right platform, products for the benefit of the people can be developed in the university. A case study for Malaysia is presented by V.V.R.C. Gobinaraja (2010). If the students, engineers can be properly motivated, made them acquainted with the state of the art technology and finally an environment can be created for them to work, products designed and developed by a university can be produced in the industries. The three products mentioned earlier are finally in the process of production in three companies of the country. The ICRD will be developed in such a way that industries are motivated to work with the university for developing modern products through research.

### *2.2 Collaboration between university and international & national research organizations*

In many cases, in order to bring a quick research output up to a certain level, helps will be necessary from world famous research organizations. Collaboration with them will be essential to exchange knowledge between the professionals of the two parties. This transfer can fruitfully be executed in the form of faculty and/or student exchange or by taking joint-venture project development or by inviting renowned researchers from those organizations for short term programs.

### *2.3 Collaboration between university and international & national funding agencies*

In many cases, international and/or national funding agencies become interested to fund different creative and productive initiative by a university. They also float different projects to be executed by different organizations. If a world class research and development environment and manpower can be ensured, ICRD will be able to attract funding agencies to place projects under their different development programs.

### *2.4 Collaboration between university and international & national universities*

The universities are established mainly for higher teaching and research. In reality, most of them remained confined mainly with the teaching only, little are done in research domain. This is mainly because of non-availability of huge funds necessary for HiTech research and lack of qualified manpower. But if a university can establish one world-class institute for research, many of other universities can collaborate with it to have joint researches using common platform. In this respect, the university in leading will be benefited not only by enriching their capacity through sharing research with others but also by having a financial gain through this collaboration.

### *2.5 Collaboration between university and the Government*

Government of a country is a large client for using the products of a research institute. We can cite the examples of Bangladesh Agricultural Rice Institute (BARI) who are leading in providing our different highly economical rice products for the country. In most of the cases, government is providing funds for the research and facilitating the use of the research outcome in home and abroad. Similarly in engineering field, ICRD will provide various products which our government can directly patronize for use in the country.

## **3. Learning and teaching components**

### *3.1 Academic Programs*

ICRD should run different academic programs for two reasons. The first reason is that a large number of manpower is necessary for maintaining the trends of HiTech product development created by the institute. The second benefit will be achieved by generating a continuous guaranteed cash flow for running the institute. The academic program at the

postgraduate diploma, Masters and PhD level programs will be offered by the institute. It is expected that every year almost 200 students will enrol in the programs. The postgraduate diploma program will have duration of one year while Masters and PhD programs will be of one and half and three years durations respectively.

Apart from long programs there will be short term courses in different areas running all over the year. Their duration of each course will be in between 4 to 6 weeks.

### *3.2 Incubation Centre*

Graduating students of the university should highly be encouraged to start innovative self-employed business by developing innovative technical products. But, being fresh, they are not capable of starting a new business. So, just after graduation they need assistance for starting such initiatives. Like many universities of the world, ICRD will provide incubation centres having the facilities for the outgoing students to have a space in the institute with the internet, laboratory, business consultation, funding, different administrative facility etc. Elbert et al (2010) exhibits how the incubation centres have benefited in four countries.

The duration of their stay in an incubation centre will be approximately 6 months. Within that time the student or student group must find their own place of business outside ICRD. By providing the facilities to the graduates, the benefits of ICRD are of many folds. First of all, graduates from the university will never remain jobless. Second, more and more ideas leading to future works will be generated. Third, the relationship that establishes between the new entrepreneurs and ICRD will create the opportunity for having joint-effort for new product development.

### *3.3 Centre of excellence*

ICRD, from the very beginning will be established with a goal of making this institute as a centre of excellence in the university. So, in all respect e.g., in appointment, in purchasing, in infrastructure development etc. quality has to be ensured. Just after its establishment attempt must be taken to make the institute accredited by one or more international bodies. Since this is an education institute and at the same time a product development institute, both academic and industrial standardization practices must be followed in ICRD.

## **4. Administrative and Infrastructural Components**

### *4.1 Board of Governors*

The university shall form a governing body for making time to time policies for running the ICRD. Vice Chancellor will be the chairman of BOG. The Pro-VC, representatives from few renowned industries/ companies, from UGC, from education ministry and from teaching staff of the institute will be the members of the BOG. The director of the institute will be the member-secretary of the body.

### *4.2 Manpower Setup*

The following manpower is proposed for smooth operation of the institute. As the progress becomes in positive direction the set up can be revised in order to fulfill the demands.

- a) Professor and Director - 1 (one)
- b) Associate Professor and Deputy Director - 2 (two)
- c) Assistant Professor - 4 (four)
- d) Lecturer – 10 (Ten)
- e) Project Managers - As when necessary [assigned from the faculty of the university as their additional duty]
- f) Manager (Academia-Industrial linkage) - 1 (one)
- g) Manager (Technical)- 1 (one)
- h) Assistant Manager (Technical) - 2 (two)
- i) Accounts cum Administrative Officer - 1 (one)
- j) Technical Officer - 2 (two)
- k) Technician - 3 (three)
- l) Peon - 2 (two)

### *4.3 Laboratory development*

The laboratories that are essential at the primary stage of the establishment of ICRD are listed below:

- a) Embedded System Lab
- b) Wireless Communication Lab

- c) Advanced Electronics Lab
- d) VLSI Lab
- e) Mobile application development Lab

#### 4.4 Infrastructural setup

The space required will be used for the following purposes:

- a) institute's office,
- b) staffs' rooms,
- c) laboratory rooms,
- d) meeting cum video conference room,
- e) library,
- f) incubation centres
- g) collaborators' room, etc.

### 5. Financial Components

#### 5.1 Annual Expenditure

The expenditure area can be divided into two parts. The one time expenditure includes the laboratory setup cost, furniture and decoration cost. Whereas, the recurring expenditure includes salaries, rent for spaces, investment cost for projects (to be regained from the income of the projects), office expenses, consumables, utility costs, etc.

#### 5.2 Annual Income

The income areas are as follows:

- a) Postgraduate degree programs
- b) Short Courses
- c) Projects through
  - i) collaboration with the Industries
  - ii) collaboration with international funding agencies
  - iii) collaboration with the government
  - iv) collaboration with other universities
  - v) collaboration with other research organizations

### 6. Conclusion

In this paper, a framework is drawn on the background, objectives and components for developing a Collaborative Research and Development (ICRD) Institute in a developing country. If a university is interested to establish ICRD, the outline will help her in taking the decision. Once decided, based on the framework detail elaboration and analysis should be worked out.

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# GEÇİRİMSİZLİK SAĞLAYAN KATKI MALZEMELERİNİN BETON BASIÇ DAYANIMINA ETKİSİNİN İNCELENMESİ

Ahmet APAY<sup>1</sup>, Tahir AKGÜL<sup>2</sup>, Kevser AKYOL<sup>2</sup>

<sup>1</sup>Sakarya Üniversitesi, Teknoloji Fakültesi, İnşaat Mühendisliği Bölümü, Türkiye

<sup>2</sup>Sakarya Üniversitesi, Teknik Eğitim Fakültesi, Yapı Eğitimi Bölümü, Türkiye

**Özet:** Bu çalışmada suyun beton üzerindeki olumsuz etkilerinin ortadan kaldırılması amacıyla piyasada üretilen ve betona geçirimsizlik sağlayan katkı malzemelerinin betonun basınç dayanımı ile betonun su geçirimsizliği üzerindeki etkisi incelenmiştir. Yapılan deneysel çalışmada beş farklı numune tipi hazırlanmıştır. Numuneler aynı beton dayanım sınıfına göre karışım hesabı yapılmış ve ağırlıkça farklı oranlarda katkı malzemesi kullanılarak hazırlanmıştır. Bu numunelerle katkı malzemesi kullanılmayan şahit numunenin basınç dayanımları karşılaştırılmıştır. Ayrıca tüm numunelerin su geçirimsizlik oranlarının belirlenmesi amacıyla su emme deneyi yapılarak, kullanılan katkı malzemesinin performansı incelenmiştir. Sonuç olarak geçirimsizlik sağlayan katkı malzemesi oranı arttıkça betondaki hava boşluklarının azalmasına bağlı olarak betonun basınç dayanımı ve betonun su geçirimsizliği belirli oranlarda arttığı tespit edilmiştir [1].

**Anahtar kelimeler;** Beton, Su geçirimsizliği, Basınç dayanımı, Katkı malzemesi

## 1. Giriş

Betonun yıllar boyunca dış etkilerden ve betonun bileşenlerinden ileri gelen faktörlerden olumsuz etkilenmesi, dayanım ve niteliklerini kaybetmesi kaçınılmazdır. Bu etkiler dalga, akıntı, süprüntü maddelerinin çarpması gibi aşındırıcı, asit tuz etkisi, kristalleşme, alkali-agrega reaksiyonu gibi kimyasal, donma-çözülme gibi fiziksel etkenler olabilir [2]. Dayanıklı bir beton üretiminde göz önüne alınan en önemli özelliklerden biri betonun boşluk yapısı ve boşluk oranıdır [3]. Bu durum betonun geçirimsizliği ile doğrudan bağlantılıdır. Suyun veya diğer akışkanların beton içinde iletimi bu yolla olur ve zararlı maddelere bu şekilde betonun içine taşınır. Örneğin; sülfat hasarında, sülfatlı sular beton içine geçirimsizlik nedeni ile taşınarak hasar verici birtakım kimyasal reaksiyonlara sebep olur. Bu açıdan beton içindeki rutubet hareketinin mekanizmasını iyi anlamak gerekir. Betonda akışkan hareketi üç şekilde gerçekleşir [4]. Bunlar;

1. Malzemenin boşluklarının tamamının suya doygun olduğu ve mevcut su basıncı etkisi ile meydana gelen doymuş akım.
2. Betonun boşluklarının kısmen suyla dolu olduğu, yüzey gerilim kuvvetlerinin etkisiyle meydana gelen doymamış akım veya kılcallık
3. Betonun boşluklarında iki bölge arasındaki mevcut buhar basıncı farkı dolayısıyla meydana gelen su buharı akımıdır.

Öte yandan beton bileşimi ile ilgili olarak su/çimento oranı, çimento cinsi ve miktarı ve kullanılan katkı maddeleri betonun geçirimsizliğini etkileyen önemli faktörlerdendir [5]. Günümüzde betonda kullanım amacına göre birçok katkı maddesi kullanılmaktadır. Bu katkı maddelerinin en yaygınlarından biride betonda geçirimsizlik sağlayan katkı maddeleridir. Betonlarda geçirimsizliği sağlayan katkıları; kılcal su emme özelliğini düzeltten su itici katkıları ile basınçlı suya karşı geçirimsizlik sağlayan kütle su iticileridir [6]. Bu katkıların esas maddeleri yağ asidi sabunları (stearat, oleat ve loreat'lar ve özellikle bunların çinko ve alüminyum sabunları) ve ince tozlardır. (Kiselguhr, bentonit, yağlı kireç, öğütülmüş kalker unu, mineral tozlar, asetat türü plastik madde emülsiyonları gibi.) Betonda kılcallığı azaltmak amacıyla en çok kullanılan stearat grubu maddelerin su itici niteliğe sahip olanlarının yanında hava sürükleyici özellikte olanları da vardır [7]. İnce tozlar ise esas olarak tıkaç görevi üstlenerek basınçlı su geçirimsizliğine karşı yarar sağlar. Öte yandan, betonda geçirimsizlik üzerinde önemli rol oynayan su azaltıcı katkı maddeleri ile hava sürükleyici ve priz hızlandırıcı katkılarda geçirimsizlik amacıyla kullanılmaktadır [8].

Kullanılan tüm bu katkı maddelerinin pratikte yaş beton üzerindeki etkileri gözlem yoluyla rahatlıkla izlenebilmekte kullanımları hızla artmaktadır. Bu çalışmadaki amaç geçirimsizlik sağlayan katkı maddelerinin betonun su geçirimsizliği üzerindeki etkisi ile basınç dayanımı üzerindeki etkisinin deneysel çalışmalar yoluyla ortaya konmasıdır [9].

## 2. Materyal ve Metot

### 2.1. Metot

Öncelikle deneysel çalışmada karşılaştırma yapabilmek amacıyla hiçbir katkı maddesi kullanılmadan 320 kg/m<sup>3</sup> dozlu beton karışım hesabına göre elde edilmiş 3 adet küp şahit numune hazırlanmış, daha sonra geçirimsizlik sağlayan katkı

maddelerinin betonun su geçirimsizliğine ve beton basınç dayanımına etkisinin incelenmesi amacıyla farklı dozajlarda kimyasal kullanarak deney numuneleri hazırlanmıştır. Bu katkı oranları %0,5, %1, %1,5 ve %2 olarak belirlenmiştir. Çalışmada üretilen betonlarda agrega granulometrisi B eğrisine uygun seçilmiştir. Karışımlarda özgül ağırlığı 3150 kg/m<sup>3</sup> olan PÇ 42,5 çimentosu kullanılmıştır. Numuneler basınç dayanımı deneyleri için 15×15×15 cm'lik küp kalıplarda hazırlanmış ve her bir karışım için 3'er adet küp numune üretilmiştir. Bu numuneler üzerinde ayrıca su emme deneyleri de yapılmış bu deneysel çalışmalar Epo Yapı Kimya Arge laboratuvarına bağlı kimya ve beton laboratuvarlarında yapılmıştır.

## 2.2. Materyal

Yapılan deneysel çalışmalarda, Nuh Çimento fabrikası tarafından üretilen PÇ 42,5 çimentosu kullanılmıştır. Kullanılan katkı ise piyasada yaygın olarak kullanılan X geçirimsizlik katkısıdır. Agrega karışımı, kırma kum, doğal kum, 1 no'lu kırma taş ve 2 no'lu kırma taş agregalarından oluşturulmuştur. B referans eğrisine yakın agrega granulometrisi kullanılmıştır. Deneysel çalışmalarda kullanılmak üzere hazırlanacak beton numunelerinde kullanılacak agregaların B eğrisine yakın olup olmadığını belirlemek amacıyla elek analizleri yapılmıştır (Şekil 1).



Şekil 1. Elek analizinin yapılması

## 2.3. Beton Karışımı ve Beton Özellikleri

Beton karışımlarında mutlak hacim esasına uygun olarak hesaplar yapılmış, Beton 320 kg/m<sup>3</sup> çimento dozlu olacak şekilde üretilmiştir. Yapılan bu denemede katkısız (şahit) beton ve geçirimsizlik sağlayan katkıyı farklı oranlarda kullanmak üzere toplam 5 karışım üretilmiştir. Betonların çökme değerlerinin 15±1 cm de sabit tutulacak şekilde su miktarları ayarlanmıştır. Üretilen kontrol ve katkılı betonların, 1m<sup>3</sup>'üne giren gerçek malzeme miktarları ve taze beton özellikleri aşağıdaki tablo 1'de verilmiştir.

Tablo 1. 1 m<sup>3</sup>' e Giren Malzeme Miktarları ve Taze Beton Özellikleri

| Beton Kodu                         | 1 (Şahit)                                 | 2 (% 0,5 Katkılı) | 3 (% 1 Katkılı) | 4 (% 1,5 Katkılı) | 5 (% 2 Katkılı) |
|------------------------------------|---|-------------------|-----------------|-------------------|-----------------|
| Çimento (kg)                       | 320                                       | 320               | 320             | 320               | 320             |
| Su (kg)                            | 205                                       | 190               | 185             | 180               | 175             |
| D.Kum (kg)                         | 455                                       | 471               | 475             | 478               | 484             |
| K.Kum (kg)                         | 429                                       | 445               | 450             | 452               | 457             |
| No 1 (Mıçır) (kg)                  | 472                                       | 489               | 491             | 495               | 503             |
| No 2 (Mıçır) (kg)                  | 435                                       | 452               | 455             | 460               | 465             |
| Katkı Miktarı (%)                  | Yok                                       | %0.5              | %1              | %1.5              | %2              |
| Su / Çimento                       | 0,64                                      | 0,58              | 0,58            | 0,58              | 0,5             |
| Çökme (cm)                         | 14  | 14                | 14              | 14                | 14,5            |
| Birim Ağırlık (kg/m <sup>3</sup> ) | 2420                                      | 2390              | 2380            | 2375              | 2370            |
| Hava Miktarı (%)                   | 1.1                                       | 2.4               | 3.2             | 3.5               | 3.8             |
| 1 Nolu Deneme:                     | Katkısız olarak yapılan kontrol betonudur |                   |                 |                   |                 |

|                       |   |
|-----------------------|---|
| <b>2 Nolu Deneme:</b> | Geçirimsizlik sağlayan beton katkısıdır.%0,5 oranında kullanılmıştır. |
| <b>3 Nolu Deneme:</b> | Geçirimsizlik sağlayan beton katkısıdır.%1 oranında kullanılmıştır.   |
| <b>4 Nolu Deneme:</b> | Geçirimsizlik sağlayan beton katkısıdır.%1,5 oranında kullanılmıştır. |
| <b>5 Nolu Deneme:</b> | Geçirimsizlik sağlayan beton katkısıdır.%2 oranında kullanılmıştır.   |

Karışım hesabı sonucu elde edilen ve yukarıdaki tabloda verilen malzeme miktarları dikkate alınarak mikserlerde hazırlanan beton harcı 15×15×15 cm'lik yağlanmış küp kalıplara yerleştirilerek gerekli sıkıştırma ve yüzey işlemleri yapılmıştır. (Şekil 2).



Şekil 2. Beton harcının kalıplara yerleştirilmesi

Kalıplara yerleştirilen beton 24 saat bekledikten sonra kalıptan çıkarılarak, kür havuzunda, su içerisinde 7 gün bekletilmiştir. Kür havuzundan 7 gün sonunda çıkarılıp 4 gün dışarıda (oda sıcaklığında) bekletilmiş daha sonra tekrar 3 gün boyunca kür havuzuna bırakılmıştır (Şekil 3).



Şekil 3. Beton numunelerinin kür havuzuna yerleştirilmesi

### 3. Deneysel çalışmalar

#### 3.1. Basınç Deneyleri

Hazırlanan deney numuneleri 14.gün sonunda kür havuzundan çıkarılarak basınç deneyine tabi tutulmuştur (Şekil 4). Deneyler sonucunda elde edilen maksimum yük numunenin yüzey alanına bölünerek numunelerin basınç gerilmeleri bulunmuştur. Basınç gerilmeleri bağıntısı aşağıdaki formül 1 'de verilmiştir.

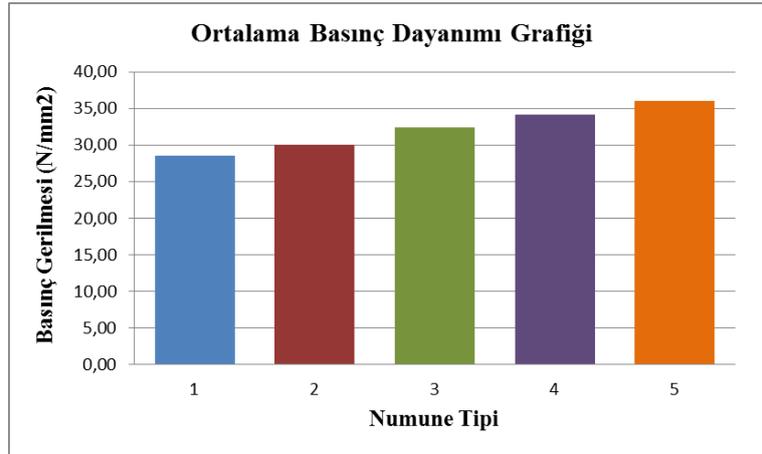
$$\sigma = \frac{P}{A} \quad (1)$$

$\sigma$  = Gerilme (N/mm<sup>2</sup>),  $P$  = Yük (N),  $A$  = Kesit Alanı (mm<sup>2</sup>)



**Şekil 4.** Beton numunelerin basınç deneylerinin yapılması

Yapılan hesaplamalar sonucunda elde edilen numunelerin 14 günlük ortalama basınç dayanımları tablo2’de verilmiştir.



**Şekil 5.** Numunelerin ortalama basınç dayanımları grafiği

**Tablo 2.** Numunelerin 14 Günlük ortalama basınç dayanım sonuçları

| Basınç Dayanımı (N/mm <sup>2</sup> ) | 1   | 2    | 3    | 4    | 5    |
|--------------------------------------|---|------|------|------|------|
| 14. Gün (N/mm <sup>2</sup> )         | 28.5  | 30.1 | 32.4 | 34.2 | 36.1 |
| 1 Nolu Deneme:                       | Katkısız olarak yapılan kontrol betonudur                             |      |      |      |      |
| 2 Nolu Deneme:                       | Geçirimsizlik sağlayan beton katkısıdır.%0,5 oranında kullanılmıştır. |      |      |      |      |
| 3 Nolu Deneme:                       | Geçirimsizlik sağlayan beton katkısıdır.%1 oranında kullanılmıştır.   |      |      |      |      |
| 4 Nolu Deneme:                       | Geçirimsizlik sağlayan beton katkısıdır.%1,5 oranında kullanılmıştır. |      |      |      |      |
| 5 Nolu Deneme:                       | Geçirimsizlik sağlayan beton katkısıdır.%2 oranında kullanılmıştır.   |      |      |      |      |

Deney sonuçları elde edilen basınç dayanımları açısından incelendiğinde katkı miktarı arttıkça betonun basınç dayanımının arttığı görülmektedir. Numuneler içerisinde en yüksek basınç gerilmesi değerini % 2 oranında geçirimsizlik sağlayan katkı maddesi içeren numuneler vermiştir. Bu numunelerde şahit numunelere göre %27 oranında beton basınç dayanımında artışı tespit edilmiştir.

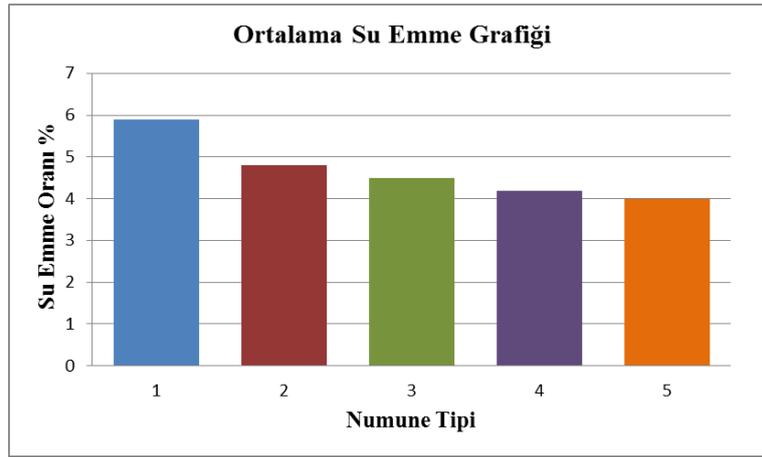
### 3.2. Su Emme Deneyi

Su emme deneyi beton kalıplardan çıkarıldıktan sonra 7 gün kür havuzundan bekletilmiş ardından kür havuzundan çıkarılarak dış yüzeyleri hafifçe kurulanmış ve 0,1g hassasiyetli terazide tartılmış ve numune ağırlıkları kayıt altına alınmıştır. Aynı numuneler daha sonra 4 gün boyunca sıcak bir ortamda bekletilmiş tekrar kür havuza konmadan aynı terazide tartılmış ve kuru ağırlıkları kaydedilmiştir. Yapılan bu ölçümler sonucu numunelerin su emme miktarları aşağıdaki formül 2’den elde edilmiştir. ile ölçülmüştür.

$$As = \frac{Wsh - Wo}{Wo} \quad (2)$$

As = Ağırlıkça su emme (%), Wo = Numunenin kuru ağırlığı (gr), Wsh = Suya doymun numunenin havadaki ağırlığı (gr)

Küp numunelerin tartı sonucunda elde edilen kuru ve yaş ağırlıkları yukardaki formüle göre hesaplanarak her bir numune grubunun ortalama su emme miktarları bulunmuştur. Bulunan bu değerler Şekil 6 ve Tablo 3’te verilmiştir.



Şekil 6. Numunelerin ortalama su emme grafiği

Tablo 3. Su Emme Miktarları

| Su emme (%)           | 1   | 2   | 3    | 4   | 5   |
|-----------------------|---|-----|------|-----|-----|
|                       | 5,9   | 4,8 | 4,50 | 4,2 | 4,0 |
| <b>1 Nolu Deneme:</b> | Katkısız olarak yapılan kontrol betonudur                           |     |      |     |     |
| <b>2 Nolu Deneme:</b> | Geçirimsizlik sağlayan beton katkıdır.%0,5 oranında kullanılmıştır. |     |      |     |     |
| <b>3 Nolu Deneme:</b> | Geçirimsizlik sağlayan beton katkıdır.%1 oranında kullanılmıştır.   |     |      |     |     |
| <b>4 Nolu Deneme:</b> | Geçirimsizlik sağlayan beton katkıdır.%1,5 oranında kullanılmıştır. |     |      |     |     |
| <b>5 Nolu Deneme:</b> | Geçirimsizlik sağlayan beton katkıdır.%2 oranında kullanılmıştır.   |     |      |     |     |

Yapılan su emme deneyi sonucunda numunelerin su emme oranları karşılaştırıldığında en az su emme oranı yine % 2 oranında geçirimsizlik sağlayan katkı maddesi içeren numunelerden elde edilmiştir. Bu numuneler şahit numunelere göre %37 oranında daha az su emmiştir.

#### 4. Sonuç ve Değerlendirme

Yapılan çalışmalar sonucunda elde edilen deney sonuçlarına göre;

1- Farklı dozajlarda ki geçirimsizlik katkısıyla üretilmiş betonlarda, aynı işlenebilmenin sağlanabilmesi için farklı su miktarlarına gereksinim duyulmuştur. Bu sonuçlara göre en az su gereksinimi, dolayısıyla en düşük su/çimento oranı %2 oranında kullanılan geçirimsizlik katkısıyla elde edilmiştir.

2- Basınç dayanımlarına bakıldığında, en büyük basınç dayanımı değeri geçirimsizlik katkısı %2 oranında kullanılan numunelerden elde edilmiştir. Bu sonuç, su/çimento oranının diğer karışımlara göre daha düşük olması ile açıklanabilir.

3- Yapılan bu denemelerde, hava miktarlarına bakıldığında kullanılan katkıların hepsi şahit numune karışımına göre daha fazla hava sürüklemektedir.

4- Betonların birim hacim ağırlıklarına bakıldığında ise, en yüksek birim hacim ağırlığı şahit numune betonunda elde edilmiştir. Geçirimsizlik sağlayan katkı ile yapılan betonların birim hacim ağırlığının düşük çıkmasının sebebi ise katkının hava sürüklemesidir.

5- Kullanılan katkı türleri betonun su geçirimsizliğini azaltarak rutubet ve nem tutma açısından olumlu etki göstermişlerdir.

6- Geçirimsizlik katkılarının en temel etkisi karışımdaki su/çimento oranını düşürerek betonun hem basınç dayanımını artırmış hem de su geçirimsizliği sağlamıştır.

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# GEZGİN ROBOTLAR İÇİN KONUMLANDIRMA VE HARİTALAMA PROBLEMLERİ

## PROBLEMS OF LOCALIZATION AND MAPPING FOR MOBILE ROBOTS

Yunus SANTUR, Muhammed Fatih TALU  
Bilgisayar Mühendisliği Bölümü  
İnönü Üniversitesi  
{ysantur , [fatih.talu](mailto:fatih.talu@gmail.com)}@gmail.com

### Özet

Otonom gezgin robotlar görevlerini yerine getirmek için gezinim sırasında öncelikli olarak konumlarını belirlemelidir. Robot konumunun belirlenebilmesi için odometrik veriler, algılayıcı ölçümler ve harita bilgileri birlikte kullanılmaktadır. Harita bilgisi, çevrenin sayısal bir modelini ifade eder ve başlangıçta robota verilebileceği gibi robotun hareketi sırasında da oluşturulabilir. Eş zamanlı konumlandırma ve haritalama (EKVH) yöntemi ile bilinmeyen bir çevrenin haritası çıkarılırken aynı zamanda robot konumu da belirlenebilmektedir. Bu çalışmada, EKVH yöntemi ve konumlandırma, yol planlama, engellerden kaçınma, haritalama problemleri ayrıntılı bir şekilde incelenmiş ve önerilen çözüm yöntemleri yapılarına göre sınıflandırılmıştır.

### Abstract

During navigation, autonomous mobile robots have to localize their own positions to perform their tasks. By fusing the odometric data, measurements acquired from sensors and map features, it is possible to localize the robot position. The map information represents a digital model of environment and it either can be given to robots in initialization or created during motion. Simultaneous localization and mapping (SLAM) method can simultaneously build maps of unknown environments and compute current robot position. In this study, SLAM method and localization, path planning, obstacle avoidance and mapping problems have been investigated in detail and proposed solution methods have been classified according to their structures.

## 1. Giriş

Robotlar buldukları ortamı denetleyecek algılayıcılara, bu algılayıcılardan gelen bilgileri işleyip sonuç çıkaran işlem birimlerine ve işlem sonuçlarını çıkışa aktarabilecek hareket mekanizmalarına sahip elektromekanik sistemlerdir [1].

Pratikte pek çok alanda kullanılan gezgin robotlar yapısal olarak, tekerlekli, paletli, bacaklı ve kanatlı olarak tasarlanabilmektedir [2]. Kullanımları en yaygın olan tekerlekli gruba iş merkezleri, hastane, müze ve buna benzer yerlerde güvenlik, temizlik ve taşıma gibi alanlarda kullanılan robotlar [3] ve sürücüsüz otomobiller [4] örnek olarak verilebilir. Felaket durumlarında kazazede arama kurtarma çalışmaları için yılan benzeri robot [5] bir başka gruba örnek olarak verilebilir. Araştırma, keşif, gözetleme, arama, kurtarma ve takip gibi uygulamalarda su altı [6] ve popülerliği yıllar içerisinde artmaya devam eden insansız hava araçları (İHA) olarak adlandırılan uçan robotlar [7] örnek verilebilir.

Mobil robotlardan üst düzeyde faydalanmak için otonom olması beklenmektedir. Otonom; robotun üzerindeki algılayıcılardan gelen verileri yorumlayarak bir operatöre ihtiyaç duymadan konumunu belirlemesi, hedef noktaya varmak için yol planlaması yapması ve hareket ettiği ortamın haritasını oluşturması ve/veya güncellemesi anlamına gelmektedir [8].

Bu alanda uygulama geliştirmek için benzetim ortamları ya da gerçek robotlar kullanılabilir. Gerçek robotlar üzerinde uygulama yapmadan önce benzetim ortamlarında çalışmak zaman ve enerji kaybını önleyecektir. Söz konusu benzetim ortamları [9] da incelenmiştir.

## 2. Konumlandırma

Robotun içinde hareket edeceği fiziksel ortam hakkında her türlü engel ve hedefleri barındıran bilgiye “Dünya Uzayı” adı verilmektedir [19]. Bu uzay içerisinde hareket eden robotun “ben neredeyim?” sorusuna verdiği cevap “konumlandırma(localization)” olarak adlandırılmaktadır [10]. Müzede eserleri tanıtmakla görevli bir robotun tam olarak hangi eserin önünde durduğu konumlandırma problemine bir örnektir. Bir kara robotunun konumu Denklem 1’ de ki gibi, modellenilebilir. Burada  $(x, y)$  robotun konumunu  $\theta$  ise yönünü simgelemektedir.

$$(x, y, \theta) = [x, y, \theta]^T \quad (1)$$

Konum belirleme işlemi için kullanılan en yaygın yöntemler olasılığa dayalı yöntemlerdir [10,11].  $x$  ve  $y$  birbirinden bağımsız olaylar olmak üzere, Y olayı gerçekleştiğinde X olayının olma olasılığı  $P(X|Y)$  şeklinde gösterilir ve Bayes formülüne göre aşağıdaki gibi formülize edilebilir.

$$P(x|y) = \frac{P(x)P(y)}{P(y)} \quad (2)$$

Buradan yola çıkarak, geliştirilen “markov zinciri” yaklaşımında robotun  $x$  anına kadar olan konum bilgileri esas alınarak  $x + 1$  anındaki konumu, Denklem 3’teki gibi ifade edilir. Denklem 4’te ise Bayes kuralları kullanılarak Robotun  $x + 1$  anındaki konumu sadeleştirilmiş olarak verilmektedir. Benzer şekilde robotun anlık konumu  $x_t$ ,  $x$  anına kadar yapılan ölçümleri  $x^t$  ve denetim girdilerini  $x^t$  ile gösterirsek robot konumu bu değişkenlere göre Denklem 5’teki gibi hesaplanabilir [10,12].

$$P(x_{t+1}|x_0, x_1, \dots, x_t) = P(x_{t+1}|x_t) \quad (3)$$

$$P(x_{t+1}) = \int P(x_{t+1}|x_t) P(x_t) P(x^t) \quad (4)$$

$$P(x_t|x^t, x^t) = \int P(x_t|x_{t-1}, x^{t-1}, x^t) P(x_{t-1}|x^{t-1}, x^t) P(x^t) \quad (5)$$

Robotun uzay içerisinde bulunduğu konumunu hesaplamak için algılayıcılardan gelen bilgiler ve odometri bilgisi kullanılabilir. Odometri bilgisi bir kara robotu için tekerlek dönüş sayısı olarak düşünülebilir. Tekerlek dönüş sayısı ve çapı bilindiğine göre robotun başlangıç konumuna göre ne kadar yol aldığı hesaplanabilecektir [8]. Ölçümlerden kaynaklanan odometri hatası konumun yanlış hesaplanmasına yol açacaktır. Buda zamanla artan bir hatalı konum hesaplamaya sebep olacaktır. Bu duruma “Konum Kaçırma Problemi” adı verilmektedir [13].

Bir başka yöntem, robot konumunun uzay içerisinde konumu bilinen nesnelere ve mesafe ölçer algılayıcılardan gelen bilgileri kullanarak hesaplanmasıdır [14]. “Newton Özyinelemeli Konumlandırma” adı verilen bu yöntem, aynı zamanda odometrik sistemlerdeki hata oranını da azaltmaktadır. Robotun yön bilgisini elde etmek için ise elektronik pusula kullanılmaktadır [14].

Konum belirleme işlemi için günümüzde kullanılan en yaygın yöntemlerden olan GPS birkaç metre hata payıyla konum bilgisini verebilmektedir. Konum belirlemek için GPS kullanmak gözetleme amacıyla kullanılan açık alanda hareket eden bir İHA için uygun bir çözüm olabileceken, bina içerisinde taşıma görevi gerçekleştiren bir robot için yeterli olmamaktadır [15].

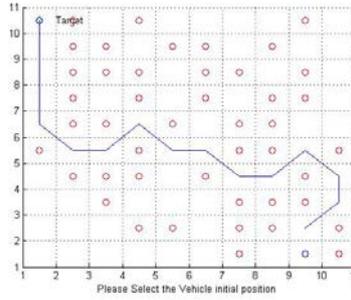
Kentsel, kırsal ve kapalı alanlarda uydu sinyallerinin kesintiye uğraması GPS kullanan uygulamalarda problemlere sebep olmaktadır. Bu nedenle GPS sistemi inersiyal algılayıcılarla (elektronik pusula, ivmeölçer) desteklenmektedir. Inersiyal Navigasyon sistemi (INS) ve GPS kıyaslandığında; GPS sistemlerde hata zamandan bağımsız, INS ölçümlerinde ise hata zamanla artmaktadır. Kısa zaman aralıklarında INS etkin sonuçlar verebilirken, GPS daha uzun zaman aralıklarında etkin sonuçlar vermektedir. Böylece yüksek hassasiyet gerektiren daha doğru konumlandırma bilgisine ihtiyaç duyan sistemlerde GPS/INS entegrasyonu güvenilir ve etkin bir çözümdür [16].

### 3. Yol Planlama

Robotun bir başlangıç konumundan belirlenen hedef ya da hedeflere hareket ederken izleyeceği yolun belirlenmesi işlemi “Yol Planlama (Path Planning)”, “navigasyon” ya da “rotalama” olarak adlandırılmasına rağmen daha çok yol planlama olarak benimsenmiştir [8,17,18]. Yol planlama işlemi “evrensel planlama” ve “yerel planlama” olmak üzere ikiye ayrılmaktadır. Evrensel planlamada robotun hareket edeceği uzayla ilgili yolları, engelleri, uzay içerisindeki nesnelere ve bu nesnelere konumları gibi tüm bilgilerin robot tarafından önceden bilindiği varsayılır. Evrensel planlamada söz konusu harita, programcı ya da operatör tarafından robot hafızasına yüklenir. Böylece robot harekete başlamadan yol planını oluşturabilir. Genellikle temizlik, nesne taşıma ve güvenlik amacıyla kullanılan robotlar [15] önceden bilinen bir ortamda hareket etmekte, dolayısıyla evrensel planlama kullanılmaktadır. Diğer yöntem olan yerel planlamada ise robot tanımadığı bir ortam içerisinde hareket etmektedir. Yani robot hareket edeceği uzay hakkında önsel bir bilgiye sahip değildir.

Robotun manevra yapabileceği, engeller dışında kalan alana “Serbest Uzay” denilmektedir. Serbest uzay, harita içerisinde bir alt kümedir, robotun yol planlama kapsamında izleyeceği güzergah ise serbest uzayın bir alt kümesi olmaktadır. Yol planlama, teknik olarak başlangıç konumu ile hedef konumu arasında serbest uzay içerisindeki optimal yolun bulunmasıdır. Yol planlama teknikleri Klasik, Olasılığa dayalı ve Sezgisel olmak üzere üç grup altında incelenebilir. *Rafet Aksoy ve Sefer Kurnaz* tarafından yapılan çalışmada robot manevralarına ilişkin 1973-2007 yılları arasında yayımlanan çalışmalar incelenmiş ve çalışmalarda kullanılan yol planlama tekniklerinin istatistiği çıkarılmıştır [8].

Yol planlama ile ilgili çalışmalar incelendiğinde genetik algoritma [8,19], bulanık mantık tabanlı [20], klasik [21], sezgisel yöntemlere dayalı A\* algoritması ise [22,23] da kullanılmıştır. Şekil 1’de A\* algoritmasına ait bir matlab programı çıktısı verilmektedir [24].



Şekil 1. A\* algoritması ile yol bulma

#### 4. Engelden Sakınma

Gezgin robotun gezinimi süresince yol üzerinde engellerle çarpışma ihtimali bulunmaktadır. Robot algılayıcılardan gelen verileri yorumlayarak engel algılama işlemini gerçekleştirmeli ve çarpışma olmadan hedefe ilerlemesini sağlayacak bir davranış sergilemelidir. Bu davranış “engelden kaçınma” olarak bilinmektedir. *Selim Yannier* tarafından yapılan çalışmada, mobil robot için dört katmanlı bir denetim sistemi önerilmiştir. Bu sistemde katmanlardan biri engel tespiti ve çarpışma işlemi için ayrılmıştır. Önerilen sistemde engelden kaçınma işlemi “potansiyel alan metodu” kullanılmıştır. Bu metotta her bir engelin robot üzerinde itici bir kuvvet uyguladığı varsayılır. Böylece robot engele yaklaştıkça bu kuvvet büyüyerek robotun hızını düşürecek ve yönünü değiştirecektir [25].

*Osman Parlaktuna ve Elif Eroğlu* tarafından yapılan çalışmada, mobil robotun ön ve arkasında herbiri  $\pm 15$  dereceyi tarayabilen 8 adet sonar mesafe algılayıcı konumlandırılmıştır. Robotun gezinimi sırasında farklı algılayıcılardan gelen bilgiler yorumlanarak duvar bulma, duvar takibi, engellerden kaçınma ve köşe dönüşleri işlemleri için robot davranış modelleri geliştirilmiştir [26].

*Ülkü Yücel ve Tülay Yıldırım* tarafından tasarlanan gezgin robotta, 3 adet mesafe ölçer algılayıcı kullanılmış, engellerden uzak durması için “kendi kendini organize eden haritalar (SOM)” yöntemi kullanılmıştır. SOM yöntemi, engellere olan oklit uzaklıklarının iki katmanlı bir yapay sinir ağına giriş olarak verilmesi ve 1 ya da 0 şeklinde iki boyutlu bir çıkış elde edilmesi şeklinde çalışır. Her bir çıkış, bir vektörünü simgelemektedir. Böylece robot kazanan çıkışı simgeleyen vektör doğrultusunda yön değiştirmektedir [27].

#### 5. Haritalama

Robotun hareket ettiği uzay içinde ortamın sayısal bir modelinin çıkarılması işlemi haritalama olarak tanımlanabilir [28]. Haritalama işlemi hareketli nesnelerin bulunduğu dinamik bir ortama ait var olan bir haritanın robotun hareketi sırasında güncellenmesi ya da “yerel planlama” sistemi ile hareket eden bir robotun birtakım referans bilgilere sahip olmadan ortam haritasını çıkarması şeklinde gerçekleşebilir. Bu durumda robot eş zamanlı olarak hem kendi konumunu tahmin belirlemeye çalışacak hem de ortam haritasını çıkaracaktır. Bu kavram literatürde “eş zamanlı konum belirleme ve haritalama(SLAM)” olarak bilinmektedir[29,30]. Şekil 2 de örnek bir harita gösterilmiştir, slam konusu ile ilgili canlı bir animasyon [31] de izlenebilir.

Ortam haritası çıkarılması amacıyla robot üzerinde nesnelerin konum ve uzaklıklarını ölçebilmek için geliştirilen yöntemlerde kamera ve mesafe ölçümünde kullanılan algılayıcılar kullanılmaktadır. Kamera kullanarak imge işleme teknikleriyle harita çıkarmadaki en büyük problem işlem yüküdür bu nedenle gerçek zamanlı çalışan yüksek maliyet gerektiren uygulamalarda kullanılabilmektedir.



Şekil 2. SLAM

Kamera yerine mesafe ölçümünde kullanılan optik, sonar ve lazer algılayıcıları kullanmak daha az işlem yükü gerektirmektedir. Optik algılayıcılar uygun maliyetlere sahip olmasına rağmen uzun mesafelerde verimli değildir, lazer algılayıcılar uzun mesafelerde de etkin olmalarına rağmen maliyetleri yüksektir. Sonar algılayıcılar, ses dalgasının bir noktaya gönderilip geri gelme süresine bağlı olarak mesafenin ölçülmesi prensibiyle çalışırlar. Denklem 6'da,  $d$  mesafeyi,  $t$  yankılanan ses dalgasının toplam uçuş süresini,  $c$  ise ses dalgasının hızını göstermektedir.

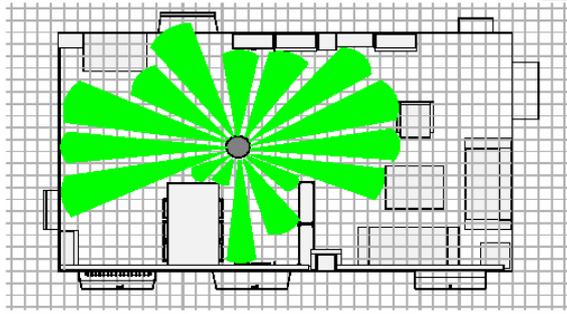
$$\square = \frac{vt}{2} \quad (6)$$

Sonar algılayıcılar kullanarak ortam haritasının oluşturulması üzerine birçok çalışma gerçekleştirilmiştir [26,32]. Sonar algılayıcılarda karşılaşılan en büyük problem “çapraz etkilenme” adı verilen, bir algılayıcının gönderdiği ses dalgasını kendisinin değil de başka bir algılayıcının alması durumudur. Bu problem daha çok köşelerde oluşmakta ve nesnenin olduğundan daha uzakta algılanmasına sebep olmaktadır [32]. Çapraz etkilenme problemi, sonar algılayıcılardan gelen bilgiyle kameradan alınan görüntü bilgisinin birlikte kullanılarak çözülebilmektedir [26]. *Aysun Taşyapı Çelebi* tarafından yapılan çalışmada, engel tespiti için tarama temelli çalışan sonar kullanılmıştır. Tarama temelli çalışan sonarlarda ses dalgaları saat yönü veya tersi yönde küçük açı artışları ile gönderilmekte, böylece 360 dereceyi kapsayan imgeler oluşturulabilmektedir [6].

*Erdoğan DUR* tarafından gerçekleştirilen çalışmada ise engel tespiti için kameradan elde edilen görüntüler MATLAB ortamında gerçekleştirilen bir yazılımla, sayısal bir vektöre dönüştürülmüş bu bilgilerde çok katmanlı bir yapay sinir ağına giriş olarak verilerek nesne algılama işlemi gerçekleştirilmiştir [33].

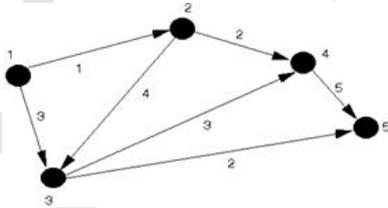
Algılayıcı ve/veya kamera kullanılarak engel ve konum algılama işlemi gerçekleştirildiğinde bu bilgilerin haritada gösterilmesi için metrik ve topolojik olmak üzere iki yöntem kullanılmaktadır[10]. Metrik yöntemde ortam belli sayıda hücelere bölünerek matris şeklinde temsil edilir(Şekil 3), bu matris gösterimine ızgara adı da verilmektedir. Izgara gösteriminde satır ve sütunlar haritadaki konumu, hücre değerleri ise o konumda bir engel olup olmadığını göstermektedir. Bu yöntemde hücre değerleri üç farklı yöntemle güncellenebilmektedir. “Bayes güncelleme” yönteminde, bir hücrenin dolu ya da boş olma olasılığı tahmin edilmektedir [26]. Bu yöntemde göre hücre toplamları 1 olacak şekilde, olasılık değerleri atanır. Bayes güncellemeli ızgara metodu ile harita oluşturma [8,26,31,33]’da kullanılmıştır.

Dempster-Shafer yaklaşımında hücreler dolu, boş ya da durumu bilinmiyor olabilir. Her üç durum için olasılık değerleri toplamı yine 1 olmaktadır. Histogrammic in Motion Mapping (HIMM) yaklaşımında, hücre değeri 0-15 arası tam sayılarla ifade edilir [34].



Şekil 3. Izgara tabanlı harita oluşturma

Diğer harita oluşturma yöntemi olan topoloji (çizge), bilgisayar, ekonomi, haberleşme gibi birçok alanda kullanılmaktadır. Bir çizge düğümler ve kenarlardan oluşmaktadır. Harita gösteriminde düğümler başlangıç, hedef ya da ortamda bulunan nesnelerin konumlarını, kenarlar ise düğümler arasındaki yolları göstermektedir. Yönlü çizgelerde oklar iki düğüm arasındaki bağlantı yönünü simgelemektedir. Ağırlıklı çizgelerde çizge değerleri iki nokta arasındaki yol maliyetini simgelemektedir. Haritalama yaparken iki nokta arasındaki mesafe kenar ağırlığı olarak belirlenebilir. Çizgeleri sayısal olarak robot hafızasında depolayabilmek için “bitişiklik matrisi” ya da “komşuluk matrisi” inden yararlanılır [13]. Çizge yöntemi ile haritalar araçlarda sıklıkla kullanılan GPS tabanlı navigasyon cihazlarında kullanılmaktadır. Şekil 4’te yönlü ağırlıklı bir çizge ve komşuluk matrisi verilmektedir.



|   | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 |   | 1 | 3 |   |   |
| 2 |   |   | 4 | 2 |   |
| 3 |   |   |   | 3 | 2 |
| 4 |   |   |   |   | 5 |
| 5 |   |   |   |   |   |

Şekil 4. Yönlü ağırlıklı örnek bir çizge ve komşuluk matrisi

Uygulama geliştirme sürecinde hangi yöntem kullanılırsa kullanılsın sistem mutlaka algılayıcı ölçümlerinden kaynaklanan bir gürültüye sahip olmaktadır ve bu gürültüde sistemde mutlaka modellenmelidir. Kalman filtresi doğrusal sistemler için iki aşamalı ve tekrarlı bir tahmin algoritmasıdır. İlk aşama “tahmin” aşamasıdır, sistemin eldeki verilere göre bir sonraki adımı tahmin edilmeye çalışılır. İkinci aşama “doğrulama” olarak adlandırılır. Bu aşamada tahmin değerleri ölçümlerle doğrulanır. Denklem 7’de, Kalman filtresi için tahmin modeli verilmektedir. Burada  $\square_{\square}$  sistemin durumunu,  $\square_{\square-1}$  önsel durumu,  $\square_{\square-1}$  gauss dağılımlı sistem gürültüsünü ifade etmektedir.  $\square$  matrisi, sistemin durum geçiş matrisidir.

$$\square_{\square} = \square_{\square} \square_{\square-1} + \square_{\square-1} \quad (7)$$

$$\square_{\square} = \square_{\square} \square_{\square} + \square_{\square} \quad (8)$$

Denklem 8’de, Kalman filtresi için ölçüm modeli gösterilmektedir. Eşitlikte verilen  $\square$ , gauss gürültüsünü  $\square$  ise ölçüm matrisini ifade etmektedir [13,35].

Kalman filtresi robotun başlangıç pozisyonunda kayma olmaması durumunda etkin olmaktadır [3]. Kalman filtresindeki en büyük problem, çevrenin değişmesine bağlı olarak ortaya çıkan “veri ilişkilendirme” problemidir. Kalman filtresine alternatif olarak “beklenti en büyütme” algoritmaları veri ilişkilendirme problemine çözüm sunmakla beraber gerçek zamanlı olarak çalışmamaktadır [35]. Bir diğer problem ise kalman filtresinin doğrusal olmayan sistemlerde kullanılamamasıdır. Bu amaçla geliştirilen “genişletilmiş kalman filtresi” doğrusal olmayan sistemleri modellemede kullanılabilir [36].

SLAM probleminin ele alındığı ilk yıllardan günümüze kadar ağırlıklı olarak olasılığa dayalı metotlar kullanılmış ve sistem kalman filtresiyle modellenmiştir. SLAM probleminde iki temel dezavantaj bulunmaktadır. Birincisi, Kalman filtresinde veri ilişkilendirme sorunu, diğeri ise harita büyüklüğüne bağlı olarak artan işlem karmaşıklığıdır. SLAM ve Kalman filtresiyle birlikte parçacık süzgeci [37,38] algoritmalarının birleştirilmesi esasına dayanan fastSLAM algoritması hem veri ilişkilendirme problemine etkin çözüm üretebilmekte hem de SLAM’de  $\square(\square^3)$  olan algoritma hesaplama karmaşıklığını  $\square(\square\square\square)$ ’e düşürmektedir [39,40].

## 6. Sonuçlar

Bu çalışmada, otonom robot uygulamalarının en önemli problemlerinden biri olan “eş zamanlı konumlandırma ve haritalama” probleminin çözümü, ulusal ve uluslararası araştırmaların incelenmesi, sınıflandırılması ve önerilen yöntemlerin karşılaştırmaları yapılarak, elde edilen bilgiler bu alanda ilerleme kaydetmek isteyen yeni araştırmacıların istifadelerine sunulmuştur. Konumlandırma, yol planlama, engelden kaçınma ve haritalama problemleri ayrı ayrı bölümler halinde ele alınmış kullanılan yöntemler avantaj ve dezavantajları ile birlikte sunulmuştur.

## 7. Kaynaklar

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# HASAR GÖREN NARİN ÇELİK PLAKALARIN CFRP İLE ONARILMASI

Emine AYDIN, Muharrem AKTAŞ, Elif AĞCAKOCA  
Sakarya Üniversitesi  
Türkiye

[emineb@sakarya.edu.tr](mailto:emineb@sakarya.edu.tr), [muharrema@sakarya.edu.tr](mailto:muharrema@sakarya.edu.tr), [elifd@sakarya.edu.tr](mailto:elifd@sakarya.edu.tr)

**Özet** Endüstri yapılarının büyük bir bölümü çelik konstrüksiyondan oluşur ve olası bir depremde bu çelik endüstri yapıların göçmemiş ama hasar görmüş elemanları olmaktadır. Bunların hızlı ve etkili bir şekilde onarılıp, tesislerin hizmete açılması ülke ekonomisi açısından önemlidir. Ayrıca çelik alt yapı elemanlarının (köprü vs.) acil durumlarda çok kısa sürede onararak hizmete açılması, afet sonrası yardımların yerine ulaştırılması açısından önem arz etmektedir. Literatürde hasar görmüş çelik elemanların önce ısıtılıp sonra da preslenerek onarılması önerilmektedir. 1995 Hanshin-Awaji (Japonya) depreminden sonra benzer uygulamalar yapılmıştır. Bu tür onarımlar çelik elemanlarda rijitlik azalmasına sebep olduğundan dolayı servis yükleri altında geçici olarak tavsiye edilmektedir. Geçici olan bu onarımları kalıcı kılmak amacıyla ısıtılıp işlem uygulanan bölgelere karbon fiber takviyeli polimerler (CFRP) yapıştirılarak onarım yapılabilir. Bu çalışmada, ısıtılıp işlem sonucu çelik malzemede oluşacak dayanım ve rijitlik kayıpları CFRP eklenerek giderilmiştir. Çalışmada yapılan deneylerde karbon fiber takviyeli polimerler eklenerek hazırlanan çelik plakalar kullanılmıştır. Ayrıca yüzey etkisini görebilmek amacı ile bazı çelik plakalara kumlama işlemi yapılmıştır. Deneysel verilere dayanarak ısıtılıp işlem gören çelik plakalara güçlendirme yapılarak kalıcı bir onarım metodu önerilmiştir.

**Anahtar kelimeler:** CFRP, ısıtılıp işlem, çelik plakalar, kalıcı onarım.

## Giriş

Deprem ve ani yüklemeler gibi eksenel yükler altında narin olan çelik yapı elemanlarında yerel burkulmalar meydana gelebilmektedir (Şekil 1). Bu elemanlar burkulma sonucu kararsız denge haline geçebilmektedir. Bu tür elemanlar için hasar oluşan bölgeye ısıtılıp işlem uygulanarak yumuşatılması ve presleme işlemi uygulanarak geometrisinin düzeltilmesi önerilmektedir (Kim ve Hirohata, 2007). Ancak bu işlem sonucunda çelik elemanların yük taşıma kapasitelerinde ve rijitliklerinde azalma meydana gelmektedir. Bu sebeple, ısıtılıp işlem ve presleme işlemi ile yapılan onarım geçici bir çözümdür. Böyle durumlar için kalıcı bir onarım şekli geliştirilebilir.



**Şekil 1:** Basınç elemanlarında yerel burkulma

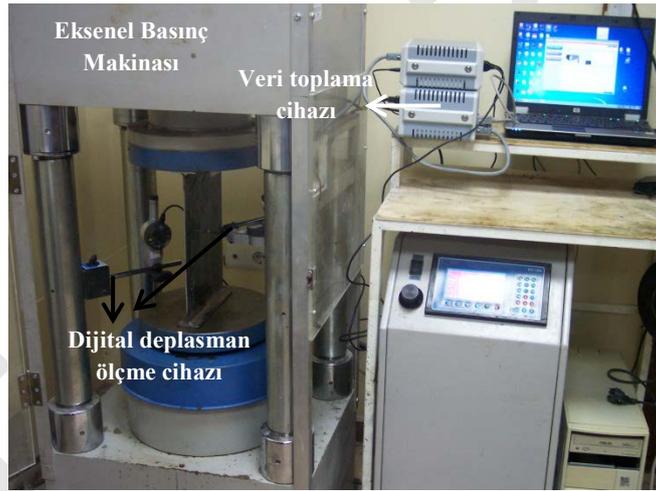
Kim ve Hirohata (2007), artı kesitli çelik basınç elemanlarının öncelikle eksenel basınç yükü uygulayarak burkulması sağlanmış, daha sonra deforme olan elemanlara ısıtılıp işlem ve presleme ile düzeltilerek tekrar eksenel basınç yükü ile test etmişlerdir. Elde edilen sonuçlarda bu iki durumda maksimum yük taşıma kapasitesi bakımından önemli bir fark bulunmadığı, ancak meydana gelen artık gerilmelerden dolayı ısıtılıp işlem uygulanan elemanların rijitliklerinde azalma meydana geldiğini gözlemlemişlerdir. Hirohata ve diğerleri (2004), ısıtılıp işlem ve presleme işlemi uygulanan artı kesitli çelik elemanları burkulma deneyine tabi tutarak yük ve düşey deplasman verileri elde etmişlerdir. Presleme işleminin levha birleşim noktalarında tam olarak yapılamaması ve bunun sonucu olarak kalıcı deplasmanların giderilememesinden dolayı elemanların basınç altında davranışlarının değişmekte olduğunu göstermişlerdir. Kim ve Hirohata (2008), yaptıkları çalışmada, içi boş olan kare kesitli çelik kolonlar kullanmışlardır. Bu kolonlara burkulma deneyinin ardından ısıtılıp işlem ve presleme işlemi uygulamışlardır. Kolonların maksimum yük taşıma kapasitelerinde çok

önemli bir değişiklik olmadığını, burkulma modlarının değiştiğini, kalıcı gerilmeler ve sertlikteki değişiklikler nedeniyle elemanın burkulma yükü altındaki davranışının değiştiğini hem deney hemde sonlu elemanlar modelini oluşturarak göstermişlerdir. Dolayısıyla onarım için yapılan bu işlemler sonrasında kesit rijitliğinde azalma, olası burkulma modunda değişiklik ve geometrik kusurlarda artış olmaktadır. Güven (2009), çelik plakaların yerel burkulma performanslarını artırmak üzere çelik plakalara cam fiber takviyeli polimerler eklemiş ve elemanların basınç performanslarının %11 arttığını raporlamıştır. Harries ve diğerleri (2008), yapısal çelik kesitlerin basınç altında kararlılık durumlarını artırmak amacıyla hem CFRP hem de GFRP kullanmış ve özellikle kesitlerin yerel burkulma davranışında olumlu katkılar sağladıklarını belirtmişlerdir.

Bu çalışmada, literatürde geçici olarak önerilen ısıt ve presleme işlemi ile yapılan onarımı kalıcı hale getirebilmek için CFRP plakalar kullanılması önerilmiştir. Bu sayede azalan dayanım ve rijitlikler artırılmıştır. Çalışmada uygulama kolaylığı, ekonomi ve bütün çelik eleman kesitlerinin plakaların birleştirilmesi sonucu olduğu gerçeğinden yola çıkılarak küçük ölçekli çelik plakalardan oluşan deney numuneleri seçilmiştir. Yüzey etkisini görebilmek amacı ile çelik plaka üzerine kumlama işlemi yapılmıştır. Kalıcı onarımda CFRP plakaların kullanılmasının dayanıma etkisi deneyler ile gösterilmiştir.

## Deney Düzenegi

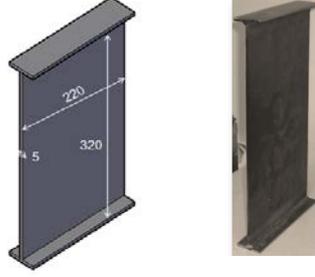
Eksenel basınç deneyi yapabilmek için, eksenel basınç makinası, deplasman ölçer, veri toplama cihazı ve verilerin aktarma cihazı kullanılmıştır (Şekil 2). Deneylerden elde edilen veriler bilgisayara aktarılmıştır. Kullanılan eksenel basınç makinası 3000 kN kapasitelidir. Deplasman ölçme cihazları yatay ve düşey doğrultudaki deplasmanları ölçebilmek için iki adet kullanılmıştır. Yatay doğrultudaki cihaz deney numunesinin yatay ve düşey doğrultusunda tam orta kısma yerleştirilmiştir. Düşey doğrultudaki cihaz ise alt mesnet referans alınarak yerleştirilmiştir. Veri toplama için kullanılan cihaz eksenel basınç makinası ve deplasman ölçerlerin bağlandığı, 8 kanaldan veri alabilen, saniyede 8 veriyi kaydedebilen kapasitededir. Ayrıca özel bir yazılım ile verileri bilgisayara aktarmaktadır.



Şekil 2: Eksenel basınç deney düzenegi ve ölçüm cihazları

## Deney Numunelerinin Hazırlanması

**Çelik Plakalar:** Çelik yapılarda kullanılan bütün elemanlar plakaların birleştirilmesi sonucunda oluşmaktadır. Dolayısıyla plakalar kullanılarak yapılacak olan deneyler ile çelik profillerinde meydana gelecek davranışlar elde edilebilir. Bu nedenle yapılan deneylerde çelik plakalar kullanılmıştır. Plakalara yüklemenin eşit yapılabilmesi ve deney düzeneginde dengede durabilmesi için alt ve üst taraflarından başlıklar eklenmiştir. Bu şekilde deney numuneleri alt ve üst kısımlarından kaynaklanmıştır. Kullanılan plakaların boyutları deney düzenegine bağlı olarak  $b:220$  mm,  $t: 5$  mm ve  $L: 320$  mm olarak seçilmiştir (Şekil 3). Bu şekilde  $b/t= 44$ ,  $L/b= 1.45$  olan çelik plakalar hazırlanmıştır. Hazırlanan bu plakalar eksenel basınç deneyi ile burkulmuştur.



Şekil 3: Çelik plaka deney numuneleri

**Isıl İşlem ve Düzeltme:** Eksenel basınç deneyi ile burkulan plakalara eski şeklinin verilmesi amacı ile ısıl ve presleme işlemi uygulanmıştır. Isıl işlem oksijen-gaz alevi ile verilmiştir. Bu sırada çelik malzemenin dönüşüm sıcaklığı olan A1 (550~650 °C) değerine ulaşmaması için sıcaklık ölçümü yapılmıştır. Bu işlem için thermocouple cihazı kullanılmıştır. Sıcaklıklar düzenli olarak hem cihaz ekranından, hemde cihazda toplanan verilerin bilgisayara aktarılması ile kontrol edilmiştir. Bu cihaz -200 ile +1370 °C aralığında ölçüm yapabilecek kapasitededir ve 16000 adet veriyi kaydedebilme özelliğine sahiptir.

Isıl işlem uygulamasının hemen ardından presleme işlemine geçilmiştir. Böylece plakalarda burkulma şekli ortadan kaldırılmış ve çelik plakaların şekilleri düzeltilmiştir (Şekil 4). Ayrıca gerçekte de yerel burkulma meydana gelen çelik plakalara yerinde bu işlem uygulanabilir.



a. Isıl işlem ve thermal couple ile ölçüm alınması



b. Isıl işlem sonrası elemanın preslenerek düzeltilmesi

Şekil 4: Çelik Plakalara ait ısıl işlem ve presleme işlemi uygulama adımları

**Kumlama:** Çelik plakalara kalıcı onarım yapabilmek için CFRP eleman yapıştırılmasında yüzey etkisini görebilmek amacı ile kumlama işlemi yapılmıştır. Bu sayede kullanılan yapıştırıcı ile çelik plaka arasında herhangi bir değişiklik olup olmayacağı gözlenmiştir. Şekil 5' te kumlama işlemi yapılmış çelik plakalara ait resim görülmektedir.



Şekil 5: Çelik plakalara kumlama işlemi yapılması

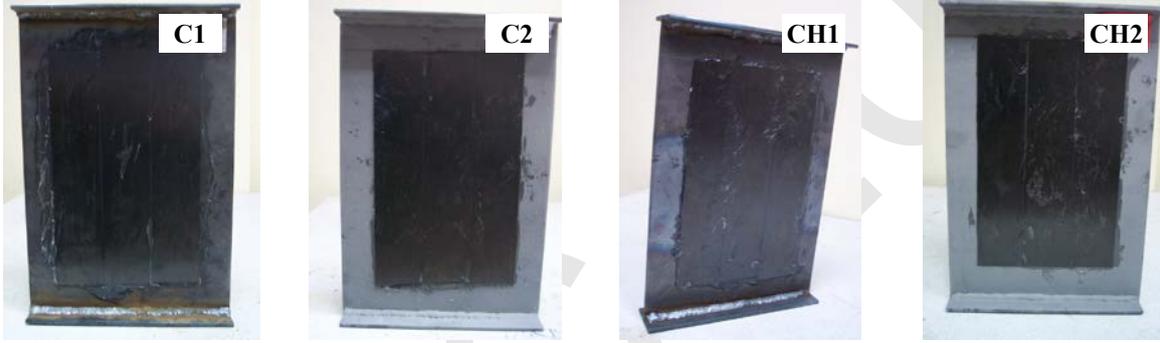
**CFRP Yapıştırma:** Isıl işlem uygulanmayan ve uygulanan çelik plakalara ek olarak birde kumlama işlemi yapılan plakalara CFRP yapıştırılmıştır. Kullanılan CFRP 50 mm genişliğinde, 250 mm yüksekliğinde ve 1.2 mm kalınlığındadır. Yapıştırma işleminde daha önce mekanik özellikleri belirtilen yapıştırıcı kullanılmıştır. Üretici firmanın belirttiği oranlarda ve oda sıcaklığında mikser kullanılarak homojen olacak şekilde hazırlanmıştır. Hazırlanan epoksi CFRP yüzeylerine homojen bir şekilde mümkün olduğunca aynı kalınlıkta sürülmüştür. Yapıştırıcı sürülen CFRP elemanlar Şekil 6' da gösterildiği gibi üç adet yan yana boşluksuz ve çelik plaka kenarlarına 35 mm mesafede olacak şekilde yapıştırılmıştır. Yapıştırıcının homojen olarak yayılmasını sağlamak amacıyla işkence denilen aletler ile sıkıştırılmıştır (Şekil 6).



Şekil 6: Yapıştırma ve sıkıştırma işlemleri

Çelik yüzeye yapıştırılan CFRP 'ler üretici firmanın yapıştırıcı için belirttiği sertleşme süresi doluncaya kadar işkence aletleri ile sıkıştırılmıştır. Bu süre dolduğunda işkence aletleri sökülüştür ve numuneler deney yapılmaya hazır hale gelmiştir (Şekil 7).

Isıl işlemli ve işlemsiz, kumlmalı ve kumlamasız olmak üzere 4 adet deney grubu oluşturulmuştur. Her bir deney grubundan ikişer adet numuneler hazırlanmıştır. Numunelere C1, C2, CH1 ve CH2 isimleri verilmiştir. Bu isimlerden; C1: herhangi bir ısıl işlem görmemiş (referans) çelik plakasının üzerine CFRP yapıştırılan, C2: herhangi bir ısıl işlem görmemiş (referans) çelik plakasının üzerine kumlama işlemi yapıldıktan sonra CFRP yapıştırılan, CH1: ısıl işlem görmüş (ısı) çelik plakasının üzerine CFRP yapıştırılan, CH2: ısıl işlem görmüş (ısı) çelik plakasının üzerine kumlama işlemi yapıldıktan sonra CFRP yapıştırılan numuneleri temsil etmektedirler.



Şekil 7: Hazırlanan deney grupları

## Deneylerde Kullanılan Malzemelerin Özellikleri

Isıl işlem görmüş çelik plakalara yapılacak olan kalıcı onarım deneylerinde, ilk önce herhangi bir ısıl işlem görmemiş çelik plakalara aksel basınç deney yapılarak burkulmaları sağlanmıştır. Daha sonra burkulmuş bu plakalar oksijen-gaz alevi ile ısıtılarak yumuşatılmış ve hemen ardından preslenmiştir. Bu şekilde plakaların ilk şeklini alması sağlanmıştır. Isıl işlem gören plakalara yapıştırıcı kullanılarak CFRP (karbon fiber takviyeli polimerler) eklenmiştir. Deneylerde kullanılan çelik, CFRP ve yapıştırıcı malzemelerine ait mekanik özellikler yapılan deneylerden ve üretici firmalardan alınmıştır. Kullanılan malzemelere ait özellikler aşağıda sıra ile verilmiştir.

**Çelik:** Deneylerde kullanılan çelik levhalar için St 37 çeliği kullanılmıştır. Herhangi bir ısıl işlem uygulanmayan çelikler "Referans", ısıl işlem uygulanan çelikler ise "Isıl" olarak adlandırılmıştır. Malzemenin mekanik özelliklerini belirlemek amacıyla yapılan aksel çekme deneyi için deney numunelerinden üçer adet örnekler alınmıştır. Alınan örnekler ASTM A370-10 (2010) standardına göre boyutlandırılmıştır. Yapılan deney sonucunda hem referans hem de ısıl çelik numuneler için gerilme-şekil değiştirme grafikleri elde edilmiştir. Elde edilen sonuçlar Tablo 1' de gösterilmiştir.

Tablo 1: Referans ve Isıl çelik numunelerin mekanik özellikleri.

|                         | Referans | Isıl   |
|-------------------------|----------|--------|
| Elastisite Modülü (MPa) | 210000   | 210000 |
| Akma Dayanımı (MPa)     | 350      | 315    |

**CFRP:** Deneylerde kullanılan CFRP elemanlar, korozyon riski olmayan, çok yüksek dayanıma sahip, hafif, sınırsız boyda imal edilebilen ve bu sayede ek yapılmasına ihtiyaç duyulmayan, kolay taşınan, mükemmel yorulma dayanımına sahip, katmanlar halinde uygulanabilen özelliklere sahiptir. Deneylerde kullanılan CFRP plakalar 50 mm genişliğinde, 1.2 mm kalınlığında ve 250 mm uzunluğundadır. Bu plakaların mekanik özelliklerinin belirlenmesi amacıyla, numune boyutları ilgili standartlara (ASTM D 3039 M-08 2007, TS EN ISO 527-4 2007, TS EN ISO 527-5 2010) ve deney şartlarına uygun şekilde hazırlanmış üç adet numune çekme deneyine tabi tutulmuştur. Elde edilen sonuçlar Tablo 2' de gösterilmiştir.

**Tablo 2:** CFRP numunelerin mekanik özellikleri.

|                         | CFRP   |
|-------------------------|--------|
| Elastisite Modülü (MPa) | 165000 |
| Çekme Dayanımı (MPa)    | 1300   |

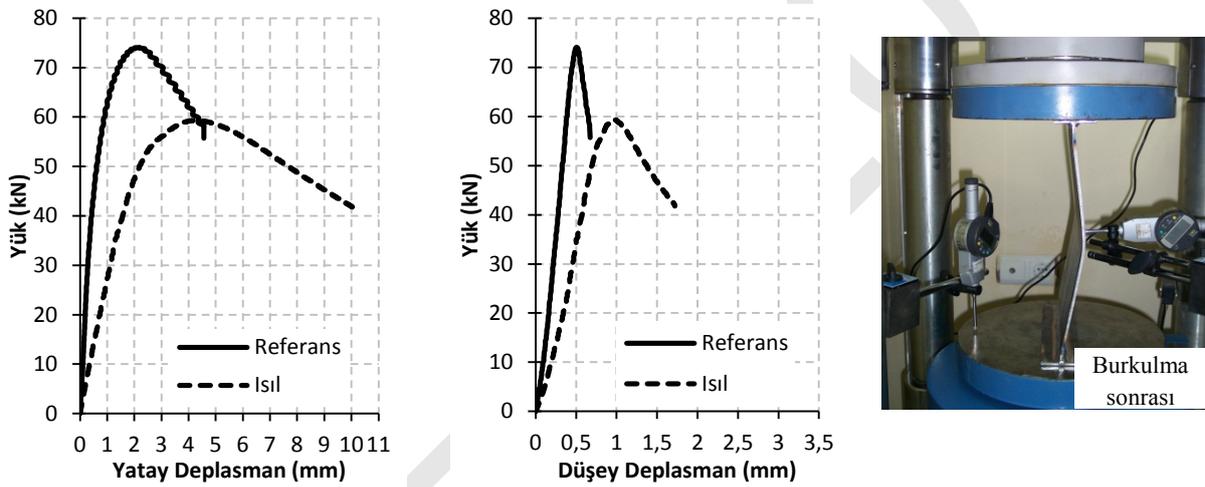
**Yapıştırıcı:** Huntsman Araldite AW-106 isimli yüksek mukavemet ve tokluğa sahip olan bu epoksi yapıştırıcı ve sertleştirici olmak üzere iki bileşenlidir. Bileşenler üretici firmanın belirttiği miktarlarda (1/1 oranında) homojen olarak karıştırılmıştır. Yapıştırıcının kuruma süresi iki gündür. Yapıştırıcıya ait özellikler Tablo 3’ te verilmiştir.

**Tablo 3:** Yapıştırıcı özellikleri

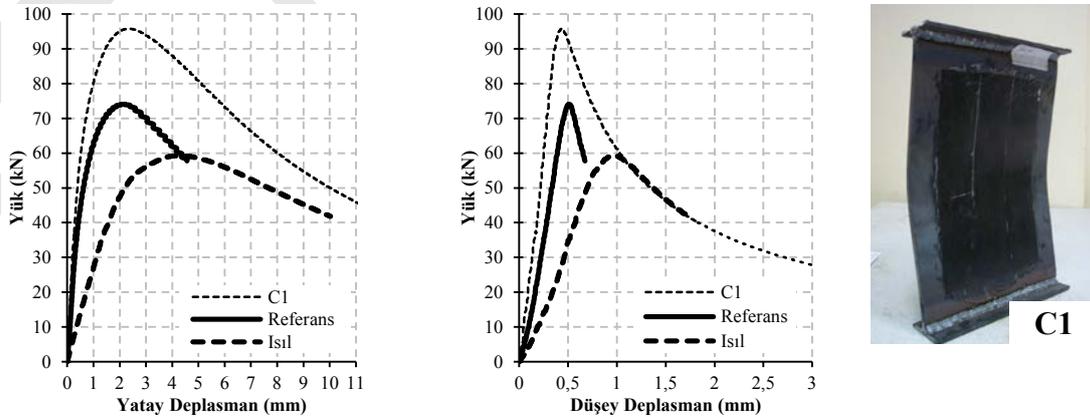
|             | Elastisite Modülü (MPa) | Yoğunluk (gr/cm <sup>3</sup> ) |
|-------------|-------------------------|--------------------------------|
| Yapıştırıcı | 1900                    | 1.13                           |

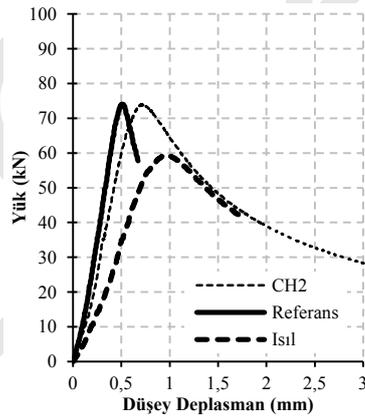
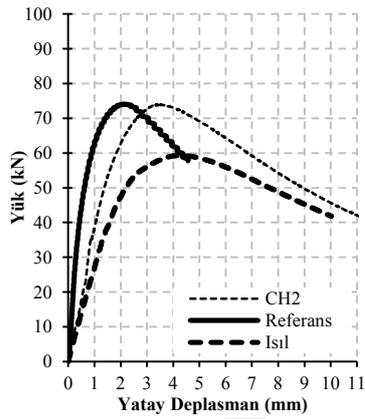
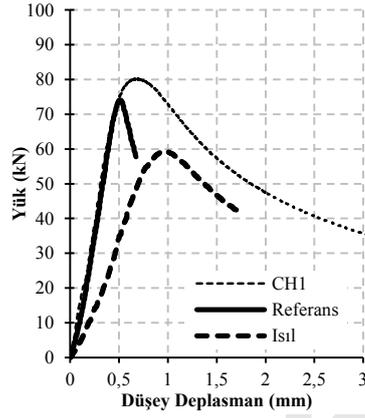
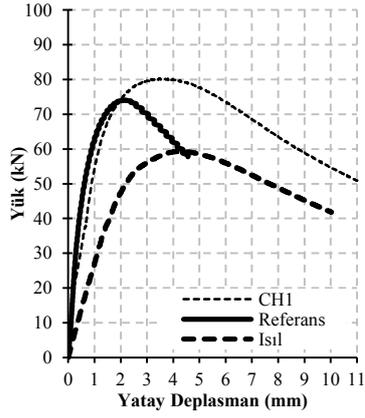
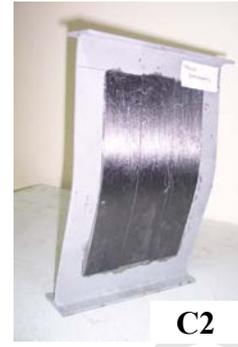
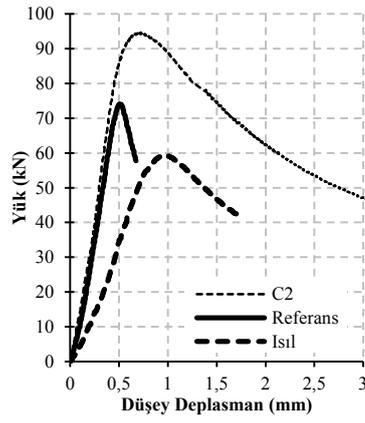
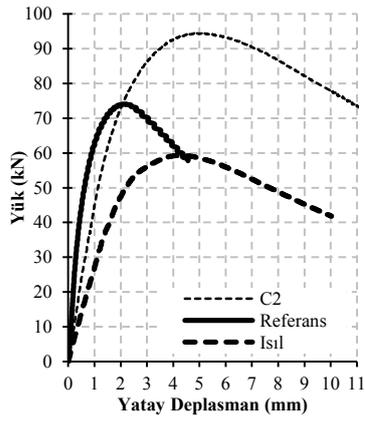
## Deney Sonuçları ve Değerlendirme

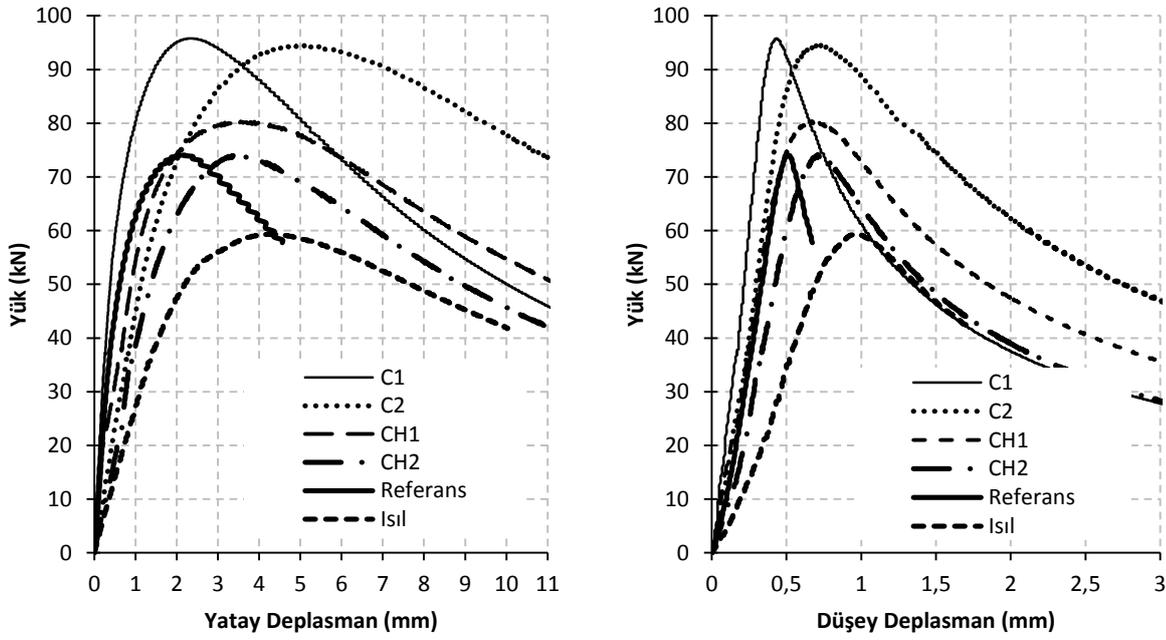
Yukarıda belirtilen deney düzeneği ile ilk önce Referans ve Isıl deney numuneleri eksenel basınç deneyi yapılmıştır. Bu numuneler sadece çelik plakalardan oluşmaktadır ve herhangi bir CFRP ile güçlendirme işlemi yapılmamıştır. Deneylerden elde edilen veriler ile her iki tür numune için yük-yatay ve düşey deplasman grafikleri çizilmiştir (Şekil 8). Bu grafikler incelendiğinde ısıl işlem uygulanan çelik plakaların yük taşıma kapasitelerinde % 20’ lik bir dayanım azalması olduğu görülmektedir.


**Şekil 8:** Referans ve Isıl çelik plakaların yük-deplasman grafikleri

Azalan dayanımı arttırmak amacı ile hazırlanan C1, C2, CH1, CH2 isimli CFRP ile güçlendirilen çelik plakaların eksenel basınç deneyleri yapılmıştır. elde edilen verilerin grafikleri hazırlanmıştır. Bu grafikler ve numunelerin deney sonrası görüntüleri Şekil 9’ da verilmiştir. Grafikler her bir deney grubu için ayrı ayrı ve bir arada olacak şekilde gösterilmiştir.







Şekil 9: CFRP ile güçlendirilen çelik plakalara ait yük deplasman grafikleri

Elde edilen veriler ışığında bütün numunelere ait maksimum yükler, referans ve ısıtılmış numuneler ile karşılaştırıldığında Tablo 4' teki sonuçlar elde edilmiştir. Bu sonuçlara göre CFRP eklenen bütün deney numunelerinde dayanım ve rijitlik artışı sağlanmıştır.

Tablo 4: Güçlendirilmiş plakaların referans ve ısıtılmış numunelere göre artış yüzdeleri

|          | Maximum Yük<br>(kN) | % Artış<br>(Isıtılmış Göre) | % Artış<br>(Referansa Göre) |
|----------|---------------------|-----------------------------|-----------------------------|
| C1       | 95.80               | 61.5                        | 29.4                        |
| C2       | 94.56               | 59.4                        | 27.7                        |
| CH1      | 80.35               | 35.5                        | 8.0                         |
| CH2      | 74.09               | 24.9                        | 0.04                        |
| Referans | 74.06               | ---                         | ---                         |
| Isıl     | 59.31               | ---                         | ---                         |

## Sonuçlar

Elde edilen sonuçlar incelendiğinde aşağıdaki sonuçlar elde edilmiştir.

- Genellikle elemanların çekme bölgelerinde kullanılan CFRP elemanların aksel basınç yükü altında da etkili olduğu görülmüştür.
- Kumlama işlemi yapılan elemanların, yapılmayanlara göre dayanımlarının düşük olduğu tespit edilmiştir.
- Herhangi bir ısıtılmış işlem yapılmamış çelik plakalara, yukarıda belirtilen kesitte ve boyutlarda CFRP ile güçlendirme yapıldığında % 61.5 oranında bir dayanım artışı sağlanmıştır.
- Isıtılmış işlem yapılan çelik plakalara, yine belirtilen kesitte ve boyutlarda CFRP ile güçlendirme yapıldığında % 35.5 oranında bir dayanım artışı elde edilmiştir.
- Yerel burkulma hasarı oluşmuş çelik elemanlara ısıtılmış ve presleme işleminin ardından CFRP eleman yapıştırılması ile kalıcı bir onarım yapılabileceği sonucuna varılmıştır.

## Teşekkür

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# HEAVY METAL SCAVENGING EVALUATION OF *IN VITRO* GROWN *BRASSICA CAMPESTRIS* VAR. SARSOON FROM THE TANNERIES CONTAMINATED SOIL USING ATOMIC ABSORPTION SPECTROSCOPY

Farah Khan\* and Faiza Khan

Molecular Genetics and Plant Biotechnology Lab

Department of Botany, LC Women University, Lahore

\*Corresponding author's e-mail: drfarah\_khann@yahoo.com

**Abstract** The study was conducted to evaluate and compare the scavenging efficiency of *in-vivo* and *in-vitro* grown *Brassica campestris* var. Sarsoon, for the uptake of Lead and Chromium (two major components of inorganic contaminants in the tanneries contaminated soils) using Atomic Absorption Spectroscopy. *In vitro* plants were grown on MS basal medium containing 2,4-D (2.5 mg/l). Both *in-vivo* and hardened *in-vitro* grown plants were shifted to contaminated soil near Kasur Tanneries. After 60 days of growth in this contaminated soil, the plants bioassays were subjected to Atomic Absorption Spectroscopy for the estimation of lead and Chromium uptake. The *in-vivo* grown *Brassica* plants absorbed much lesser amount of both the metals (2.69 & 1.62 ppm) as compared to *in-vitro* grown plants which showed higher ranges (4.61 & 2.69 ppm) of Pb and Cr respectively. The results supported our idea that, in future, the *in-vitro* grown hyper accumulator plants specially weeds can be used as an effective and better tool of phytoremediation (compared to field grown ones) for the removal of heavy metals through their rhizosphere scavenging action, from the contaminated lands on a wider scale.

**Keywords.** Phytoremediation, *In-vitro* grown plants, Lead, Chromium, Inorganic contaminants, Scavenging evaluation.

## Introduction

Tanning industry always gives rise to serious environmental problems in countries lacking implementation of environmental regulations. Currently, the contamination of the environment by by-products of rural and mining industries is the most threatening problem. District Kasur in Punjab Province of Pakistan represents such an area, which is being spoiled by tanning industry due to deposition of its lethal exudates in the local soils, damaging their biological life on a wider scale.

Hundreds of thousands of acres of country's lands area are disturbed and polluted by these contaminants. Some of these lands are in remote locations making cleanup very difficult. Others have minimal funds for cleanup or are so large that cleanup becomes economically impractical. There is a need for low energy green technologies that can be applied at these sites.

Phytoremediation is considered as the most emerging field of environmental biotechnology. Most of the soil contaminants can be removed by many other physical methods but the heavy metal pollution of vast cultivated land is a serious threat to the agricultural biology because of their prolonged stay in the soil. The plants roots have natural ability to absorb the heavy metals of the soil thus behaving as phytoremediates. Metals uptake using plants provides an environmental friendly solution of the soil pollution, which is a low cost, *in-situ* process, energized by solar energy (McCutcheon and Schnoor, 2003).

Many plants species behave as hyper accumulators of the metals, depending upon their scavenging efficiency, and ability to accumulate these metals in the different cellular compartments of their cells. The metals pass through the root cell membrane to the symplast, inside the cell, then metals could be passed to the vacuoles, (where they are degraded enzymatically) by membrane metal transporters, and are deposited there with the help of metallothioneins i.e metal-binding proteins.

Heavy metals replace other essential metals in pigments inside the cellular structure, destroying the natural balance of these molecules (Manios *et al.*, 2003). They may cause oxidative stress too, especially transition metals like  $Fe^{2+/3+}$  and  $Cu^{+2+}$  (Rivetta *et al.*, 1997).

Plant tissue culture provides a selected environment for the evaluation of many limiting factors. It is in extensive use nowadays, to obtain variants with variable tolerance to different biotic stresses (Ben-Hayyim, 1987; Santos-Díaz and Ochoa-Alejo, 1994). This technique is also found to be useful for cultured plant organs to know the metal accumulation properties by each separate plant part e.g the removal of  $Sr^{2+}$  using shoots of *Solanum laciniatum* (Kartosentono *et al.*, 2001), and Cd hyper-accumulation by roots of *Thlaspi caerulescens* (Nedelkoska and Doran,

2000).

Atomic Absorption Spectroscopy is an alternative, simple and rapid technique for quantitative isolation of the group of eight elements (Al, Ca, Cd, Cu, Fe, Mg, Pb and Zn) from vegetable material (Wieteska *et al.*,1998). The proposed method allows to obviate the organic matrix destruction stage, shortens the analyte dissolution time, reduce cost, and minimize hazards of loss and contamination. Therefore main objective of the present study is to evaluate and compare the Lead and chromium uptake by *in vivo* and *in vitro* grown *B.campestris* var Sarson with the help of Atomic Absorption Spectroscopy (AAS).

The present research was aimed to study the accumulation of heavy metals ( Pb & Cr) in the plant body of *B.Campestris*. It can help identify the comparative efficiency potential of plants to remediate the metals from the contaminated soil in which they were cultivated.This study also examined the growth performance and physiological responses of these plants under contamination stress.

So by employing this method, one may be able to find the effect of heavy metal contamination to the plant body as well as to give practical implementation of phytoremediative use of tissue cultured plants and their future prospects on a wider scale in future.

## Materials and Methods

This piece of work was divided into two steps:

1. The *in-vivo* and *in -vitro* growth of *B.campestris* var Sarson and the hardening of the *in-vitro* *B.campestris* and its transfer, along wit *in-vivo* grown *B.campestris*, to the Pb and Cr polluted soils of Kasur tanneries for a period of 60 days.
2. Estimation of Lead and Chromium uptake by these plant( grown in contaminated soil) using Atomic Absorption Spectroscopy.

### 1. The *in-vivo* and *in -vitro* growth of *B.campestris*.

For *in-vivo* growth the certified seeds of *B.campestris* were sown in the normal soil of Lw university and were grown for 60 days. For the *in -vivo* growth, the explants were taken from the wild *B.campestris*, were cultured and then subcultured in the PGRs optimum media for 60 days.

For the *in-vitro* growth, following protocol was followed.

#### a. Medium and Phyto Growth Regulators (PGRs):

MS (Mrashaige and Skoog, 1962) basal medium was used. Different PGRs were used separately and in combinations in MS basal medium as follows to select the best one.

- i. 2, 4-D,2.5mg/l
- ii. BAP, 0.5mg/l
- iii. NAA,1.0mg/l
- iv. 2, 4-D,2.5mg/l+BAP,0.5mg/l

#### b. Physical Factors:

Sucrose was added to medium at 3% concentration (30g/l).The optimum temperature required for culture environment was maintained at  $25\pm 2^{\circ}\text{C}$ . The cultures were incubated at 16 hours light period (under cool light fluorescent tubes,with light intensity of 2000-3000 lux) and the pH of the medium was adjusted between 5.6-5.7.

#### c. Hardening and shifting of the plants to the Kasur Tanneries contaminated soil

*In vitro* grown plants were shifted to the sterilized soil of different grades and and gradually to the normal regular soil in order to harden the plants.These plants and other set of field grown plants were shifted to the contaminated soil near Tanneries located in vicinity of Kasur city .

**d. Plan of experiment and data recording:** Three sets of each experiment were designed with three replica of each experiment. The cultured explants were observed after inoculation and the contamination percentage, percentage of callus formation and number of frequency of micro-propagated plants per explants after given culture period was worked out.Mean deviation was calculated after using SPSS software(Levesque,2007) following Steel *et al* (1997).

## 2. Estimation of Lead and Chromium uptake by *in-vivo* and *in-vitro* *B.campestris* using Atomic Absorption Spectroscopy (AAS) after their shifting to Pb and Cr contaminated soils:

Atomic Absorption Spectroscopy (AAS) provides accurate quantitative analysis for metals in water, sediments, soils or rocks. Samples are analyzed in solution form, so solid samples must be leached or dissolved prior to analysis. The second step of the study was to estimate the Lead and Chromium uptake by *B.campestris* (Phyto remediation) using AAS. All chemicals and reagents used in the study were of analytical grade and were used without further purification. Solutions were prepared in double distilled water.

**a. Preparation of Biomass:** Elements in plants parts cannot be detected directly by atomic absorption spectroscopy, so solutions for plants were prepared by wet digestion method and then samples were analyzed to determine the concentration of metal ions. After collecting leaves of plant they were washed with double distilled water to remove dust from plant. These leaves were then dried in an oven. The dried plants were then digested. The same procedure was done with *in vitro* grown plants except that regenerated plants were not sterilized.

**b. Methods for digestion:** The dried plant leaves were weighed separately and 5.0g of them was taken in a round bottom flask. The dried material was ashed in crucible muffle furnace at 500C for 1 hour. The residue was then wet digested by HCl/HNO<sub>3</sub> 5ml (1:3) and heated till dryness. After drying 5ml of HNO<sub>3</sub> was added in the same beaker and heated for 5-10 minutes. The volume was adjusted up to 50 ml with double distilled water and then was filtered. The sample solutions were ready to be aspirated in AAS. These sample solutions of *in vivo* and *in vitro* grown leaves were kept at 4°C with UV protection in amber bottles.

## Results and Discussion

It was found that among all the PGRs and their combinations 2, 4-D was the best PGR for the *invitro* growth of *Brassica campestris*. The effect of different concentration of the 2, 4-D (mg/l) on *in vitro* growth of *Brassica campestris* in MS medium using different explants is given in table 1 and text figure 1. Twenty-five cultures were inoculated for each explant and the best response was observed in leaf explants and gave maximum percentage of *invitro* growth i.e. 79% in the medium containing 2, 4-D (2.5 mg/l), whereas the minimum percentage i.e. 46% was found in 2, 4-D (1.0mg/l). Nodal explants gave highest percentage of growth i.e. 68% in 2, 4-D (2.5 mg/l), while in medium containing 2, 4-D (1.0mg/l) showed a lowest percentage of growth i.e. 33%. The bud explants showed the maximum percentage of growth i.e. 66% in 2, 4-D (2.5mg/l), whereas the minimum percentage of growth i.e. 37% was found in 2, 4-D (1.0mg/l). Internode explants gave the maximum percentage of growth i.e. 52% in the medium containing 2, 4-D (2.5mg/l), while the minimum growth i.e. 22% was found in 2, 4-D (1.0mg/l).

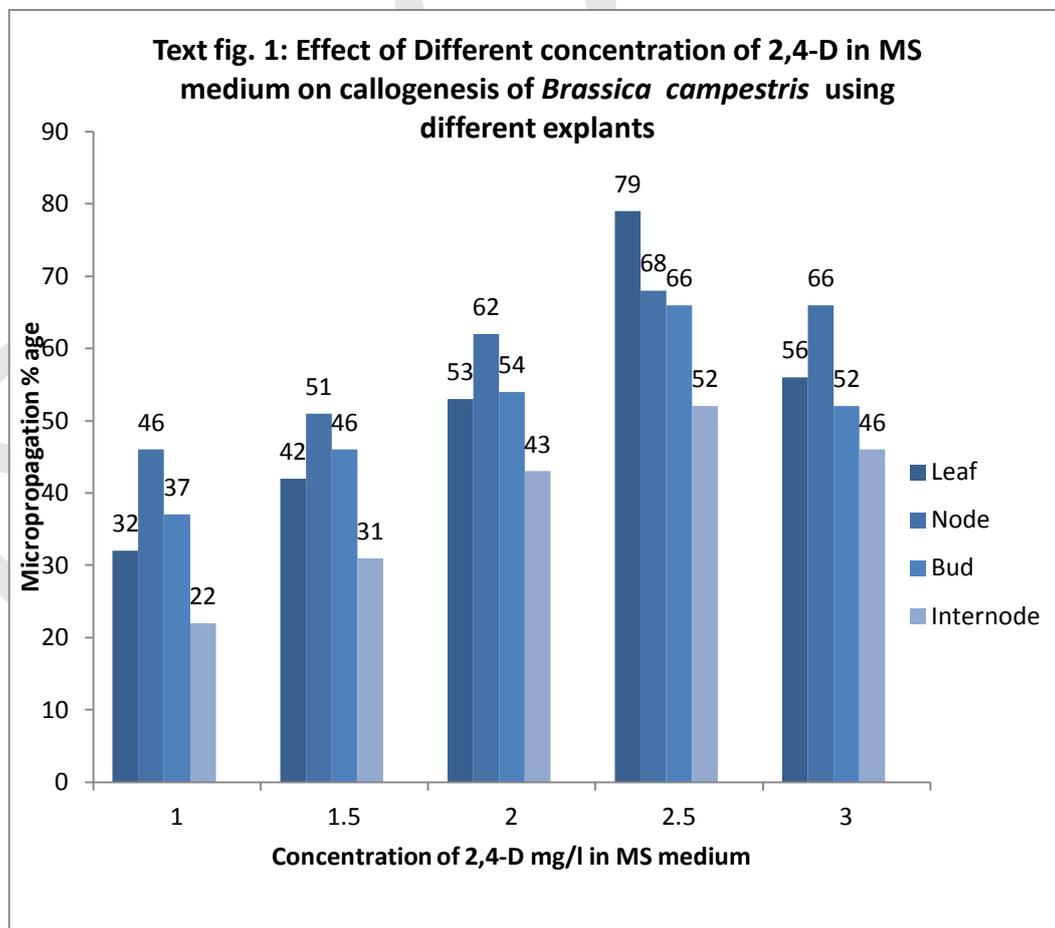
**Table.1: Effect of different concentration of 2,4-D (mg/l) on *in vitro* growth of *Brassica campestris* using different explants.**

| Sr. no. | Expalnts Used | 2,4-D(mg/l) used | Number of cultures inoculated | Callogenesis and micropropagation mean (%) | LSD value |
|---------|---------------|------------------|-------------------------------|--|-----------|
| I.      | Leaf          | 1.0              | 25                            | 33±0.51 <sup>cd</sup>                      | 1.46      |
|         |               | 1.5              | 25                            | 42±0.58 <sup>c</sup>                       |           |
|         |               | 2.0              | 25                            | 53±0.57 <sup>b</sup>                       |           |
|         |               | 2.5              | 25                            | 79±0.34 <sup>a</sup>                       |           |
|         |               | 3.0              | 25                            | 56±0.22 <sup>b</sup>                       |           |

|      |            |            |           |                            |      |
|------|------------|------------|-----------|----------------------------|------|
| ii.  | Node       | 1.0        | 25        | 46±0.11 <sup>cd</sup>      | 1.23 |
|      |            | 1.5        | 25        | 51±0.39 <sup>c</sup>       |      |
|      |            | 2.0        | 25        | 62±0.41 <sup>b</sup>       |      |
|      |            | <b>2.5</b> | <b>25</b> | <b>68±0.21<sup>a</sup></b> |      |
|      |            | 3.0        | 25        | 66±11 <sup>b</sup>         |      |
| iii. | Bud        | 1.0        | 25        | 37±57 <sup>cd</sup>        | 1.67 |
|      |            | 1.5        | 25        | 46±0.58 <sup>c</sup>       |      |
|      |            | 2.0        | 25        | 54±0.31 <sup>b</sup>       |      |
|      |            | <b>2.5</b> | <b>25</b> | <b>66±0.47<sup>a</sup></b> |      |
|      |            | 3.0        | 25        | 52±0.37 <sup>b</sup>       |      |
| iv.  | Internodes | 1.0        | 25        | 22±0.99 <sup>cd</sup>      | 1.83 |
|      |            | 1.5        | 25        | 31±0.52 <sup>c</sup>       |      |
|      |            | 2.0        | 25        | 43±0.41 <sup>b</sup>       |      |
|      |            | <b>2.5</b> | <b>25</b> | <b>52±0.32<sup>a</sup></b> |      |
|      |            | 3.0        | 25        | 46±1.32 <sup>b</sup>       |      |

± =Standard error of the mean

The mean with different letter in each column are significantly different according to Duncan's multiple range test (0.005p value)



As far as, physical factors were concerned, it was noted that maximum and minimum *in vitro* growth, i.e 79% and 20% were seen at  $25\pm 2^{\circ}\text{C}$  and  $18\pm 2^{\circ}\text{C}$  respectively (Table 2). It was also observed that *Brassica campestris* in liquid medium gave only 5% *in vitro* growth. Whereas, solidified medium (using Difco-Bacto agar as solidifying agent) gave 79% *in vitro* growth for the plant (Table 3). The effect of different photoperiods was also observed and it was concluded that 16hrs photoperiod (3000 lux) showed 80% *in vitro* growth and zero hour photoperiod (complete dark) gave minimum, i.e.10% *in vitro* growth rate of the plant (Table 3). Most suitable pH value for *in vitro* growth was found to be 5.7 with 79% i. e maximum percentage. Where as for pH 5.9 minimum, i.e. 25% *in vitro* growth was noted for *Brassica campestris*.

**Table 2: Effect of temperatures & pH on *in vitro* growth of leaf explants of *Brassica campestris* in MS medium using 2, 4-D,2.5mg/l.**

| S.No | Physical factors                   | Ranges    | Maximum % <i>In vitro</i> growth (% mean) |
|------|------------------------------------|-----------|---|
| 1.   | Temperature ( $^{\circ}\text{C}$ ) | $25\pm 2$ | $79 \pm 1.93$                             |
| 2.   | pH                                 | 5.7       | $79\pm 2.08a$                             |

**Table 3; Effect of Agar Solidified medium & Photoperiod on *in vitro* growth of leaf explants of *Brassica campestris* in MS medium using 2,4-D,2.5mg/l**

| S.No | Physical factors              | Maximum% <i>In vitro</i> growth (% mean) |
|------|-------------------------------|--|
| 1.   | 16 hrs Photoperiod (3000 lux) | $79\pm 2.60$                             |
| 3.   | Agar Solidified Medium        | $79\pm 1.78$                             |

On the basis of observations made for physical factors and nature of media it was concluded that maximum *in vitro* growth i.e 79% was seen at  $25\pm 2^{\circ}\text{C}$  and minimum *in vitro* growth of *Brassica campestris*, i. e 20% was observed at  $18\pm 2^{\circ}\text{C}$ . The agar solidified MS medium supplemented with 2,4-D ( 2.5mg/l) gave 79% *in vitro* growth. Ebrahim, *et al.* (2000) reported influence of medium, solidification and pH value on *in vitro* micropropagation of shoot tip explants. The effect of different pH ranges on *in vitro* growth of *B.campestris* were also studied during the present piece of work. It was observed that the most suitable pH range was 5.7 for *in vitro* growth (Table 2). At this pH, callus formation was 80% where as 5.9 pH gave minimum growth (25%). Ebrahim, *et al.* (2000) studied the effect of pH on the *in vitro* growth of *Maranta leuconeura*. A medium with pH of 5.7 resulted in the maximum multiplication rate, shoot strength and leaves differentiation. *Maranta leuconeura* can be successfully micropropagated at pH 5.7 irrespective of nature of media, either it is liquid or solid .

The effect of different photoperiods on micropropagation of *Brassica campestris* was also recorded. It was observed that the most suitable photoperiod was 16 hours.. At this photoperiod 79% *in vitro* growth was observed and the minimum photoperiod result was 10% at 0hours photoperiod. In 2004, Morini, *et.al.* (1991) studied the effect of different photoperiods on *in vitro* growth of plum rootstock. Three photoperiods i.e16h (control), 12h and 8h were applied, with a PAR of  $39 \text{ mol m}^{-2} \text{ sec}^{-1}$ . Tips collected from *in vitro* established shoots were used. Growth medium was MS. Shoot proliferation after 45 days of growth was not statistically different between 12 h and 16 h of light, while the 8-h photoperiod gave a much lower rate of shoot formation.

The second step of this research work was to determine concentration of two mineral elements i.e; Lead (Pb) and Chromium (Cr) in *in vivo* and *in vitro* grown plant tissues of *B.campestris* after their shifting to the Kasur tanneries contaminated fields so that their comparison may be carried out.

*In vivo* grown *Brassica campestris* gave Lead and Chromium uptake up to 1.21 and 1.62 ppm. Where as in *in vitro* grown *Brassica campestris* uptake for Lead (Pb) Chromium (Cr) uptake was found to be 2.69& 4.61 ppm respectively. The concentration of Chromium (Cr) and Lead (Pb) was determined by Yuwai *et al;* (1991) in *in vivo* grown plant tissues of *Brassicaceae*. According to them was Chromium (Cr) 3.54ppm and Lead (Pb) was 5.97ppm. One of the major factors influencing trace mineral uptake in plants is the composition of the soil.

This study also leads to the conclusion that *in vitro* grown plants can behave as natural scavengers if planted to the chemically polluted soils on large scale in future.

**Table. 4:Concentration of Cr and Pb in *In-vivo* plant material of *B.campestris* determined by Atomic Absorption Spectrometry (AAS)**

| Plant used                                | Plant tissue  | Heavy metal | Concentration(ppm) | Mean%      |            |
|---|---------------|-------------|--------------------|------------|------------|
| Field grown<br><i>Brassica campestris</i> | Leaf Explants | Pb          | 2.21               | 2.21±0.000 |            |
|   |               |             | 2.21               |            |            |
|   |               |             | 2.21               |            |            |
|   |               |             | Cr                 | 1.62       | 1.62±0.000 |
|   |               |             |                    | 1.62       |            |
|   |               |             |                    | 1.62       |            |

**Table. 5: Concentration of Cr and Pb in *In-vitro* plant material of *B.campestris* determined by Atomic Absorption Spectrometry (AAS)**

| Plant used  | Plant tissue  | Heavy metal | Concentration(ppm) | Mean%      |            |
|---|---------------|-------------|--------------------|------------|------------|
| <i>In vitro</i> grown<br><i>Brassica campestris</i> | Leaf Explants | Pb          | 4.61               | 4.61±0.000 |            |
|   |               |             | 4.61               |            |            |
|   |               |             | 4.61               |            |            |
|   |               |             | Cr                 | 2.69       | 2.69±0.000 |
|   |               |             |                    | 2.69       |            |
|   |               |             |                    | 2.69       |            |

Table 4 and 5 show that Lead (Pb) and Chromium (Cr) both are in high quantity in *in vitro* grown plant tissues as compared to *in vivo* grown plant tissues which indicate that the composition of the media and soil plays an important role in mineral uptake of plants. This study also leads to the conclusion that *in vitro* grown plants can behave as natural scavengers if planted to the chemically polluted soils. In future, the purified *in vitro* grown hyper accumulator plants can be used as the natural phytoremediates and heavy metal scavengers of the toxic elements e.g Pb and Cr, for the treatment of contaminated and polluted agricultural lands on commercial scale.

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## HERBAL PLANTS OF FAMILY SOLANACEAE: EXPLORATION OF THE MEDICINAL WEALTH OF THE PAKISTAN.

Dr. Shabnum Shaheen

Lahore College For Women University, Lahore, Pakistan.

Department of Botany

[shabnum\\_shaheen78@hotmail.com](mailto:shabnum_shaheen78@hotmail.com)

**Abstract** The present project includes a comprehensive study of multiple parameters (morphology, anatomy (LM & SEM), palynology (LM & SEM), Organoleptography, UV and IR analysis, solubility, fluorescence and chemical analysis of the selected medicinal plants of family Solanaceae. i.e. *Datura stramonium* L., *Solanum nigrum* L. and *Withania somnifera* L. The present research has been carried out to update the inventory of existing natural drug plants of the country. Anatomical studies carried out have also been successful to identify the species from the taxonomic point of view. A variety of characters like epidermal cells, subsidiary cells, guard cells, trichomes, macro-hairs, micro-hairs and stomata can be used as a tool for the taxonomic grouping of different species. Pollen characters in the all the three taxa have been helpful to distinguish the taxa at species as well as at generic level. The organoleptic, ultra violet, infra red and chemical analysis of the taxa showed a lot of variation among them. and can be used as a taxonomic tool for the identification and authentication of the taxa. It is concluded that Pakistan is quite rich in medicinal plants but no systematic attempt has been made to work on these natural resources properly. Many of the plants which are used for various ailments have either not been properly investigated or the findings have not been correlated with the phytochemical and pharmacological studies. The present research work gave a comprehensive detail of the systematics along with the pharmacognosy of the selected taxa which can be used as an aid in the identification and exploration of the medicinal wealth of the Pakistan.

**Key words:** Solanaceae, Chemosystematic analysis, Leaf epidermal anatomy, Pollen analysis, organoleptography, UV & IR analysis.

### Introduction

Solanaceae is a large Family with around 3000-4000 species in 90 different genera, found in most temperate and tropical regions, (NHM 2008). It is a family mainly of herbs, with a few shrubs and trees, (ITIS, 1999). In Pakistan 14 genera and 52 species of Solanaceae are present of which 27 species are native, 6 naturalized and the others exclusively cultivated or found occasionally. The Solanaceae family is characteristically ethnobotanical that is extensively utilized by humans. Medicinally, members of Solanaceae have been prized and used throughout history (NHM 2008). About 400-600 medicinal plant species are estimated to exist in Pakistan, (ITIS 1999).

Among the medicinally important species of Solanaceae, *Solanum nigrum* L. is a fairly common herb or short-lived perennial shrub. The plant has a long history of medicinal usage, dating back to ancient Greece. This plant's leaves are used to treat mouth ulcers. The fruit is also used for diabetes. (NHM 2008). *Datura* are potent medicinal members of the Solanaceae family, relatives of other well known narcotic plants. Varied species of *Datura* have been used in traditional medicine worldwide, primary among them *Datura innoxia*, *Datura metel*, and *Datura stramonium*. *Datura* has been employed as both a medicinal and ceremonial plant in many diverse cultures including Chinese, Indian, Mexican and Native Americans of the Southwest. *Datura* has played a major role in religious rites and medicine. (Richard, 2002). *Withania somnifera* is also known as Ashwagandha. The herbal root extract has been traditionally used as a tonic and as a sedative. The leaves, berries and tubers of Ashwagandha have been in use for centuries as a home remedy and the extract is an important part of Indian Ayurvedic medicine. (NHM 2008). In Pakistan medicinal plants are primarily used by tibia dawakhanas (medical centers of indigenous physicians known as hakims). Unfortunately, very little attention has been paid to the pharmacognostic and ethno-botanical aspect of plants, as hakims are only concerned with the floral and vegetative parts of medicinal plants without any regard to their botanical characteristics, or distribution in the various ecological zones of Pakistan. In Pakistan 80% of the people belonging to the rural areas still depends upon the herbal medicines (Anonymous, 2008). In the recent years, more efforts have been made to document the traditional knowledge.

Although a lot of work has been carried out on *Solanum nigrum*, *Datura stramonium* and *Withania somnifera* but still there are certain gaps which are needed to be carried out in continuation of previous work. In this study these species were screened out for taxonomic characterization for correct identification. The pharmacognostic analysis of these medicinal plants might lead to the discovery of new herbal drugs. This study was first time done with reference to

the applications of multiple parameters and helps to identify the species, which are capable of multiple uses, as well as alternative products such as medicines.

### Materials and methods

| Sr no. | Investigations  | Methodology   |
|--------|---|---|
| 1      | <b>Anatomical Analysis<br/>LM &amp; SEM</b>                           | Leaves samples were prepared according to the method of Shaheen <i>et al.</i> , 2010. Leaves were soaked in lactic acid for a few minutes to make them soft and unfolded. Fully developed leaves were placed in test tubes containing 70% hot lactic acid and 30% ammonia solution and boiled for about 50-60 minutes to soften the leaves. The abaxial and adaxial slides of the leaves were prepared and observed by using Light Microscopy and Scanning Electron Microscopy.   |
| 2      | <b>Palynological Analysis<br/>LM &amp; SEM</b>                        | The method was followed by Wodehouse technique Ronald (2000). The pollen fertility was carried out by employing the techniques used by Meo and Khan (2004).   |
| 3      | <b>Organoleptic<br/>Analysis</b>                                      | Organoleptic analysis involved the use of sight, smell, taste, touch and macroscopy of crude drugs to evaluate plant materials often comparing the properties of a known sample with those of a reference standard. Material for organoleptic analysis was procured from herbal shops and collected from the field. All parts of herbal drugs including, wood bark, roots, rhizomes, leaves, stems, fruit, flowers and seeds of problematic medicinal plants were identified by examining macro-morphological characters. |
| 4      | <b>Microphotographs<br/>LM &amp; SEM</b>                              | Microphotographs of leaves and pollen samples were taken by Nikon (FX-35) Camera equipped light microscope and Scanning Electron Microscope   |
| 5      | <b>Phytochemical Analysis</b>   | Detection of alkaloids, glycosides, tannins, starch grains, Anthraquinones, saponins, fixed and volatile oils and acid hydrolysis is done by following the method British Pharmacopoeia, 1999.  |
| 6.     | <b>Fluorescence and<br/>Solubility Screening of<br/>Powdered Drug</b> | 5 gram powdered drug was mixed in 20 ml sulphuric acid, hydrochloric acid, acetic acid, and water to analyze the fluorescence and solubility of the herbal drugs.   |

### Results:

*Datura stramonium* L.  
Syn: *Datura tatula* L.  
*Datura stramonium* var. *tatula* (Willd.) Clarke

#### Common Name(s)

Thornapple, Stramonium, Datura, Devil's Apple, Jamestown-weed, Jimson-weed, Stinkweed, Devil's Trumpet, Apple of Peru.

#### Anatomical Analysis (LM & SEM)

In **abaxial epidermis**, the leaf epidermal cells are of polygonal type, thick smooth walled, average length of epidermal cells is 125 (90-160)  $\mu\text{m}$  and the average width is 110 (80-140)  $\mu\text{m}$ , stomata are few in number, stomatal type is diacytic, number of stomata per unit area is 4, all the stomata are open and no closed stomata are present, average length of guard cells is 27.5 (25-30)  $\mu\text{m}$  and average width of guard cells is 6 (5-7)  $\mu\text{m}$ , average length of subsidiary cells is 120 (90-150)  $\mu\text{m}$  and the average width is 40 (50-90)  $\mu\text{m}$ . Micro-hairs are present having an average length of 12.5 (10-15)  $\mu\text{m}$ . Trichomes, macro-hairs and silica bodies are absent. In **adaxial epidermis**, the leaf epidermal cells are of polygonal type, average length of epidermal cells is 93 (90-96)  $\mu\text{m}$  and the average width is 66.5 (60-73)  $\mu\text{m}$ , stomata are in abundance, stomatal type is diacytic or paracytic, number of stomata per unit area is 15, open stomata are 11 and 4 closed stomata are present, average length of guard cells is 42.5 (40-45)  $\mu\text{m}$  and average width of guard cells is 9.5 (7-12)  $\mu\text{m}$ , average length of subsidiary cells is 120 (90-150)  $\mu\text{m}$  and the average width is 40 (50-90)  $\mu\text{m}$ . Trichomes, macro-hairs, micro-hairs and silica bodies are absent. (Plate 1a, 1b, 1c, 1d).

#### Palynological Analysis (LM & SEM)

In equatorial view, the pollen are circular and semi-circular. In polar view, the pollen are semi-angular, prolate and spheroidal (Plate 1f, 1g). Polar diameter is 172  $\mu\text{m}$  (109-234  $\mu\text{m}$ ) and equatorial diameter is 165  $\mu\text{m}$  (140-179  $\mu\text{m}$ ). P/E ratio is 1.4 and exine thickness is 1  $\mu\text{m}$  entire thickness is 1.2 (0.9-1.3). Colpi length 22 (20-24). Colpi width is 50.5 (48-54). inter-cellular difference is 10 (8-12). Percentage of pollen fertility in this species is 78.66% (Fig 2).

**Organoleptographic Analysis**

Seeds are used. Colour is marvel brown and has bitter oily taste. Smell is pleasant. The shape of seeds is semicircular and smooth having a length of 0.1-0.2 cm and 0.1-0.2 cm width. (Plate 1i).

**Fluorescence and Solubility in Different Solvents**

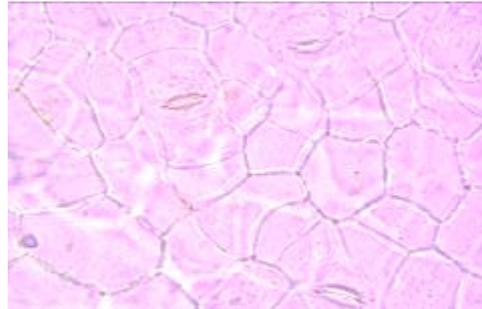
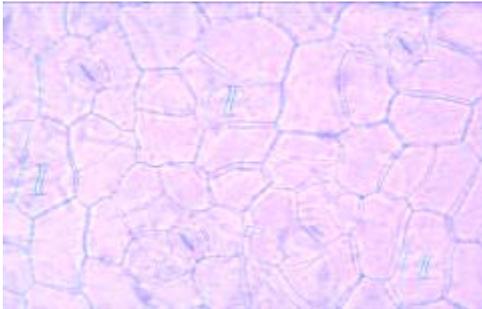
Actual colour of the powdered material is marvel brown but colour changes in different solvents, becomes copper in distilled water, brown in sulphuric acid, leather brown in hydrochloric acid, beige in acetic acid and leaf green in nitric acid. While performing cold test the powdered material is insoluble in all the solvents except sulphuric acid and hydrochloric acid but becomes soluble in acetic acid and remains insoluble in nitric acid during hot test.

**Chemical Analysis**

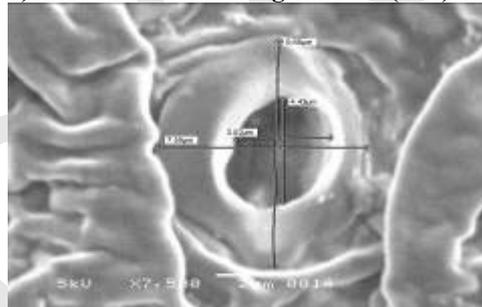
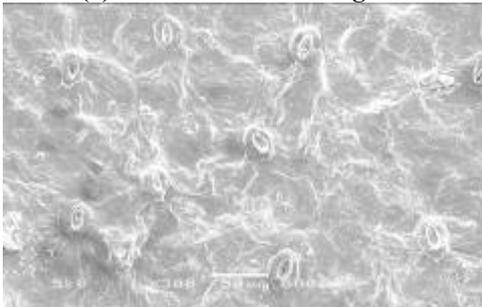
Alkaloids, glycosides, starch grains, tannins, anthraquinone, saponins and ferric chlorides were present whereas fixed and volatile oils were absent.

**Folk Medicinal Uses**

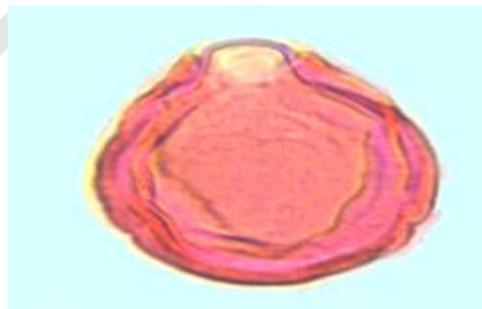
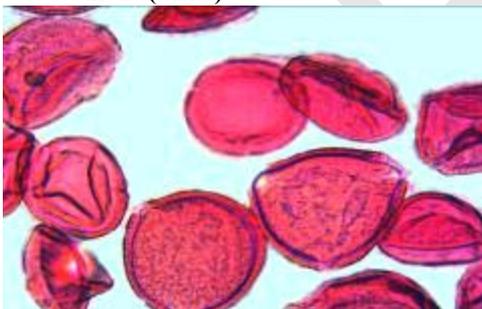
Used in the past as a pain killer and also in the treatment of insanity, fevers, diarrhea and skin diseases.



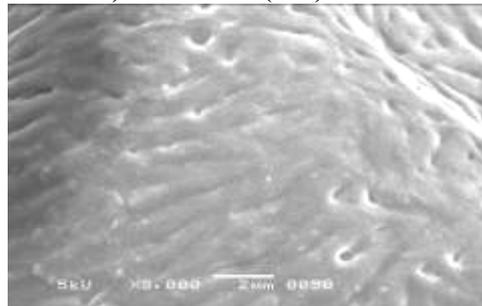
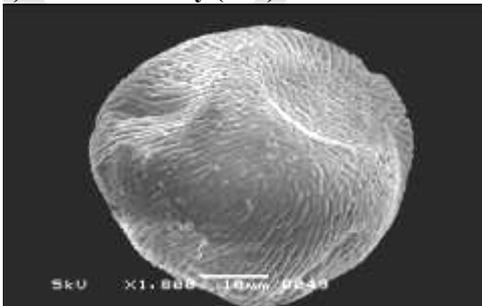
**Plate 1(a). Abaxial side showing microhairs (LM) b). Adaxial side showing stomata (LM)**



**c). Abaxial side showing epidermal cells and stomata (SEM) d). Open stomata with guard cells (SEM)**



**e). Pollen Fertility (LM) f). Polar view (LM)**



**g). Patches on pollen (SEM) h). Pollen sculpturing (SEM)**



i). Seeds under visible light



j). Seeds under UV light



k). Seeds under IR light

*Solanum nigrum* (Linn)

Syn: *Solanum rubrum* auct. non L.

*Solanum villosum* (L.) Moench

**Common Name(s)**  
**Anatomical Analysis**  
**(LM & SEM)**

Night shade, makko

In **abaxial epidermis**, the leaf epidermal cells are irregular shaped, smooth thick walled, average length of epidermal cells is 50 (40-60)  $\mu\text{m}$  and the average width is 35 (30-40)  $\mu\text{m}$ , stomata are present, stomatal type is anisocytic, number of stomata per unit area is 11, open stomata are 4 and 7 closed stomata are present, average length of guard cells is 13 (10-16)  $\mu\text{m}$  and average width of guard cells is 4.5 (2-7)  $\mu\text{m}$ , average length of subsidiary cells is 115 (80-150)  $\mu\text{m}$  and the average width is 75 (50-100)  $\mu\text{m}$ . Trichomes are present, number of trichome per unit area is 1, the average length of trichomes is 200 (180-220)  $\mu\text{m}$ . Silica bodies are absent. In **adaxial epidermis**, the leaf epidermal cells are irregular shaped, average length of epidermal cells is 45.25 (30-60.5)  $\mu\text{m}$  and the average width is 25 (20-30)  $\mu\text{m}$ , stomata are present, stomatal type is diacytic, number of stomata per unit area is 6, open stomata are 2 and 4 closed stomata are present, average length of guard cells is 30.25 (20-40.5)  $\mu\text{m}$  and average width of guard cells is 7.75 (5-10.5)  $\mu\text{m}$ , average length of subsidiary cells is 110 (100-120)  $\mu\text{m}$  and the average width is 70 (50-90)  $\mu\text{m}$ . Multicellular micro-hairs are present, average length of micro-hairs is 47.75 (35.5-60)  $\mu\text{m}$  and the average width is 8 (5-11)  $\mu\text{m}$ . Silica bodies are absent. (Plate 2a, 2b, 2c, 2d).

**Palynological Analysis**  
**(LM & SEM)**

In equatorial view, the pollen are circular and semi-circular (Plate 2h). In polar view, the pollen are semi-angular, prolate and spheroidal. Polar diameter is 103.4  $\mu\text{m}$  (102.2-103 $\mu\text{m}$ ) and equatorial diameter is 107.3  $\mu\text{m}$  (101.1-107.3  $\mu\text{m}$ ). P/E ratio is 1.0 and exine thickness is 0.9  $\mu\text{m}$  (0.9-1  $\mu\text{m}$ ) and entire thickness is 1.2. Colpi length is 11 and colpi width is 22.7. Pore is endoporus. Percentage of pollen fertility in this species is 78.66% (Fig 2).

**Organoleptographic**  
**Analysis**

Dried fruit is used. Colour of fruit is rose wood and has sweet taste and unpleasant smell, shape is round and smooth less. It is circular in shape and diameter is about 0.02 to 0.03 cm. (Plate 2i).

**Fluorescence and**  
**Solubility in Different**  
**Solvents**

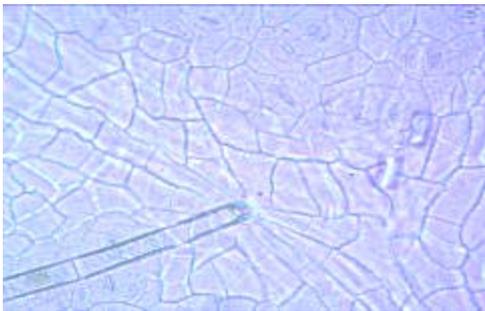
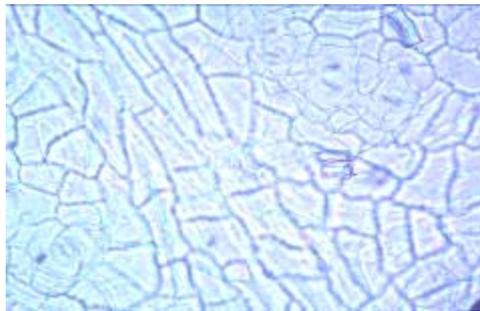
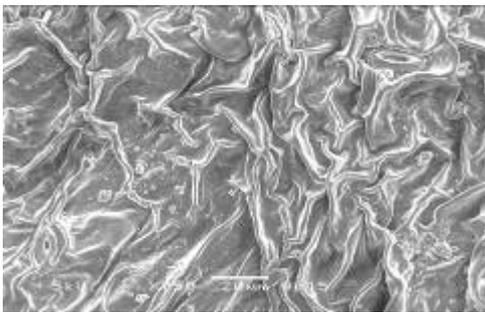
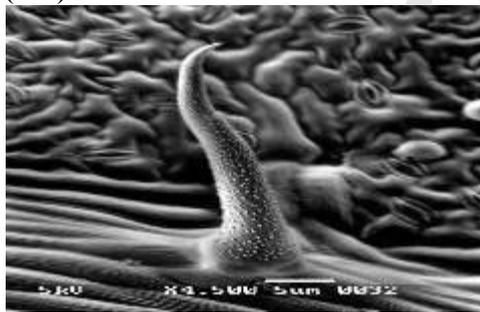
Actual colour of the powdered material is rose wood but colour changes in different solvents, becomes sonora in distilled water, brown in sulphuric acid, brown in hydrochloric acid, zest in acetic acid and leaf green in nitric acid. While performing cold test the powdered material is insoluble in all the solvents except sulphuric acid but becomes soluble during hot test.

**Chemical Analysis**

Alkaloids, glycosides, starch grains, tannins, anthraquinone, saponins and ferric chlorides were present whereas fixed and volatile oils were absent.

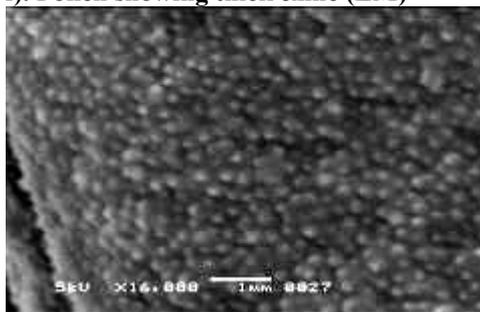
**Folk Medicinal Uses**

The plant has emollient, diuretic, antiseptic and laxative properties. It shows protective effect on the liver and hepatoprotective activity in cases of toxicity induced by drugs and chemicals. It is also effective in the treatment of cirrhosis of the liver. Sometimes the fresh juice of this herb is used for curing fever and alleviating pain.


**Plate 2(a). Abaxial side showing trichomes (LM)**

**b). Adaxial side showing irregular shaped epidermal cells (LM)**

**c). Epidermal cells and stomata (SEM)**

**d). Trichome (SEM)**

**e). Circular shaped pollen (LM)**

**f). Pollen showing thick exine (LM)**

**g). Equatorial view (SEM)**

**h). Granulated sculpturing (SEM)**

**i). Fruit under visible light**

**j). Fruit under UV light**



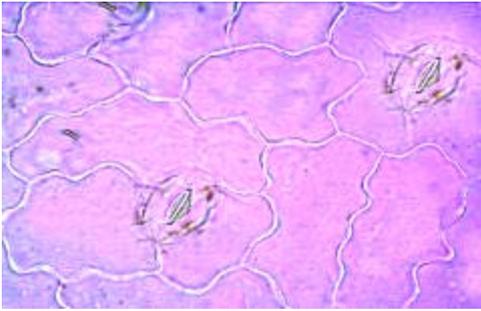
k). Fruit under IR light

*Withania somnifera* (L.)

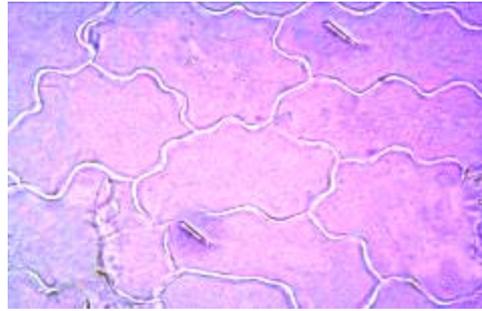
Syn: *Physalis somnifera* L.

*Withania kansuensis* Kuang & A. M. Lu

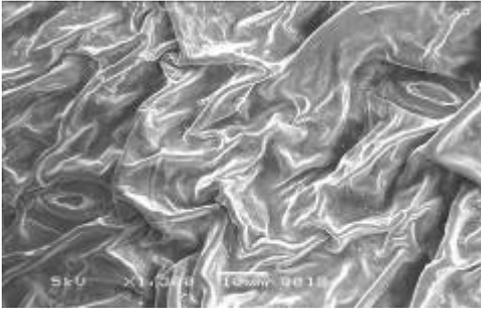
|  |  |
|--|--|
| <b>Common Name(s)</b>                                    | Winter-cherry, ashwagandha, Indian ginseng, Ajagandha, Kanaje hindi, Amukkara in Tamil.  |
| <b>Anatomical Analysis (LM &amp; SEM)</b>                | In <b>abaxial epidermis</b> , the leaf epidermal cells are irregular shaped having thick undulate walls, average length of epidermal cells is 160 (130-190) $\mu\text{m}$ and the average width is 72.5 (65-80) $\mu\text{m}$ , stomata are present, stomatal type is anisocytic and diacytic, number of stomata per unit area is 3, open stomata are 2 and 1 closed stomata is present, average length of guard cells is 42.5 (25-60) $\mu\text{m}$ and average width of guard cells is 20 (10-30) $\mu\text{m}$ , average length of subsidiary cells is 130 (100-160) $\mu\text{m}$ and the average width is 85 (80-90) $\mu\text{m}$ . Multicellular micro-hairs are present having an average length of 25 (20-30) $\mu\text{m}$ . Silica bodies are absent. In <b>adaxial epidermis</b> the leaf epidermal cells are irregular shaped having thick undulate walls, average length of epidermal cells is 155 (120-190) $\mu\text{m}$ and the average width is 70 (60-80) $\mu\text{m}$ , stomata are present, stomatal type is anisocytic and diacytic, number of stomata per unit area is 5, open stomata are 4 and 1 closed stomata is present, average length of guard cells is 40 (20-60) $\mu\text{m}$ and average width of guard cells is 20 (10-30) $\mu\text{m}$ , average length of subsidiary cells is 130 (110-150) $\mu\text{m}$ and the average width is 65 (60-70) $\mu\text{m}$ . Multicellular micro-hairs are present having an average length of 40 (30-50) $\mu\text{m}$ . Silica bodies are absent (3a, 3b, 3c, 3d). |
| <b>Palynological Analysis (LM &amp; SEM)</b>             | In equatorial view, the pollen are circular and semi-circular. In polar view, the pollen are semi-angular, prolate and spheroidal (Plate 3e, 3f, 3g, 3h). Polar diameter is 195.9 $\mu\text{m}$ (211.6-180.2 $\mu\text{m}$ ) and equatorial diameter is 155 $\mu\text{m}$ (175.5-134.9 $\mu\text{m}$ ). P/E ratio is 1.3 and exine thickness is 1.1 (.9-1.1 $\mu\text{m}$ ). Entine thickness 1.5. intercellular differences is 9.9 (7.8-12). Colpi length is 44.5 and colpi width is 83.4. Percentage of pollen fertility in this species is 79.66% (Fig 2).  |
| <b>Organoleptographic Analysis</b>                       | Dried parts of root are used. Colour of root is yellowish brown or light brown, its outer surface is bugg to grey yellow with longitudinal wrinkles and in the center soft and solid mass with scattered pores. Smell is unpleasant like horse's smell and taste is bitter and acrid. Lenth ranges from 0.9-1.5 cm and diameter is 0.3 cm. (Plate 3i)  |
| <b>Fluorescence and Solubility in Different Solvents</b> | Actual colour of the powdered material is Camel colour but colour changes in different solvents, becomes copper in distilled water, brown in sulphuric acid, mustard in hydrochloric acid, pale cream in acetic acid and honey-dew in nitric acid. While performing cold test the powdered material is soluble in all the solvents except sulphuric acid but becomes soluble in all solvents during hot tests.   |
| <b>Chemical Analysis</b>                                 | Alkaloids, glycosides, starch grains, tannins, anthraquinone, saponins and ferric chlorides were present whereas fixed and volatile oils were absent.  |
| <b>Folk Medicinal Uses</b>                               | Used to treat bronchitis, asthma, constipation, ulcer and scabies.   |



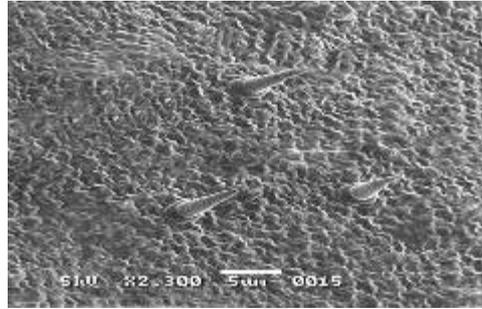
a). Abaxial side showing stomata (LM)



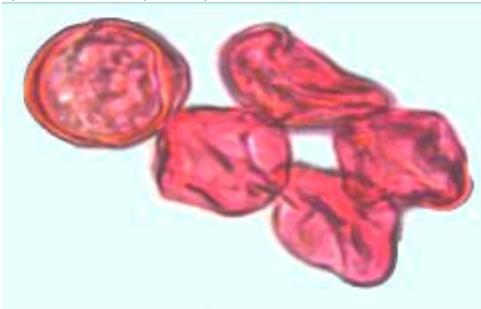
b). Adaxial side showing microhairs (LM)



c). Stomata (SEM)



d). Microhairs (SEM)



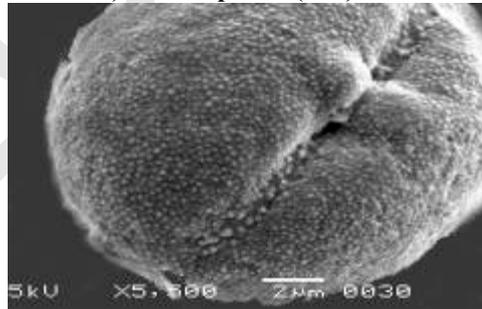
e). Equatorial view (LM)



f). Porate pollen (LM)



g). Tricolporate pollen (SEM)



h). Pollen Cleave (SEM)



i). Roots under visible light



j). Roots under UV light



k). Roots under IR light

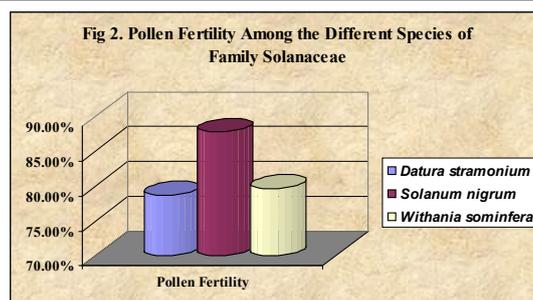
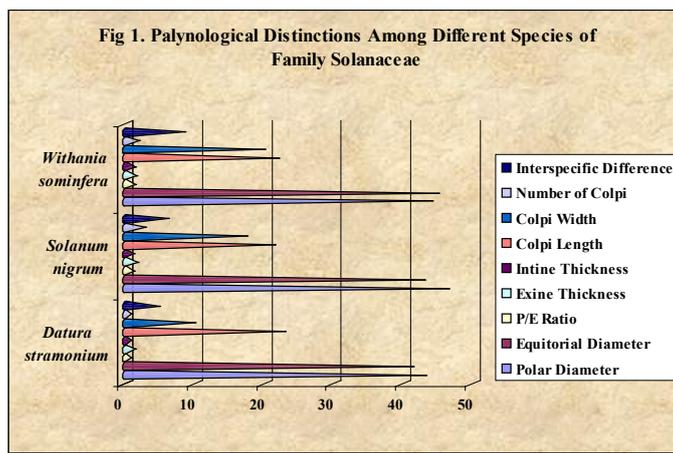
## Discussion:

### Epidermal Leaf Anatomy:

The present study described the biological significance and implications of leaf anatomical characteristics of the three species studied. It also discussed the extent to which leaf epidermal features might be utilized in the systematic consideration in view of their perceived similarities in structural and reproductive biology. The walls of the epidermal cells of the two species (*Datura stramonium* and *Solanum nigrum*) are smooth and thick whereas *Withania somnifera* showed the thick undulate walls. The distribution of stomata varied in the taxa studied. In *Datura stramonium* the number of stomata per unit area is 4, in *Solanum nigrum* 11 and in *Withania somnifera* 3. Rogers and Ogg, (2001) reported that stomata number is two to three-fold higher on abaxial than on adaxial epidermis of the Solanum species. (*S. nigrum*, *S. sarrachoides*, *S. americanum* and *S. ptycanthum*). Stomatal type showed variation in the species studied. In *Datura stramonium* stomata are diacytic, in *Solanum nigrum* stomata are anisocytic and in *Withania somnifera* stomata are diacytic and anisocytic. (Plate 3a, 3c). Seithe and Anderson (1982) reported that stomata are anomocytic to anisocytic in *S. nigrum*. Microhairs are seen in almost all the taxa studied. These hairs differed in form, length and width. Glandular hairs were not numerous. Mostly hairs seen are multicellular as in *S. nigrum* and *W. somnifera*. (Plate 2e, 3d) Seithe and Anderson *et al.*, (2002) investigated hair morphology of some species from the genus *Solanum*, but not in *S. nigrum*. Silica bodies were absent in all the taxa studied. It is well known that the leaf, compared with the other vegetative organs, is the best and fastest to react to changes in the environment. The influence of different ecological factors on plant organisms is best reflected on leaf morphological and anatomical structure. The present study provided the anatomical structure of leaves with the aim of determining their structural adaptations.

### Palynology:

Pollen morphology of the family Solanaceae is quite heterogeneous. Most striking variation is found in the shape class and apertural types. The greatest variation is observed in pollen morphology of the Solanaceae species which lies in the size of their pollen wall. Exine thickness ranged from 1.4(1.3-1.5)  $\mu\text{m}$  -1.8(1.7-1.9)  $\mu\text{m}$ . among the species studied. *Withania somnifera* showed the highest value whereas *Solanum nigrum* showed the lowest value. *Datura stramonium* showed the highest intine thickness i.e. 1.5(1-2)  $\mu\text{m}$  whereas *Solanum nigrum* showed the lowest value i.e. 1(0.5-1.5)  $\mu\text{m}$ . Exine and intine thickness are prominent features in this study. Nwachukwu and Okeke (2001) reported that pollen grains are very helpful in assigning the status of plant since pollen grain wall has specific characters. Pollen size is variable among the species. It was observed that the pollen grain of *Solanum nigrum* is smaller in size 43.25(42.5-44)  $\mu\text{m}$  and pollen grain of the *Withania somnifera* is larger in size 46.5(45-48)  $\mu\text{m}$  in polar diameter where as in equatorial view the size ranged from 41.5 (40.5-42.5)  $\mu\text{m}$  to 45(44-46)  $\mu\text{m}$ . *Solanum nigrum* appears to be the smallest in size whereas *Datura stramonium* is the largest. The colpi length ranged from 21.5(21-22)  $\mu\text{m}$  to 23(22-24)  $\mu\text{m}$ . *Solanum nigrum* showed the highest where as *Withania somnifera* showed the lowest value. (Fig. 1). This variation in size may be due to indiscriminate mating leading to hybridization. This is not surprising since previous workers have made similar observations in other groups of angiosperm. The pollen grains of the species studied showed similarities in their pollen attributes of wall sculpture, aperture, and symmetry. The pollen grain of each species is radially symmetrical, iso diametric and isopolar. These results corroborate with the findings of Nwachukwu and Okeke (2001) according to which the pollen of Solanaceae is grain polar & radially symmetrical. The pollen shape is found to be more or less circular to semi-circular and angular in polar view and angular, semi angular spheroidal, elliptic and oval in equatorial view in the species studied. Further more, similarities are found in aperture type (tricolporate), and wall structure (scabrate) of the pollen grain of species studied. P/E ratio ranged from 1 to 1.4 among the species. The pollen grains are monoporate and psilate (smooth). The pore position is endoporus in *Solanum nigrum* and *Withania somnifera* where as exoporus in *Datura stramonium*. The taxonomic significance of pollen morphology in Solanaceae is more or less obscure. Sometimes different tribes or sub tribes have similar type of pollen or vice versa and sometimes species referred to the same genera and tribe have different type of pollen.



### UV, IR And Organoleptic Analysis:

The Solanaceae family is characteristically ethno-botanical that is, extensively utilized by humans. It is an important source of food, spice and medicine. Organoleptic evaluation with the advanced microscopic equipments provides more accuracy for botanical authentication. (Jackson and Snowdown, 2000). The analysis of market samples of *Datura stramonium* collaborates with the samples collected from different localities of Lahore. Seeds are semi circular and smooth surfaced. (Plate 1i). But the colour of seeds of market samples (marvel brown colour) differs with the fresh having dark brown to black colour. These results are similar to the findings of Davihazy, 2004. In case of *solanum nigrum* the market samples revealed the presence of non smooth surface and semi circular fruit. (Plate 2i). Market fruit is dried therefore its shape becomes semicircular while the fresh fruit is circular shiny and have smooth surface. In case of *Withania somnifera* market sample collaborates with actual sample. The outer surface of roots is bugg to grey yellow with longitudinal wrinkles and in the center soft, solid mass with scattered pores whereas fresh roots are brownish grey with long fleshy tubers. (Plate 3i). These results are in accordance with the Seithe and Anderson (2009).

### Fluorescence and Chemical Analysis:

The present research work was confined to the macro, microscopic features of the powdered drug and their solubility and fluorescence analysis. The powdered drug of all the three species were soluble in all the solvents by cold and hot tests except *Datura stramonium* which was soluble in all the solvents except nitric acid and it did not retain its original marvel brown colour on dry filter paper and in various solvents by cold and hot tests. Dastagir and Haq (2005) also reported similar results of *Datura stramonium* on solubility in different solvents. In all the three selected plant species alkaloids, glycosides, starch grains, tannins, anthraquinone, saponins and ferric chlorides were present whereas fixed and volatile oils were absent. These findings were in agreement with the Dweck, 2007.

### Conclusion:

The present study was a step towards preparing a systematic inventory of selected medicinal plants of family Solanaceae. Medicinal plants face the problems in their identification due to confusion in nomenclature, taxonomic ranking, and differentiation of various species at specific level sometimes at generic level also, but these problems can be overcome by using classical and applied approaches of taxonomy. The present account includes the comprehensive study of these approaches. Classical approaches are morphology, anatomy, palynology, UV and IR analysis and organoleptography whereas the applied approaches include their chemical analysis. While studying anatomical features a lot of variation was observed in the stomata type of the selected taxa. All the three taxa can be distinguished easily on the basis of pollen features, which were found useful in the delimitation of the taxa. UV and IR and organoleptographic analysis also showed a lot of variations among the selected taxa. The fluorescence, solubility and chemical analysis was

also done in order to delimit the taxa. All these parameters showed successful findings and can be helpful for the identification, authentication and classification of the selected plants. All the available records are listed and mapped.

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# HUMAN MOTION ANALYSIS WITH ARTIFICIAL NEURAL NETWORK USING THE KINECT SENSOR

Cemil Oz<sup>1</sup>, Ming C. Leu<sup>2</sup>

<sup>1</sup>Sakarya University, Computer Engineering Department, Sakarya University, Turkey

<sup>2</sup>Missouri University of Science and Technology, Mechanical and Aerospace Engineering Department, Rolla, Missouri, USA

[coz@sakarya.edu.tr](mailto:coz@sakarya.edu.tr), [mleu@mst.edu](mailto:mleu@mst.edu)

**Abstract:** In this study a real-time human motion classification system is developed by using Artificial Neural Networks (ANN). The system uses a Microsoft Kinect to extract the human motion features. The x, y, z values of human skeleton joints are obtained from the Kinect using Microsoft Kinect Library and Microsoft C#. The data obtained from this device are processed by noise reduction, feature extraction and classification modules. The neural network is used as a classifier. The test results show that the developed system can be successfully used in the recognition of human motion. This system is flexible and open for future extensions.

**Keywords:** Human Motion Analysis, Microsoft Kinect, Artificial Neural Network, Natural Interface

## Introduction

Analysis of 3D human motion is an important tool for various interactive systems used in virtual reality, video games, animation movies, medical analysis, scientific visualization, puppetry, and gesture-based control. To realize such interaction, the system has to estimate motion parameters of human bodies in real-time. An efficient 3D human motion analysis system should be able to recognize and understand the human behavior from observations alone. This task is very difficult, and misinterpretations and mistakes are very common. The efficient human activity monitoring system should also provide independent movement ability and a secure environment to the user.

Real-time human body tracking research can be categorized into three major classes: (i) computer-vision based, (ii) special device (such as a data glove) based, and (iii) a combination of the two classes (Oz and Leu, 2011). Most of the vision based human motion capture systems have multiple cameras which are specially located. The user wears a special body suit and places markers on various parts of the suit to capture the movement of the joints in the human body (Zhang et al., 2010). Recently, in parallel to the development of the computer hardware and software, some fully image-feature-based motion capturing systems without such restrictions have been developed as a computer vision application (Fiaz and Ijaz, 2010; Svendsen and Albu, 2010; Ye et al., 2010).

Marker-less motion capture technology has been harnessed for several years to track human movements for developing various applications. Shimosaka et al. (2011) introduced a robust framework for multiple people pose tracking. The notable aspects of their approach are real-time ensuring speed (up to 30 fps), and flexibility towards various complex motions and environments. Their framework successfully obtains multiple body pose estimation in real-time even when contacts between people occurs in the scene, which is not addressed in the conventional approaches. They demonstrated the effectiveness of their approach with experiments on indoor cluttered scene sequences. Raf et al. (2011) presented a marker-less 3D motion capture system based on a volume reconstruction technique of non-rigid bodies. It depicted a new approach for pose estimation in order to fit an articulated body model into the captured real-time information. They aimed at analyzing athlete's movements in real-time within a 3D interactive graphics system. Wang et al. (2010) provided a comprehensive survey of recent developments on gait recognition approaches. Their survey emphasized on three major issues involved in a general gait recognition system, namely, gait image representation, feature dimensionality reduction, and gait classification. Also, a review of the available public gait datasets was given. Their conclusion outlined a number of research challenges and provided promising future directions for the field.

Recently with the launch of Microsoft Kinect researchers have been keenly interested in developing applications using this device (Souza Santos et al., 2011; Jing et al., 2012; Jalal et al., 2010). Since Kinect costs about \$100, it is a low-cost and good substitute for the comparatively expensive other vision based motion capture systems. Although it is designed for home entertainment, but numerous applications can be developed with the capabilities of Kinect. The skeleton data of a human being tracked by a single Kinect device is enough to obtain the human motion simulation in many cases. In the study presented in the present paper, a human motion analysis system is designed with an Artificial Neural network using Kinect sensor.

## System Hardware

One of the primary means by which we physically connect to the world is through our limbs, especially the hands. We perform most of our everyday tasks with them; however, along with our hands, we also rely on devices such as a mouse, keyboard, or joystick to work with a computer and computer applications. Virtual Reality input devices like data glove, motion tracker, and Kinect could overcome the limitations of these devices (Sturman and Zelter, 1994; Oz and Leu, 2007). However, most commercially available virtual reality devices are very expensive.

The Kinect sensor (see Figure 1) was developed for the Microsoft Xbox 360 video game platform (Microsoft; Redmond, Washington). Then it was transferred to the personal computers and this device offers portable 3-D motion capture capabilities that can overcome the limitations of most existing systems. The Kinect was designed to allow users to interact with the gaming system without the need for a traditional handheld controller. Instead, the sensor recognizes the user's gestures and voice commands.

The key to gesture recognition is the device's "depth camera" which consists of an infrared laser projector and an infrared video camera mounted within the sensor bar. The system uses the infrared camera to detect a speckle pattern projected onto objects in the sensor's field of view. The Kinect is able to create a 3-D map of these objects by measuring deformations in the reference speckle pattern. The sensor bar also houses a color video camera which provides color data to the depth map. The sensor bar also contains an array of four microphones and is connected to a motorized base that allows the sensor bar to be tilted up and down. The technology was developed by PrimeSense (Tel-Aviv, Israel) and is disclosed in detail in their patents (Freedman et al., 2010).

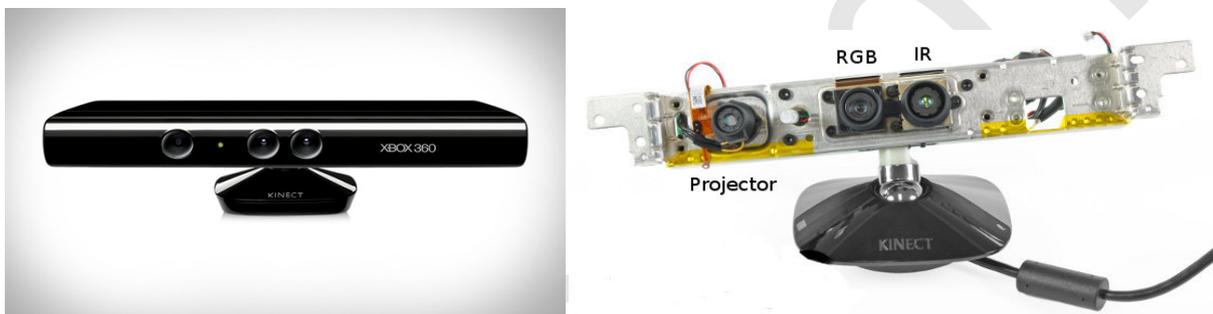


Figure 1. The Microsoft Kinect

## Feature Extraction

The  $x$ ,  $y$ ,  $z$  values of twenty body joints are captured using the Kinect sensor. The names of these joints are given in Figure 2, which also shows the joints data and feature vectors measured by Kinect. Before starting the real-time classification or data collection, every signer has to establish his own reference points. These user reference points are captured from three static user postures including the T-pose (arms are raised and parallel to ground), standing posture, and a posture with arms in front of the body and parallel to ground. Thirteen feature data are used. During the T-posture a virtual rectangle is drawn. The distance between the shoulder center and the central hip joint gives the width of the rectangle, and the  $x$  values of the coordinates of two hands give the length of rectangle. When users move their hands, another rectangle is drawn between hands and central hips. These joints determine the corner of the rectangle. Four of the features data are the areas of these four rectangles. Seven of our feature vectors are distances between joints, distance between center hip and right ankle, distance between right hand and spine, distance between left hand and spine, distance between right elbow and spine, distance between left elbow and spine, distance between center hip and left knee, and distance between center hip and right knee.

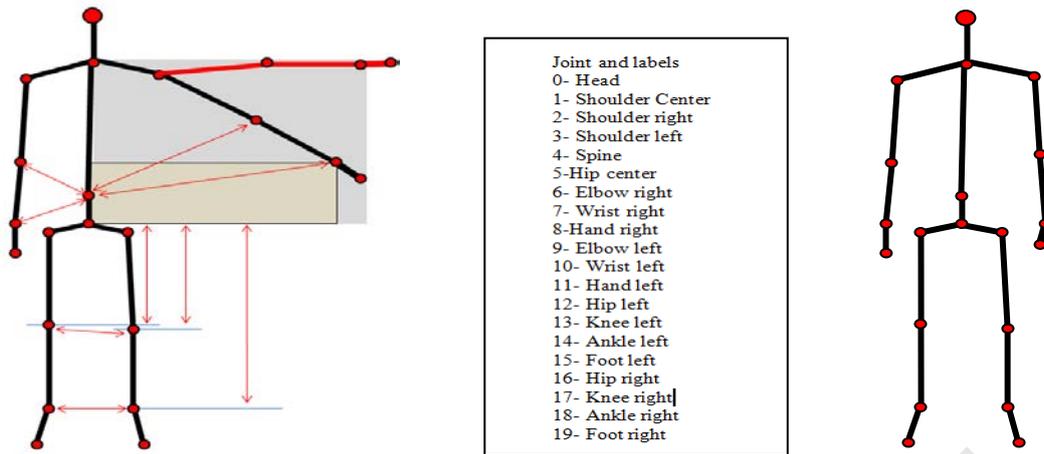


Figure 2. Kinect joints data and feature vectors

### Artificial Neural Network (ANN) Model

A backpropagation algorithm is used for training the ANN model. The basic structure and formulation of backpropagation is summarized here. Training a neural network involves computing weights so as to get an output response to the input within an error limit. The input and target vectors make up a training pair. The backpropagation algorithm includes the following steps (Lippman, 1987):

1. Select the first training pair and apply the input vector to the net.
2. Calculate the net output.
3. Compare the actual output with the corresponding target and find the error.
4. Modify the weights so as to reduce the error.

These steps are repeated until the error falls within the accepted limit. In Step 2, the output sets for test inputs are calculated. If they are nearly the same as the expected sets within the prescribed error range, then it is considered that the net has learned the problem, and the final weights are stored so that they can be reused when needed. The developed ANN has a multi-layer feedforward structure as shown in Figure 3. The variable definitions are given as follows (Abulafya, 1987; Narendra, 1992):  $L=0$ : input layer,  $L=1$ : hidden layer,  $L=2$ : output layer,  $W_{1,ji}$ : weight matrix between the input layer and the hidden layer,  $W_{2,tj}$ : weight matrix between the hidden layer and the output layer,  $B_{1,j}$ : bias values of hidden neurons, and  $B_{2,t}$ : bias values of output neurons.

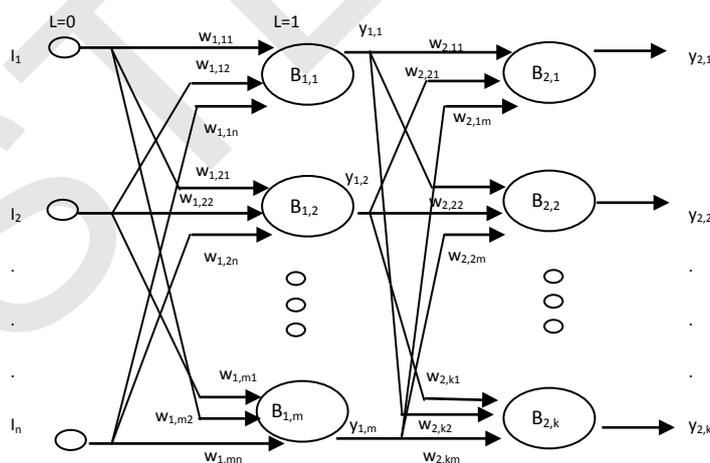


Figure 3. A multi-layer feedforward net structure

Equation (1) gives the output of the hidden layer:

$$y_{NET1,j} = \sum_{i=1}^n w_{1,ji} I_i + B_{1,j} \quad (1)$$

$$y_{1,j} = f_j [y_{NET1,j}] \quad j = 1, 2, \dots, m$$

Equation (2) gives the output of the output layer:

$$y_{NET2,t} = \sum_{i=1}^m w_{2,ti} y_{1,i} + B_{2,t} \quad (2)$$

$$y_{2,t} = f_t [y_{NET2,t}] \quad t = 1, 2, \dots, k$$

Activation function:

$$f(y_{NET}) = \frac{1}{1 + e^{-y_{NET}}} \quad (3)$$

### Design of Human Motion Analysis System with ANN

The system software written with Microsoft C# has four modules: data capturing, data selecting, ANN classifier training and testing, and real-time motion classification. The data capturing module tracks the user skeleton joint data in 3D coordinate system with Kinect using Microsoft Kinect Library and store the captured data in the database when the users move their arms and legs. Not all of the captured data are suitable for classification. Therefore, the data classifier module is used for manual classification of the human motion to prepare training and testing data for the ANN model. The recorded human skeleton is replayed step by step. If the data are good for a certain class, the extracted feature vector of the current skeleton data is stored in an input file and the classification script is recorded to an output file. Figure 4 shows a block diagram of the data selecting module.

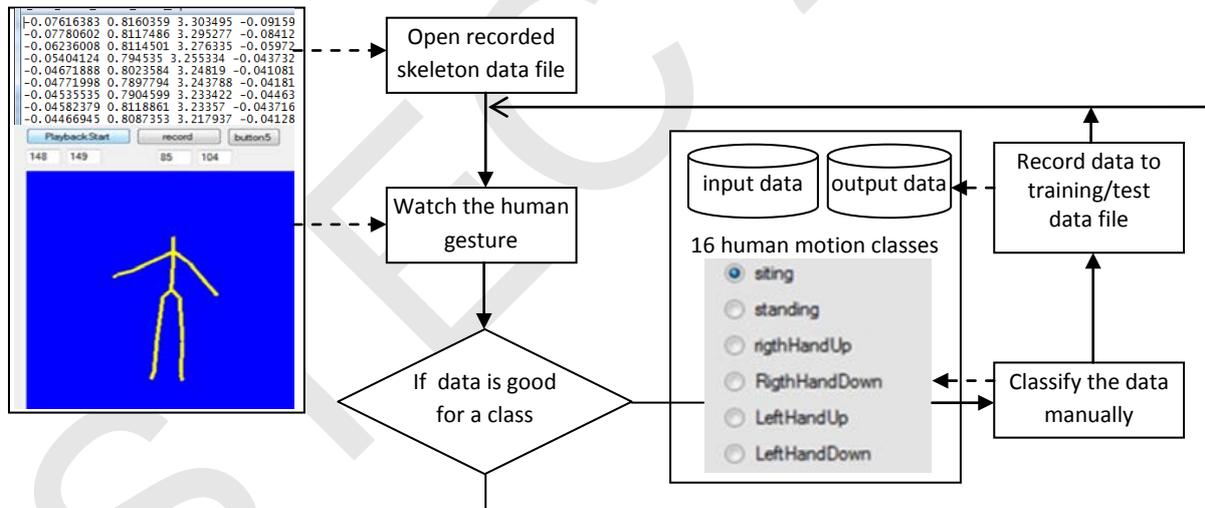


Figure 4. Block diagram of the data selecting module

The ANN classifier training and testing module works on Matlab. Training and testing ANN classifier model parameters are stored in a file for future use with the real-time motion classification module. When the real-time motion classification module starts, first the ANN classifier data are read from the data file and then a real-time motion recognition loop starts. Whenever the user's hand motions are larger than a threshold value, the skeleton joint data are captured by Kinect and 13 features are extracted. Five time instant feature vectors are used as inputs for the ANN model, with the total inputs being 65. A Multi-layer feedforward ANN model classifies the user movements to 16 classes such as sitting, standing, raising right hand, raising left hand, etc. The ANN classifier model has 65 input, 60 hidden, and 16 output neurons. Figure 5 shows the human motion classification module block diagram.

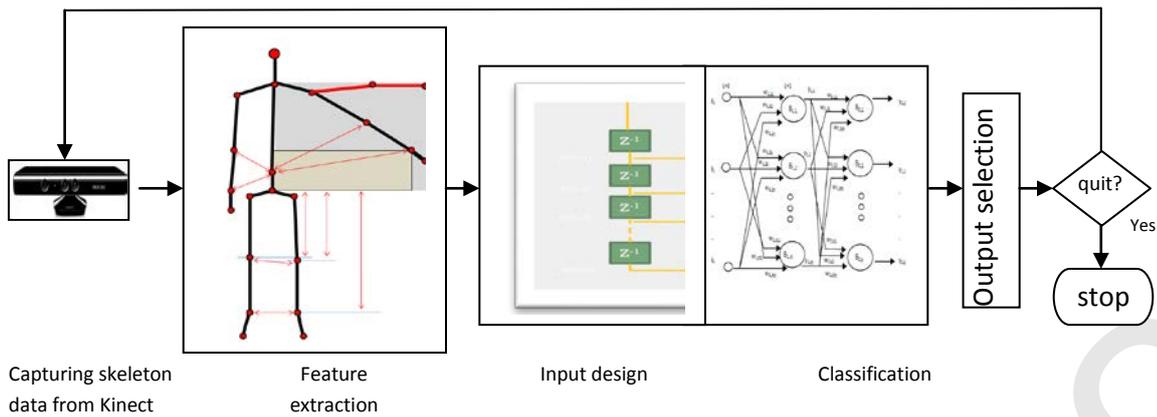


Figure 5. The Real-time motion classification module block diagram

## Test Results

The human motion recognition system is trained with 40 samples of data from 16 human actions, which are collected with the Kinect. At the testing stage, real-time data are also used. In total, 640 actions (16x40) in the training set are used for the test. Training and testing data are acquired from several people while they try to perform the same posture. Therefore, data from different people could vary. The testing results are given in Table 3. In this table, the 'unknown' come from the output selection procedure while the output decoding block determines the maximum output of the ANN; the corresponding index of the output vector is the recognized motion class. A threshold value is used for the output; any output under this threshold is regarded as an unknown. If the threshold value is increased, unknown signs will also increase; otherwise, when the threshold value is decreased, the number of misrecognized signs will increase.

Table 3. ANN test results for Human motions recognition.

|              | Data for each motion | Total test data | Missed (unknown) | Misrecognized | Recognized |
|--------------|----------------------|-----------------|------------------|---------------|------------|
| Single user  | 40                   | 640(16x40)      | 37               | 48            | 555        |
| Several user | 40                   | 640(16x40)      | 43               | 52            | 545        |

## Conclusion

The development and evaluation of a human motion classification system is described in this paper. The data from a Kinect are processed by a noise reduction, feature extraction, and a classification network. Thirteen important features are extracted for every human action and five time instants of the vector are used. Neural networks are used as a classifier of these feature vectors. The system is trained and tested, and the test results indicate that the recognition accuracy is about 87%.

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# HYBRID FIELD ORIENTED-SLIDING MODE ROBUST CONTROL USING HIGH GAIN OBSERVER FOR INDUCTION MOTOR

H. Mekki<sup>1,3</sup>, O. Benzineb<sup>2,3</sup> and D. Boukhetala<sup>3</sup>

<sup>1</sup>University of M'sila. B.P 166 Ichbilila M'sila, Algeria.

<sup>2</sup>University of Blida, Route de Soumaa, Algeria.

<sup>3</sup>Ecole Nationale Polytechnique (ENP), BP 162, Elharrach, Alger, Algeria.

E-mail: mekki.hamza@yahoo.fr, Omar\_benzineb@yahoo.fr and dboukhetala@yahoo.fr

**Abstract:** This paper presents a new hybrid field oriented-sliding mode robust control based high gain flux observer for a high-performance induction motor (IM) drive. This control technique is obtained by the combination between the field oriented and the sliding mode control strategy and present remarkable dynamic performances just as a good robustness with respect to the IM parameters variations and load torque. A high gain flux observer is also presented and associated in order to estimate the rotor flux by only using measurements of the stator voltages and currents. Simulations results are provided to evaluate the consistency and to show the effectiveness of these hybrid control strategy and the performance of the high gain flux observer in IM drive system.

**Keywords-** Induction motor, field oriented control, sliding mode control, hybrid control, robustness, high gain observer.

## NOMENCLATURE

|                    |                                       |
|--------------------|---------------------------------------|
| $s, r$             | Stator, rotor index.                  |
| $\alpha, \beta$    | Fixed stator reference frame indexes. |
| $V, i, \varphi$    | Voltage, current, flux.               |
| $L_s, L_r, (M)$    | Stator, rotor (Mutual) inductance.    |
| $R_s, R_r$         | Stator, rotor resistance.             |
| $T_s, T_r$         | Stator, rotor time constant.          |
| $\omega(\Omega)$   | Electric (rotor) speed.               |
| $\sigma$           | Total leakage coefficient.            |
| $n_p$              | Pole pair number.                     |
| $s$                | Derivate operation                    |
| $\dot{x}(\hat{x})$ | Time derivative (estimated) value.    |
| $ref$              | Reference subscript.                  |

## I. INTRODUCTION

Induction motors (IMs), due to the characteristics of their nonlinear dynamics, constitute an interesting test bed for the synthesis of advanced control laws. Moreover, IMs are widely used in industrial applications. Some of the reasons of their success are their simple mechanical construction, their low maintenance requirements, and the lower cost compared to other devices, such as DC or stepper motors [1].

In the last few decades, abundant research and development efforts for IM control technology have been made. The most popular high performance IM control technique is known as vector control (VC), proposed by Hasse and Bkashke [2]. VC of induction motor achieves decoupled torque and flux dynamics leading to independent control of the torque and flux as for a separately excited DC motor [3].

However, the decoupling control feature can be adversely affected by load disturbances and parameter variations in the motor so that the variable-speed tracking performance of an IM is degraded. In general, both conventional PI and PID controllers have the difficulty in making the motor closely follow a reference speed trajectory under torque disturbances. In this regard, an effective and robust speed controller design is needed [4].

In the resent past years, the SMC strategies have received worldwide interest, and many theoretical studies and application researches are reported [5]. It is known that the SMC can offer such properties as insensitivity to parameters variations, external disturbance rejection, fast dynamic response, and simplicity of design and implementation [3].

It is known that the sliding mode control is a very effective approach in dealing with it. However in practical applications, a pure sliding-mode control suffers the chattering problem. The chattering occurs mainly due to the switching with infinite speed cannot be satisfied [6]. In order to reduce or overcome that problem, two methods were proposed in [7] and [8]. In this paper, a hybrid controller is created by embedding a FO control into the sliding mode control. This makes the PI control robust to changes in the induction motor drive and suppress the chattering to get good performances for control system.

Several approaches for the sensorless control of induction motors have been proposed in the literature (see [9]). The control law depends on unmeasured states; a nonlinear observer shall be synthesized in order to achieve the estimation objective [10]. The High-gain observer is more adequate for non linear and observable systems, in which we can classify the induction motor [11].

In this study the observer type used here is the High gain observer, obtained by monitoring only the stator current and stator voltages to estimate the necessary control variables; which is the rotor flux.

This paper is going to show the theoretical of the sensorless high-performance induction-motor drive control using a hybrid control strategy which presented by a combination between the conventional field oriented control and the sliding mode control strategy to makes the PI control robust to changes in the induction motor drive and suppress the chattering to get good performances for the control strategy. This control strategy will be associated to a high gain flux observer. Simulation tests in terms of speed and torque responses have been carried out on the same induction motor drive to evaluate the consistency and the performance of the proposed approaches.

## II. INDUCTION MOTOR MODEL

The setting in the state form of the induction motor model allows the simulation of the latter, in a stationary reference  $\alpha$ - $\beta$  frame choosing us like states variables the stator currents, rotor flux and the mechanic speed  $\Omega$  [12]. And like control vector the stator tensions. The model of the IM is given by the state form [13]:

$$\begin{cases} \dot{x} = f(x) + Bu + dT_L \\ x = [x_1 \quad x_2 \quad x_3 \quad x_4 \quad x_5] = [i_{s\alpha} \quad i_{s\beta} \quad \varphi_{r\alpha} \quad \varphi_{r\beta} \quad \Omega] \\ B = \begin{bmatrix} b & 0 & 0 & 0 & 0 \\ 0 & b & 0 & 0 & 0 \end{bmatrix}^T \\ d = [0 \quad 0 \quad 0 \quad 0 \quad d_1]^T \end{cases} \quad (1)$$

With the following expression of field vector  $f(x)$ :

$$\begin{cases} f_1(x) = a_1x_1 + a_2x_3 + a_3x_4x_5 \\ f_2(x) = a_4x_2 + a_5x_3x_5 + a_6x_4 \\ f_3(x) = a_7x_1 + a_8x_3 + a_9x_4x_5 \\ f_4(x) = a_{10}x_2 + a_{11}x_3x_5 + a_{12}x_4 \\ f_5(x) = a_{13}x_1x_4 + a_{14}x_2x_3 + a_{15}x_5 \end{cases} \quad (2)$$

The components of this vector are expressed according to the IM parameters as follows:

$$\begin{cases} a_1 = a_4 = -\left(\frac{1}{T_s\sigma} + \frac{1-\sigma}{T_r\sigma}\right); \quad a_2 = a_6 = \frac{1-\sigma}{T_rM\sigma}; \quad a_3 = -a_5 = n_p \frac{1-\sigma}{M\sigma}; \quad a_7 = a_{10} = \frac{M}{T_r}; \quad a_8 = a_{12} = -\frac{1}{T_r}; \\ a_9 = -a_{11} = -n_p; \quad a_{13} = -a_{14} = -\frac{n_p M}{JL_r}; \quad a_{15} = -\frac{f}{J}; \quad b = \frac{1}{\sigma L_s}; \quad d_1 = -\frac{1}{J}; \end{cases}$$

With:  $\sigma = 1 - \frac{M^2}{L_r L_s}$ ,  $T_r = \frac{L_r}{R_r}$  et  $T_s = \frac{L_s}{R_s}$ .

## III. HYBRID FIELD ORIENTED-SLIDING MODE ROBUST CONTROL

For high performance control, field oriented control is the most widely used control strategy [14]. Where the Sliding Mode Control (SMC) theory is an effective control strategy in modern control theory as for its robustness and simply realization [15]. Due to its order reduction, disturbance rejection, strong robustness, and simple implementation by means of power converter, is one of the prospective control methodologies for induction motors [16]. In this section, a controller is designed by combining the field oriented control (FOC) method with Sliding Mode Control (SMC)

method. To take the best characteristics and to solve the problems of the two control strategy [4] [6]. The design procedure is based on the well-known assumption of current-fed IM [17].

#### A. Principle of field-oriented control:

The objective of FOC is to have an electromagnetic torque proportional to the stator current of the motor (as in the case of a DC machine) with an aim of controlling the electromagnetic torque and consequently the mechanical motor speed [12]. This method consists in orienting rotor flux according to the direction of the revolving axis ( $d$ ), which makes it possible to transform the motor model given by (2) in the reference mark turning ( $dq$ ) [13]. In these new coordinates.

The rotor position is defined by the angle  $\theta_s$  as follows:

$$\theta_s = \arctan \left( \frac{\phi_{r\beta}}{\phi_{r\alpha}} \right) \quad (3)$$

The transformation  $\alpha\beta \rightarrow dq$  is done as follows:

$$\begin{bmatrix} x_{sd} \\ x_{sq} \end{bmatrix} = \begin{bmatrix} \cos(\theta_s) & \sin(\theta_s) \\ -\sin(\theta_s) & \cos(\theta_s) \end{bmatrix} \cdot \begin{bmatrix} x_{s\alpha} \\ x_{s\beta} \end{bmatrix} \quad (4)$$

With ( $x$ ) can be used for the current, flux and tension.

The new machine model in ( $dq$ ) reference is given by:

$$\begin{cases} \dot{x}_1 = a_1 x_1 + \dot{\theta}_s x_2 + a_2 x_3 + b u_1 \\ \dot{x}_2 = -\dot{\theta}_s x_1 + a_1 x_2 + a_5 x_3 x_5 + b u_2 \\ \dot{x}_3 = a_8 x_3 + a_{10} x_1 \\ \dot{x}_4 = 0 \\ \dot{x}_5 = a_{14} x_2 x_3 + a_{15} x_5 + d_1 T_L \end{cases} \quad (5)$$

$$\text{With: } \begin{cases} x = [x_1 \ x_2 \ x_3 \ x_4 \ x_5]^T = [i_{sd} \ i_{sq} \ \Phi_d \ \Phi_{rq} \ \Omega]^T \\ \phi_d = \phi_{rd} = \sqrt{\phi_{r\alpha}^2 + \phi_{r\beta}^2} ; \dot{\theta}_s = \omega_s = \Omega + a_7 \frac{x_2}{x_3} \end{cases}$$

The use of the classical controllers such as the proportionnel and integral controller (PI) is insufficient to provide good speed tracking performance [18]. To overcome these problems, an robust controller based on the sliding mode principle is proposed for the speed and flux control.

#### B. Hybrid control strategy:

The application of the hybrid FO-SMC to induction motor control in this case is divided into two steps. First we take the following equilibrium surface:

$$\begin{cases} S_1 = x_3^d - x_3 \\ S_2 = x_5^d - x_5 \end{cases} \text{ and } \begin{cases} S_3 = x_2^r - x_2 \\ S_4 = x_1^r - x_1 \end{cases}$$

#### A. Flux and Speed regulator:

The condition necessary for the system states follow the trajectory defined by the sliding surfaces is  $S_i = 0$  which brings back us to define the rotor flux module and speed equivalent control in the following way:

$$\begin{cases} S_1 = 0 \\ S_2 = 0 \end{cases} \Rightarrow \begin{cases} \dot{S}_1 = \dot{x}_3^d - \dot{x}_3 = 0 \\ \dot{S}_2 = \dot{x}_5^d - \dot{x}_5 = 0 \end{cases} \quad (6)$$

In this case we get:

$$\begin{cases} x_1^d = \frac{1}{a_{10}} (\dot{x}_3^d - a_8 x_3) \\ x_2^d = \frac{1}{a_{14} x_3} (\dot{x}_5^d - a_{15} x_5 - d_1 T_L) \end{cases} \quad (7)$$

The control law which ensures the attractivity is:

$$\begin{cases} i_{sdn} = k_1 \text{eval}(S_1) \\ i_{sqn} = k_2 \text{eval}(S_2) \end{cases} \quad (8)$$

$k_1$  and  $k_2$  are positive constants. Finely we get:

$$\begin{cases} (i_{sd})_{ref} = x_1^r = x_1^d + i_{sdn} \\ (i_{sq})_{ref} = x_2^r = x_2^d + i_{sqn} \end{cases} \quad (9)$$

### B. Direct and Quadrature currents regulator:

According to the derivative of the currents surfaces we can generate the tension on the (d-q) axis.

$$\begin{cases} \dot{S}_3 = \dot{x}_2^d - \dot{x}_2 = 0 \\ \dot{S}_4 = \dot{x}_1^d - \dot{x}_1 = 0 \end{cases} \quad (10)$$

$$\Rightarrow \begin{cases} u_{2eq} = V_{sqeq} = \frac{1}{b} (\dot{x}_2^r - f_2(x)) \\ u_{1eq} = V_{sdeq} = \frac{1}{b} (\dot{x}_1^r - f_1(x)) \end{cases} \quad (11)$$

Where: 
$$\begin{cases} f_1(x) = a_1 x_1 + \omega_s x_2 + a_2 x_3 \\ f_2(x) = -\omega_s x_1 + a_1 x_2 + a_5 x_3 x_5 \end{cases}$$

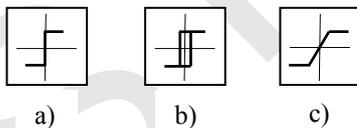
We ensure the attractive control law by:

$$\begin{cases} V_{sqn} = k_3 \text{eval}(S_3) \\ V_{sdn} = k_4 \text{eval}(S_4) \end{cases} \quad (12)$$

$k_3$  and  $k_4$  are positive constants. Finely we get:

$$\begin{cases} u_{2nom} = V_{sq} = V_{sqeq} + V_{sqn} \\ u_{1nom} = V_{sd} = V_{sdeq} + V_{sdn} \end{cases} \quad (13)$$

In this study, the *eval* block usually is any function of the following family: sign, relay or linear with saturation as shown in Figure1. Both the sign and the relay functions do not perform accurately in a discrete-time system, resulting in oscillations and undesired chattering. A linear function with a proper gain provides much better results in reducing oscillations while still maintaining the properties of sliding mode [16].



**Fig.1** Typical *eval* function: a) SIGN,  
b) RELAY,  
c) LINEAR WITH SATURATION

The *eval* function is implemented as a linear gain with saturation [19]:

$$\text{eval}(x) = \begin{cases} x.k_{eval} & \text{if lower limit} < x < \text{upper limit} \\ \text{upper limit} & \text{if } x > \text{upper limit} \\ \text{lower limit} & \text{if } x < \text{lower limit} \end{cases}$$

where  $k_{eval}$  is a constant related to the system dynamics.

#### IV. CURRENT-FLUX HIGH GAIN OBSERVER

In the following, the purpose is to design a current-flux high-gain observer based on a general class of sliding manifold  $S_c$ . In the sequel,  $(\hat{x}_1 \hat{x}_2)$  denote the observed currents,  $(\hat{x}_3 \hat{x}_4)$  the observed flux,  $e_{r1} = x_1 - \hat{x}_1$  and  $e_{r2} = x_2 - \hat{x}_2$  the current observation error,  $e_{r3} = x_3 - \hat{x}_3$  and  $e_{r4} = x_4 - \hat{x}_4$  the flux observation error [20-22].

The currents  $(x_1, x_2)$ , the rotor speed  $\Omega$  and the control inputs  $(u_1, u_2)$  are assumed available by measure. The observer is considered as a copy of the induction motor electric equations where the  $\Omega$  speed is taken as a time-varying parameter. Therefore, the following observer is proposed [23].

$$\begin{cases} \begin{bmatrix} \dot{\hat{x}}_1 \\ \dot{\hat{x}}_2 \end{bmatrix} = a_1 \begin{bmatrix} \hat{x}_1 \\ \hat{x}_2 \end{bmatrix} + A_0 \begin{bmatrix} \hat{x}_3 \\ \hat{x}_4 \end{bmatrix} + b_1 \begin{bmatrix} u_1 \\ u_2 \end{bmatrix} + \Delta \begin{bmatrix} \text{sign}(S_{c1}) \\ \text{sign}(S_{c2}) \end{bmatrix} \\ \begin{bmatrix} \dot{\hat{x}}_3 \\ \dot{\hat{x}}_4 \end{bmatrix} = a_7 \begin{bmatrix} \hat{x}_1 \\ \hat{x}_2 \end{bmatrix} + B_0 \begin{bmatrix} \hat{x}_3 \\ \hat{x}_4 \end{bmatrix} + K \begin{bmatrix} \text{sign}(S_{c1}) \\ \text{sign}(S_{c2}) \end{bmatrix} \end{cases} \quad (14)$$

$$\begin{cases} A_0 = \begin{pmatrix} a_2 & a_3 x_5 \\ -a_3 x_5 & a_2 \end{pmatrix}, B_0 = \begin{pmatrix} a_8 & a_9 x_5 \\ -a_9 x_5 & a_8 \end{pmatrix} \\ \Delta = \begin{pmatrix} \delta_1 & 0 \\ 0 & \delta_2 \end{pmatrix}, K = \begin{pmatrix} k_1 & k_2 \\ k_3 & k_4 \end{pmatrix} \\ K = \left[ B_0 + \begin{pmatrix} q_1 & 0 \\ 0 & q_2 \end{pmatrix} \right] \left[ (A_0)^{-1} \begin{pmatrix} \delta_1 & 0 \\ 0 & \delta_2 \end{pmatrix} \right] \end{cases} \quad (15)$$

Where:  $\delta_1$  and  $\delta_2$  are high-gains.

$$\text{Consider the sliding surface } S_c = \begin{pmatrix} S_{c1}(e_{r1}) \\ S_{c2}(e_{r2}) \end{pmatrix}$$

Where:  $S_{c1}(x)$  and  $S_{c2}(x)$  are strictly increasing functions satisfying:  $S_{ci}(x) = 0$  if and only if  $x = 0$  (for  $i = 1, 2$ ) [20].

One therefore has the following result.

Consider the induction motor dynamic (1) and the sliding mode observer (14). If conditions (15) are fulfilled, then these two conditions are satisfied [23]:

- 1) The current and flux observation errors  $(e_{r1}, e_{r2}, e_{r3}, e_{r4})$  are exponentially stable.
- 2) The closed-loop system obtained using the hybrid control and the high-gain observer is internally stable.

*I<sup>st</sup> Condition:*

Let us take the following Lyapunov function and its derivative:

$$\begin{cases} V_c = \frac{1}{2} S_c^T S_c \\ \dot{V}_c = S_c^T \dot{S}_c \\ S_c = (S_{c1} \quad S_{c2})^T \end{cases} \quad (16)$$

$$\text{With } \begin{pmatrix} \dot{e}_{r1} \\ \dot{e}_{r2} \end{pmatrix} = a_1 \begin{pmatrix} e_{r1} \\ e_{r2} \end{pmatrix} + A_0 \begin{pmatrix} e_{r3} \\ e_{r4} \end{pmatrix} - \Delta \begin{pmatrix} \text{sign}(S_{c1}) \\ \text{sign}(S_{c2}) \end{pmatrix} \quad (17)$$

the sliding surface dynamics  $(\dot{S}_{c1}, \dot{S}_{c2})$  becomes:

$$\begin{cases} \dot{S}_{c1} = [a_1 e_{r1} + a_2 e_{r3} + a_3 x_5 e_{r4} - \delta_1 \text{sign}(S_{c1})] \frac{dS_{c1}(e_{r1})}{e_{r1}} \\ \dot{S}_{c2} = [a_1 e_{r2} - a_3 x_5 e_{r3} + a_2 e_{r4} - \delta_2 \text{sign}(S_{c2})] \frac{dS_{c2}(e_{r2})}{e_{r2}} \end{cases} \text{ and hence } \dot{V}_c \text{ takes the form:}$$

$$\begin{aligned} \dot{V}_c = & [a_1 e_{r1} + a_2 e_{r3} + a_3 x_5 e_{r4} \\ & - \delta_1 \text{sign}(S_{c1})] S_{c1}(e_{r1}) \frac{dS_{c1}(e_{r1})}{e_{r1}} \\ & + [a_1 e_{r2} - a_3 x_5 e_{r3} + a_2 e_{r4} \\ & - \delta_2 \text{sign}(S_{c2})] S_{c2}(e_{r2}) \frac{dS_{c2}(e_{r2})}{e_{r2}} \end{aligned}$$

Since  $S_{c1}$  and  $S_{c2}$  are strictly increasing, this implies that the terms  $\frac{dS_{c1}}{de_{r1}}$  and  $\frac{dS_{c2}}{de_{r2}}$  are positive. Furthermore,  $\delta_1$  and  $\delta_2$  are high-gains, hence

$$\begin{cases} \delta_1 > \|a_1 e_{r1} + a_2 e_{r3} + a_3 x_5 e_{r4}\|_{Max} \\ \delta_2 > \|a_1 e_{r2} - a_3 x_5 e_{r3} + a_2 e_{r4}\|_{Max} \end{cases} \quad (18)$$

As a consequence,  $S_c$  tends to zero and the observation errors  $e_{r1}$  and  $e_{r2}$  exponentially converge to zero.

The first subsystem dynamic (14) is in sliding mode. We can find from (17) if  $(S_c \equiv \dot{S}_c \equiv 0)$  then  $e_{r1} = e_{r2} = \dot{e}_{r1} = \dot{e}_{r2} = 0$ , and the terms  $\text{sign}(S_{c1})$  and  $\text{sign}(S_{c2})$  are equivalent to:

$$\begin{pmatrix} \text{sign}(S_{c1}) \\ \text{sign}(S_{c2}) \end{pmatrix} \equiv \begin{pmatrix} \delta_1 & 0 \\ 0 & \delta_2 \end{pmatrix}^{-1} A_0 \begin{pmatrix} e_{r3} \\ e_{r4} \end{pmatrix} \quad (19)$$

As consequence, the second subsystem dynamic (14) is reduced to:

$$\begin{pmatrix} \dot{e}_{r3} \\ \dot{e}_{r4} \end{pmatrix} = [B_o - K \begin{pmatrix} \delta_1 & 0 \\ 0 & \delta_2 \end{pmatrix}^{-1} A_o] \begin{pmatrix} e_{r3} \\ e_{r4} \end{pmatrix} \quad (20)$$

With the gain matrix  $K$  given by (15), the observation error dynamic  $e_{r3}$  and  $e_{r4}$  become:

$$\begin{pmatrix} \dot{e}_{r3} \\ \dot{e}_{r4} \end{pmatrix} = - \begin{pmatrix} q_1 & 0 \\ 0 & q_2 \end{pmatrix} \begin{pmatrix} e_{r3} \\ e_{r4} \end{pmatrix} \quad (21)$$

With  $\begin{cases} q_1 > 0 \\ q_2 > 0 \end{cases}$

It clearly appears that the flux observation errors  $e_{r3}$  and  $e_{r4}$  exponentially converge to zero. The observations errors dynamics will be stable if only if we take  $q_1 > 0$  and  $q_2 > 0$ .

2<sup>ed</sup> Condition:

The convergence of the flux ( $e_{r3}$  and  $e_{r4}$ ) and the controlled output errors ( $e_1$  and  $e_2$ ), to zero does not implies that these variables will tend to zero when the observed flux is used instead of the real flux in the control law. A sufficient condition for the global stability of the overall system control/observer is that both control law and the used observer ensure exponential stability [24]. This condition is satisfied in our case.

## VI. SIMULATION RESULTS

Numerical simulations have been carried out; on a 1.08-kW induction motor drive which ratings are summarized in the appendix, to analyze the hybrid controller performance with the High-gain rotor flux observer.

Test 1: Speed and flux tracking are checked for no load torque and no parameter variations case. Simulation results are illustrated by Fig.2. It can be noticed that both control approach ensure good flux and speed tracking.

**Test 2:** Speed and flux tracking are now checked in the case of an unknown load torque ( $T_L = 2T_{nom}$ ) applied between  $t = 2$ sec and  $t = 4$ sec. The control performances are illustrated by Fig.3.

**Test 3:** In Fig.4, simulations have been carried-out with 50% variation in all the resistive parameters ( $R_s, R_r$ ) starting from  $t = 2$ sec till  $t = 4$ sec.

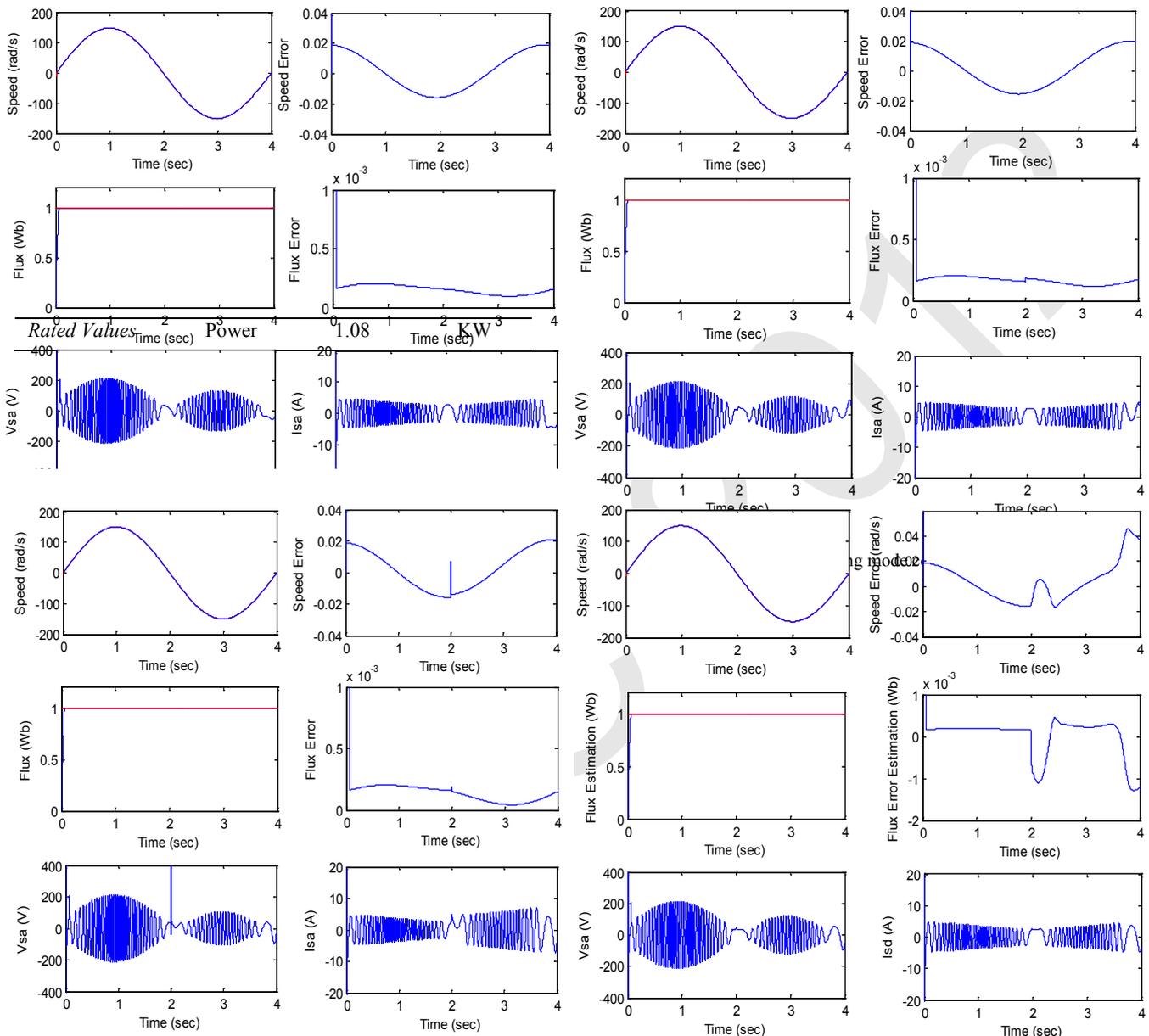


Fig. 3. FO/Sliding mode control: Test 2.

Fig. 5. FO/Sliding mode control with High Gain Observer: Test 4.

laws (Fig.5). The used observer is the above-discussed high-gain one. The obtained results are quite good and very encouraging.

## V. CONCLUSION

This paper describes a sensorless hybrid field oriented-sliding mode control strategy for a high-performance induction-motor drive. The Hybrid control technique has been selected since it has been proven to offer the best performance over the entire speed range and to ensure induction motor drive operation continuity. Among these, a practical adaptive sensorless technique (High-gain observer) has been used to estimate rotor flux. Computer simulations on a 4-kW induction motor drive show the feasibility and robustness of the proposed sensorless control strategy.

## APPENDIX

| RATED DATA OF THE SIMULATED INDUCTION MOTOR |           |         |                   |
|---|-----------|---------|-------------------|
| Rated parameters                            | Frequency | 50      | Hz                |
|   | Voltage   | 220/380 | V                 |
|   | $n_p$     | 2       |                   |
|   | $R_s$     | 10      | $\Omega$          |
|   | $R_r$     | 6.3     | $\Omega$          |
|   | $L_s$     | 0.4642  | H                 |
|   | $L_r$     | 0.4612  | H                 |
|   | $M$       | 0.4212  | H                 |
|   | $J$       | 0.02    | Kg.m <sup>2</sup> |
|   | $f$       | 0.0005  | IS                |

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# İKLİM VERİLERİ İLE ZAMAN TAHMİNİNDE MAKİNE ÖĞRENMESİ YÖNTEMLERİNİN KARŞILAŞTIRILMASI

Serap Kazan<sup>1</sup>, Mustafa Akpınar<sup>1</sup>, Ali Gülbağ<sup>1</sup>, Gözde Yolcu<sup>1</sup>

<sup>1</sup>Bilgisayar Mühendisliği Bölümü, Sakarya Üniversitesi, Türkiye.

scakar@sakarya.edu.tr

akpinar@sakarya.edu.tr

agulbag@sakarya.edu.tr

gyolcu@sakarya.edu.tr

**Özet:** Sıcaklık ve nem oranının günün farklı zamanlarında ve zamana bağlı olarak değiştiği bilinmektedir. Bu çalışmada zamanın (saatin) sıcaklık ve nem üzerindeki etkisi araştırılmıştır. Sistem girdileri sıcaklık ve nem, çıktı ise zamandır. Çalışmada Sakarya iline ait sıcaklık ve nem oranı verileri alınıp Makine Öğrenmesi yöntemleri kullanılarak hem gün içindeki saat dilimi tahmini, hem de sınıflandırıcıların performanslarının karşılaştırılması yapılmıştır. Sınıflandırıcı olarak iki farklı yöntem kullanılmıştır. Birincisi; Olasılıksal Sinir Ağı yöntemi, ikincisi ise K-Means kümeleme algoritması ve En Yakın Komşu sınıflandırıcısının birleştirildiği hibrit bir yöntemdir. Yapılan uygulamalar sonucu Olasılıksal Sinir Ağı Yönteminin diğer yöntemlere göre daha iyi performans gösterdiği görülmüştür.

**Anahtar Kelimeler:** İklim, Olasılıksal Sinir Ağları, K-means, En yakın komşu.

## Comparison of Machine Learning Methods on Estimation of Time with Climate Data

**Abstract:** It is known that temperature and humidity rates change at different times of the day thus it depends on the time. In this study the effect of the time (hour) on the day temperature and humidity is investigating. System inputs are measured day temperature and humidity, and output is time (hour). The day of the hour is estimated with the machine learning algorithm using hourly temperature and humidity data of Sakarya city. Then machine learning algorithm performances are compared. Two classifiers are used, first one is a Probabilistic Neural Network, and second one is a hibrit algorithm which is Nearest Neighbor classifiers with K-means clustering algorithm. It was seen that Probabilistic Neural Network performs better result than other method.

**Keywords:** Climate, Probabilistic Neural Network, K-means, Nearest neighbour.

### 1. Giriş

Makine öğrenmesi bilgisayarların örnek veri ya da geçmiş deneyimi kullanarak bir ölçüte göre başarımlarını arttıracak biçimde programlanmasıdır (Alpaydın, 2011). Son yirmi yıldır Makine Öğrenmesi, bilgi teknolojisinin en büyük desteklerinden biri ve her ne kadar fark etmesek de hayatımızın bir parçası haline gelmiştir. Elde edilen veri miktarının artması ile, daha başarılı veri analizlerinin gerçekleştirilme gereksinimleri ortaya çıkmıştır (Smola, 2010).

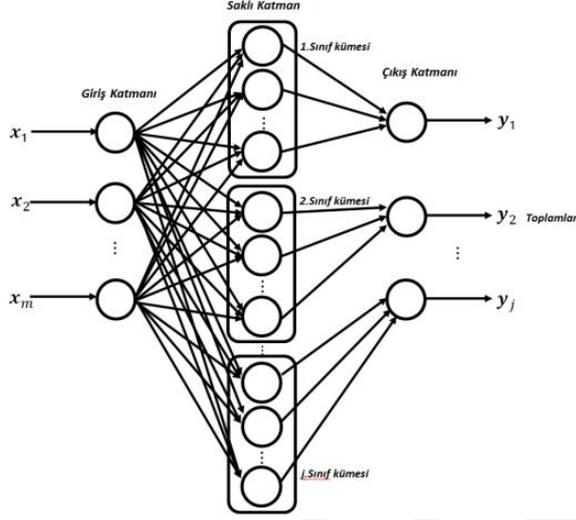
Isıtma, soğutma, havalandırma ve güneş enerjisi sistemlerinin projelendirilmesi iklim verilerine dayanmaktadır. İklim verileri bu sistemlerin simülasyonunda, enerji analizlerinde, kapasitelerinin ve uygunluklarının belirlenmesinde gereklidir (Said, 1994). Günümüzde hava tahmini çalışmaları da Makine öğrenmesi yöntemleri kullanılarak yapılmaktadır. Örneğin Olaiya (2012), yapmış olduğu bir çalışmada Yapay Sinir Ağları ve Karar Ağaçları yöntemlerini kullanmıştır. Sharma ve arkadaşları (2011) Destek Vektör Makineleri yönteminin hava tahmini üzerindeki etkisini araştırmışlardır. Cofino ve arkadaşları (2002) Bayes Ağları yöntemini kullanarak hava tahmini üzerinde olasılıksal bir model çıkarmışlardır. Li ve arkadaşları (2008) yaptıkları çalışmada fırtına olaylarının tespitinde K-means ve DBSCAN kümeleme algoritmalarını kullanarak bu iki yöntemin performansını karşılaştırmışlar ve DBSCAN algoritmasının daha başarılı sonuçlar verdiğini tespit etmişlerdir.

Sıcaklık ve nem oranının günün farklı zamanlarında ve zamana bağlı olarak değiştiği bilinmektedir. Bu çalışmada sıcaklık ve nem verileri kullanılarak zaman (saat) tahmini yapılmıştır. Sakarya iline ait saatlik sıcaklık ve nem oranı verileri alınıp Olasılıksal Sinir Ağı sınıflandırıcısı ve K-means kümeleme algoritması ile birlikte En Yakın Komşu sınıflandırıcısı hibrit yöntemi kullanılarak hem gün içindeki saat dilimi tahmini, hem de bu sınıflandırıcıların performanslarının değerlendirilmesi yapılmıştır.

## 2. Kullanılan Yöntemler

### 2.1. Olasılıksal Sinir Ağı

Bir Olasılıksal Sinir Ağı (OSA) üç katmandan oluşmaktadır. Giriş katmanı, her biri bir özneliği temsil eden  $m$  adet öznelik vektörü içermektedir. Giriş katmanında bulunan ve öznelikleri temsil eden bu düğümler; her saklı düğüm giriş öznelik vektörü olan  $x$ 'i tamamen alacak şekilde saklı (orta) katmandaki her düğüme bağlanır. Saklı düğümler her biri bir sınıfı gösterecek şekilde kümelere ayrılmaktadır. Giriş katmanındaki düğümlerin ağırlık vektörleri eğitim kümesi olarak verilen öznelik vektörleri olarak belirlenir. Aşağıda verilen Şekil 1'de  $j$  adet sınıfı tanıyan bir OSA'nın yapısı görülmektedir (Çekli ve Uzunoğlu, 2011).



Şekil 1: Olasılıksal sinir ağı modeli

$l$  sınıfının kümesindeki her saklı düğüm  $l$  sınıftaki kendisine ait öznelik vektörüyle belirlenen bir Gauss işlevi ile ilişkilidir ve her öznelik vektörüne ilişkin bir Gauss işlevi bulunmaktadır. Bir sınıfa ait kümedeki bütün Gauss işlevleri, işlevsel değerlerini sadece bu sınıfa ait olan çıkış katmanına yollar. Sonuç olarak çıkış katmanında  $l$  çıkış düğümü bulunur.

$l$  sınıfının çıkış düğümünde,  $l$  sınıfı için bütün Gauss değerleri toplanır ve toplam ölçeklenir. Bu sayede toplam işlevi, birim işlev olur ve toplam bir olasılık yoğunluk işlevi haline gelir. Herhangi bir  $l$  giriş vektörü için  $j$ . Sınıfın  $i$ . öznelik vektörü ile ilgili Gauss denklemleri  $m$  vektör boyutu olmak üzere aşağıdaki şekilde verilebilir;

$$\sigma_{ij}(x) = \left[ \frac{1}{\sqrt{(2\sigma^2)^m}} \right] \exp\left\{ -\frac{\|x - \mu_{ij}\|^2}{2\sigma^2} \right\} \quad (1)$$

Denklemdaki  $\sigma$  değeri aynı kümedeki öznelik vektörleri arasındaki ortalama mesafenin yarısı olarak veya her bir örnek için, ilgili örnekten bu örneğe en yakın diğer bir örnek vektöre olan uzaklığın yarısı olarak alınabilir.  $j$ . çıkış düğümü,  $j$ . kümedeki saklı düğümlerden alınan değerleri toplar, buna karışık Gausslar veya Parzen penceresi denmektedir. Bu toplamlar aşağıdaki denklemden verilen şekilde tanımlanabilir;

$$\sigma_{ij}(x) = \left[ \frac{1}{\sqrt{(2\sigma^2)^m}} \right] \frac{1}{\sum_{i=1}^l \exp\left\{ -\frac{\|x - \mu_{ij}\|^2}{2\sigma^2} \right\}} \quad (2)$$

Bu ifade de  $x$  giriş verilen bir öznelik vektörüdür,  $\sigma$  Gauss işlevi için ayarlanabilen bir yumuşatma parametresidir (standart sapma), öznelik vektörlerinin birbirinden ne kadar farklılaştığının bir ölçütüdür. Herhangi bir giriş vektörü  $x$  çıkış katmanındaki her bir Gauss toplam işlevine uygulanır ve işlevlerden en büyük değere sahip olanı seçilerek giriş vektörünün sınıfına karar verilir.

OSA'nın en büyük avantajı eğitiminin hızlı ve çıkışların olasılıksal olmasıdır. Dezavantajı ise bütün eğitim kümesini düğüm olarak içerir ve bundan dolayı ağ boyutu büyüktür. Bu yüzden büyük boyutlu vektörler ile işlem yapar.

## 2.2. K-means Algoritması

En eski kümeleme metodlarından biri olan k-means algoritmasının genel mantığı  $n$  adet veri nesnesinden oluşan bir veri setini, giriş parametresi olarak verilen  $k$  adet kümeyle bölümlenmektedir. Amaç, gerçekleştirilen bölümlenme işlemi sonunda elde edilen kümelerin, küme içi benzerliklerinin maksimum ve kümeler arası benzerliklerinin minimum olmasını

sağlamaktır. Küme benzerliği, kümenin ağırlık merkezi olarak kabul edilen bir nesne ile kümedeki diğer nesnelere arasındaki uzaklıkların ortalama değeri ile ölçülmektedir (Han ve Kamber, 2001; Berkhin, 2002).

K-means algoritmasının işlem basamakları şöyledir:

1. Adım: İlk küme merkezleri belirlenir. Bunun için iki farklı yol vardır. Birinci yol nesnelere arasından küme sayısı olan  $k$  adet rastgele nokta seçilmesidir. İkinci yol ise merkez noktaların tüm nesnelere ortalama alınarak belirlenmesidir,
2. Adım: Her nesnenin seçilen merkez noktalara olan uzaklığı hesaplanır. Elde edilen sonuçlara göre tüm nesnelere  $k$  adet kümeden kendilerine en yakın olan küme yerleştirilir,
3. Adım: Oluşan kümelerin yeni merkez noktaları o kümedeki tüm nesnelere ortalama değeri ile değiştirilir,
4. Adım: Merkez noktalar değişmeyinceye kadar 2. ve 3. adımlar tekrarlanır.

### 2.3. En Yakın Komşu Kuralı

Elimizde  $x_i$  örüntüleri (nokta)  $Y_j$  sınıfları ile doğru olarak ilişkilendirilmiş örnekler bulunduğunu söylemiştik. Sezgisel olarak, aynı  $j$  sınıfı ile ilişkili olan  $x$  örüntülerinin birbirlerine benzer (yakın) olduklarını söyleyebiliriz. Aynı sınıf örüntüleri genellikle bir bölgede kümeleşirler.

Bu durum, sınıflandırılmamış  $x$  örüntülerini en yakın komşusu olan  $j$  sınıfına atamanın olumlu sonuçlar üreteceğine işaret eder.

Basit sınıflandırma kurallarından bu biçimdeki olanı En Yakın Komşu Yaklaşımı olarak adlandırılır ve matematiksel olarak Denklem 3'deki gibi ifade edilir.

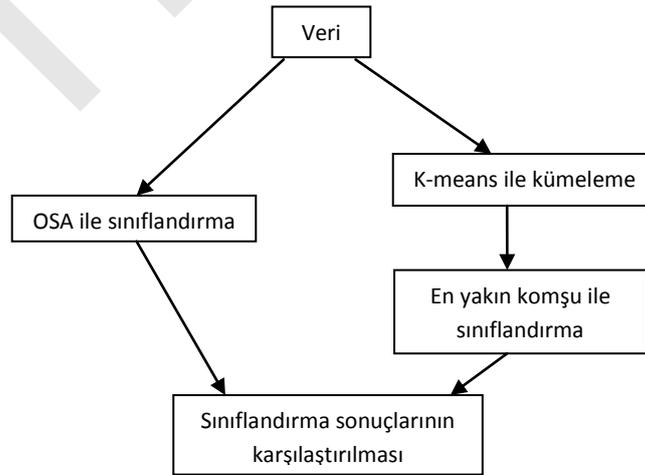
Eğer aşağıdaki eşitlik sağlanırsa,  $x'_n$ ,  $x$ 'in en yakın komşusudur.

$$\min d(x_i, x) = d(x'_n, x) \quad (3)$$

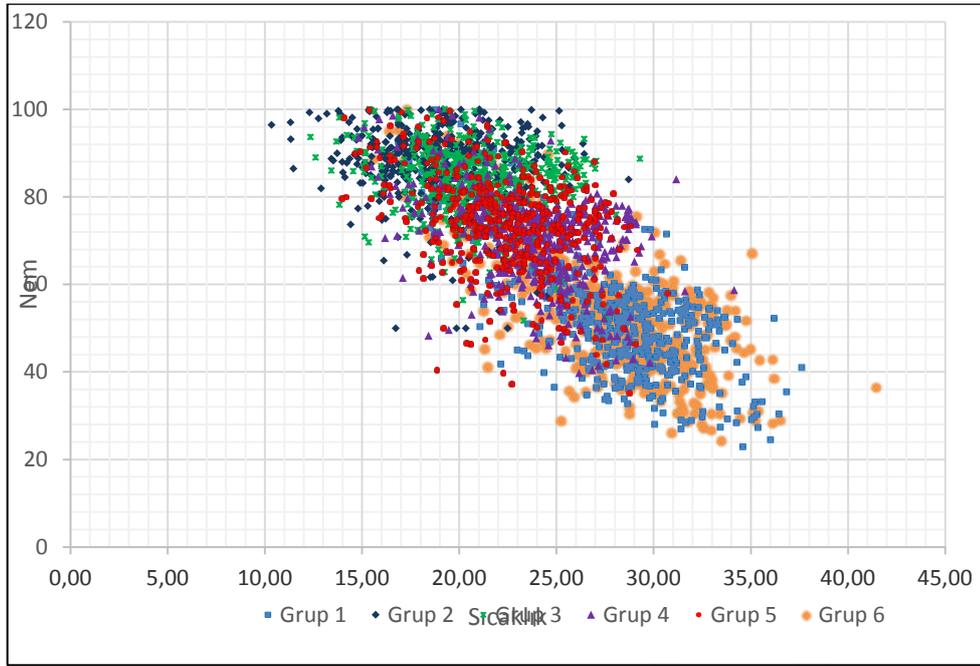
En yakın komşu yaklaşımı  $x$  örüntüsünün sınıfını,  $x$  örüntüsüne en yakın olan örüntünün sınıfı olarak belirleme yaklaşımıdır. Sınıfı belirlenen örüntü ile komşu örüntü aynı sınıfa ait değilse hata söz konusudur. Bu yaklaşım sadece en yakın komşu ile sınıflandırma yapar, önceden sınıflandırılmış diğer örüntüleri önemsemez (Duda ve arkadaşları 2001)

### 3. Uygulama Sonuçları ve Kullanılan Yöntemlerin Karşılaştırılması

Bu uygulamada giriş için sıcaklık ve nem ve çıkış için zaman (saat) verilerini kullanan iki ayrı sınıflandırma modeli oluşturulmuştur. Sınıflandırıcı olarak OSA sınıflandırma yöntemi ile K-means kümeleme ve En Yakın Komşu sınıflandırıcısının birlikte kullanıldığı hibrit yöntem kullanılmış ve bu iki yöntemin performansları karşılaştırılmıştır. Şekil 2'de yapılan uygulamanın özeti gösterilmiştir. Uygulamada toplam 3636 veri kullanılmıştır. 2008'den 2011'e kadar olan yaz ayları verileri eğitim, 2012 yaz ayları verileri ise test için ayrılmıştır. Bir tam gün 6 eşit parçaya bölünerek 4 saatte bir alınan sıcaklık ve nem verileri girişlerde saatler ise çıkışlarda kullanılmıştır.



Şekil 2: Yapılan uygulamanın özeti



**Şekil 3:** K-means kümeleme algoritması sonucunda oluşan sıcaklık-nem dağılım grafiği

Öncelikle OSA yöntemi ile sıcaklık ve nem değerlerinden oluşan 2916 tane eğitim verisi ile eğitim yapılmıştır. Daha sonra 720 tane test verisi ile sonuçlar test edilmiştir. Uygulamalar Matlab programı kullanılarak yapılmıştır. Bu yöntemle 720 tane verinin 367 tanesi doğru olarak bulunmuştur. Dolayısı ile verilerin %50.97'si doğru olarak kestirilmiştir.

Daha sonra K-means kümeleme algoritmasının ardından En Yakın Komşu sınıflandırıcısı yöntemi birleştirilerek kullanılmıştır. Öncelikle sıcaklık ve nem değerlerinden oluşan 2916 tane eğitim verisi K-means algoritması ile 6 gruba kümelendi. Şekil 3'de K-means kümeleme algoritması sonucunda oluşan sıcaklık-nem dağılım grafiği gösterilmiştir. Daha sonra her grupta her saat verisinden kaç tane olduğu Tablo 1'de gösterildiği gibi hesaplanmıştır. Her grup için hesaplanan saat değerlerinden maksimum olan saat değeri o gruba atanmıştır. Bu işlem de Tablo 2'de gösterilmiştir. Daha sonra da test verileri ile En Yakın Komşu algoritması kullanılarak verilerin sınıflandırılması gerçekleştirilmiştir. İşlem sonucunda 720 tane test verisinin 277 tanesinin doğru olarak bulunduğu tespit edilmiştir. Dolayısı ile bu hibrit yöntemle verilerin %38.41'i doğru olarak kestirilmiştir.

**Tablo 1:** K-means kümeleme algoritması sonucunda her grupta her saat verisinden kaç tane olduğu

| Gruplar/Saatler | 1          | 5          | 9          | 13         | 17         | 21         | Toplam      |
|-----------------|------------|------------|------------|------------|------------|------------|-------------|
| 1               | 3          | 6          | 138        | 124        | 9          | 1          | 281         |
| 2               | 267        | 45         | 7          | 10         | 22         | 122        | 473         |
| 3               | 166        | 115        | 16         | 11         | 52         | 253        | 613         |
| 4               | 35         | 196        | 27         | 27         | 232        | 88         | 605         |
| 5               | 9          | 94         | 81         | 93         | 133        | 19         | 429         |
| 6               | 6          | 29         | 218        | 221        | 39         | 2          | 515         |
| <b>Toplam</b>   | <b>486</b> | <b>485</b> | <b>487</b> | <b>486</b> | <b>487</b> | <b>485</b> | <b>2916</b> |

| Gruplar | Saatler |
|---------|---------|
| 1       | 09:00   |
| 2       | 01:00   |
| 3       | 21:00   |
| 4       | 17:00   |
| 5       | 05:00   |

**Tablo 2:** K-means kümeleme algoritması sonucunda gruplara karşılık gelen saatler

#### 4. Sonuçlar

Bu çalışmada Sakarya iline ait sıcaklık ve nem verileri alınarak makine öğrenmesi yöntemleri ile zaman dilimi kestirimi yapılmış ve kullanılan sınıflandırıcıların performansları karşılaştırılmıştır. Sınıflandırıcı olarak iki farklı yöntem kullanılmıştır. Birincisi, Olasılıksal Sinir Ağı yöntemi, ikincisi ise K-Means kümeleme algoritması ve En Yakın Komşu sınıflandırıcısının birleştirildiği hibrit bir yöntemdir. Yapılan uygulamalar sonucunda Olasılıksal Sinir Ağı yönteminin daha iyi performans gösterdiği görülmüştür. Kestirim oranlarının düşük olması birkaç sebebe bağlanabilir. Birincisi eğitim seti için 2008-2011 verileri kullanılarak test setinde 2012 verileri kestirilmeye çalışılmıştır. Farklı senelerde davranışlar farklı olabilir. İkincisi kullanılan verilerin çok olmasından ve değerlerin birbirine yakın olmasından dolayı kümeleme sonucu ortaya çıkan gruplar iç içe geçmiştir. Dolayısı ile testlerde yanlış gruba sınıflandırma hatası ile karşılaşmıştır. Ayrıca sınıf sayısı 6 olarak seçilmiştir. Bu rakam azaltıldığında kestirim oranlarının yükseleceği açıktır.

#### 5. Teşekkür

Bu çalışmada kullanılan verileri sağlayan AGDAŞ'a teşekkür ederiz.

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# İLETİŞİM ARAÇLARINA OLAN BAĞIMLILIĞIN UTANGAÇLIK VE YALNIZLIK DUYGUSUNA ETKİSİ

Öğr.Gör. Mustafa Öztunc\*  
Sakarya Üniversitesi  
oztunc@sakarya.edu.tr

**Özet:** Bu araştırma yalnızlık ve utangaçlık duygusunun, problemleri cep telefonu kullanımını artırıp arttırmadığının belirlenmesine yöneliktir. Üniversite öğrencilerine yönelik yapılan bu çalışmada değişkenlerden birinin bağımlı, diğerlerinin bağımsız olarak ele alındığı çoklu regresyon deseni kullanılmıştır. Çalışmada, üniversite öğrencilerinin Problemleri Cep Telefonu Kullanım düzeyleri bağımlı (yordanan) değişken olarak alınmıştır. Araştırmada Problemleri Cep Telefonu Kullanım Ölçeği, UCLA Yalnızlık Ölçeği ve Utangaçlık Ölçeği kullanılmıştır. Araştırma bulgularına göre yordayıcı değişkenler olarak ele alınan utangaçlık ve yalnızlık korelasyonları incelendiğinde utangaçlık ve yalnızlık arasında anlamlı bir ilişki varlığı belirlenmiştir. Utangaçlık ve yalnızlık ile Problemleri Cep Telefonu kullanımı arasında anlamlı bir ilişki saptanmıştır. Araştırma sonucunda yalnızlık ve utangaçlık arttıkça problemleri cep telefonuna yöneliminde arttığı belirlenmiştir.

**Anahtar Kelimeler:** Problemleri Cep Telefon Bağımlılığı, Utangaçlık Duygusu, Yalnızlık Duygusu

## 1. GİRİŞ

Teknolojik ürünlerden biri olan mobil telefonlar, internet, bilgisayar vb. iletişim araçları gibi günlük yaşamımızın ayrılmaz bir parçasını oluşturmaktadır. Önemli bir gereksinim aracı olan mobil telefonlar yaşamımızda o denli yer etmiş ki, kullanıcılar mobil telefonu yanlarında olmadığı zaman kendini boşlukta ve adeta yalnız hissetmektedir. Yediden yetmişe her kesimin kullandıkları mobil telefonlar, yalnızca iletişimi sağlamamakta, içeriğindeki programlar nedeniyle birçok bireyin eğlence amaçlı zaman geçirdikleri teknolojik ürünlerdir. Geliştirilen yazılımlar sayesinde küçük bir bilgisayar olma özelliği de taşıyan mobil telefonların bağımlılığı arttırdığı düşünülmektedir.

Bireylerde mobil telefon bağımlılığının oluşması ile ilgili çeşitli yaklaşımlar bulunmaktadır. Griffiths (2003)" e göre heyecan veren her şey bağımlılık yapmaktadır. Bu açıdan bakıldığında mobil telefon kullanımı birçok özelliği ile bireye heyecan verdiğinden o kişide bağımlılık oluşturabilmektedir. Bihevörizm (Davranışçı) bakış açısından mobil telefon bağımlılığı şu şekilde açıklanabilmektedir. Bu yaklaşıma göre, eğer bir davranışın ardından doyum ve hoş giden bir durum elde ediliyorsa (olumlu pekiştirme) ya da bir davranış gerginlik ve sıkıntı gibi olumsuz bir davranıştan kurtulmaya (olumsuz pekiştirme) yardımcı oluyorsa, o davranış artmakta ve kişi daha sonra haz almak ya da olumsuzluktan kurtulmak için o davranışı yapmaya devam etmektedir (Cüceloğlu,1993). Bihevörizm (Davranışçı) yaklaşım açısından bakıldığında, mobil telefon kullanımı hem kullanan bireylere kullanım sonucunda ihtiyaçlarını karşıladığı için haz vermekte, hem de onları stres veya taşıdığı kaygılardan kurtarmaktadır.

Durumu açıklamada kullanılabilecek yaklaşımlardan bir diğeri de Jacobs (1988) un bağımlılık genel teorisidir. Jacobs'a göre düşük ya da yüksek uyarımlar, düşük öz saygı ve olumsuz erken çocukluk yaşantıları negatif duygulara neden olmakta ve bireyin homeostatik dengesini bozmaktadır. Bu nedenle, kişiler bu negatif duygulardan kaçmak ve homeostatik dengeyi sağlamak için bağımlılık yaratan davranışlara yönelmektedirler (Jacobs, 1988). Yüksek düzeyde mobil telefon kullanan kişilerin düşük öz saygı düzeyine sahip oldukları ve bu kişilerin öz saygılarını arttırabilmek için mobil telefonunu sıklıkla kullandıkları görülmüştür (Phillips, Ogeil ve Blaszczyński, 2011).

Toplumsal literatürde "yalnızlık" kavramı bireyin tek başına olma durumu olarak bilinmektedir. Çeşitli literatürde ise kavram genelde "bireyin yaşamakta olduğu sosyal ilişkiler ile yaşamak istediği ilişkiler arasında görülen farktan ve çelişkiden dolayı ortaya çıkan, rahatsız edici, psikolojik bir durum" (Peplau ve Perlman, 1982) şeklinde tanımlanmaktadır. Bu yönüyle değerlendirildiğinde yalnızlık, toplum literatüründe algılandığı gibi bireyin tek başına olma durumu kadar basit bir duygu değildir. Bu ifadelerden de anlaşılacağı gibi yalnızlık duygusunun temelini, yaşanan sosyal ilişkilerin yetersizliği ve bu ilişkilerden sağlanmak istenen doyum seviyesinin düşük oluşu belirleyebilmektedir.

Ergenler üzerinde yalnızlık duygusunu araştıran Moore ve Schultz (1983) ergenlerin televizyon izleme veya müzik dinleme; meşgul olacak birşey bulma ve birileriyle konuşma yaparak yalnızlıkla başetmede bu yöntemleri sıklıkla kullandığını belirlemiştir.

Ülkemizde üniversite öğrencilerinin yalnızlık duygularının belirlenmesine yönelik araştırma yapan Demir (1990); ise önemli sayılabilecek bulgulara rastlamıştır. Bulgulara bakıldığında; Erkek öğrencilerin kızlardan, akademik yönden başarısız olanların başarılı olanlardan, serbest zamanını tek başına geçirenlerin başkalarıyla geçirenlerden, aylık gelirini sosyal etkinlikler için yeterli görmeyenlerin yeterli görenlerden, çevresinden sosyal destek almayanların destek alanlardan, yakın arkadaşı az olanların arkadaşı çok olanlardan, yeni sosyal ilişkiler kurmaya isteksiz olanların isteklilerden, sosyal becerilerini yetersiz görenlerin becerilerini yeterli görenlerden, sorunlarını başkaları ile paylaşmayanların sorunlarını başkaları ile paylaşanlardan, daha fazla yalnızlık duygusunu yaşadıklarını gözlemlemiştir.

Utangaçlık duygusu, kişiler arası ilişkileri etkileyen önemli bir sorundur. Utangaçlık, başkalarının bulunduğu yerde yaşanan tedirginlik ve kısıtlanma duygusu olarak tanımlanmaktadır (Jones, Briggs & Smith, 1986). Utangaçlık bireyin yeni insanlarla tanışmasını, yeni arkadaşlar edinmesini ve değişik yaşantılardan zevk almasını güçleştiren en önemli etmen olarak görülmektedir (Zimbardo 1977). Enç (1980) utangaçlığı, başkaları ile olan ilişkiler sırasında duyulan ve doğru davranışları ketyen rahatsız edici duygu olarak tanımlamaktadır. Carducci (2000) de ise utangaçlığı, bireyler arası ilişkiler sırasında yaşanan aşırı sıkılganlıktan, benlik saygısının düşük olması ve reddedilme korkusundan ortaya çıkan kişilerarası bir sorun olarak ifade etmektedir. Utangaçlığın evrensel bir kavram olduğu; aynı oranda yaşanmasa ve aynı şekilde tanımlanmasa da utangaçlığın her kültürde var olduğu öne sürülmektedir (Carducci & Zimbardo 1995).

(Henderson & Zimbardo 1998) Utangaçlığın toplumu oluşturan bireylerin önemli bir bölümünde yaşanan bir sorun olarak görmekte; Amerika’da utangaçlık üzerine yapılan bir araştırmada, araştırma kapsamına alınan bireyler arasında kendisini utangaç olarak tanımlayanların oranının % 50’lere kadar yükseldiği görüldüğünü belirtmektedir.

Utangaçlığı farklı yönlerden değerlendiren çalışmalar bulunmaktadır. Utangaçlık korku, ilgi, gerginlik ve hoş gitme gibi duyguların bir karışımı olarak hissedilir. Fizyolojik olarak ta kalp atışında ve kan basıncında artış bu duygulara eşlik eder (Hyson & Van Trieste, 1987). Ayrıca utangaçlıkta huzursuzluk, engellenme ve kaygı tepkileri kendisine yönelik aşırı farkındalık ve başkalarının yanında sessiz kalma oldukça belirgindir (Jones, Briggs & Smith, 1986).

(Booth, Barlett & Bohnsack 1992) Yalnız öğrencileri, büyük bir olasılıkla sosyal olarak kısıtlanmış ve dolayısıyla da kişiler arası iletişim becerileri gelişmemiş bireyler olarak nitelemektedir. Utangaçlık duygusu taşıyan kişilerin sosyal ortamlarda yeterince yer almamaları nedeniyle çok az arkadaşına sahip oldukları varsayılmaktadır. Bu durumun ise onları daha fazla yalnızlığa iteceği bilinmektedir. Utangaç bireylerin yalnızlığa itilmelerinin nedenlerinden birisi de akranları tarafından reddedilmeleridir. Reddedilme, utangaç bireylerin sosyal ortamlara girmemelerinden ve sosyal becerilerinin yetersiz olmasından kaynaklanmaktadır (Carducci 2000). Utangaç bireyler sosyal ortamlardan uzak durmanın doğal sonucu olarak yalnızlığa mahkum olurlar (Carducci & Zimbardo 1995).

Yurt dışında utangaçlıkla ilgili çok sayıda araştırma yapıldığı gözlenmektedir. Türkiye de ise gündelik yaşamda sıkça kullanılan utangaçlığın bilimsel açıdan oldukça yeni olduğu görülmektedir (Güngör 2001: Gökçe 2001)

## **Problem Cümlesi**

Yalnızlık ve utangaçlık duygusu Problemlili Cep Telefonu kullanımını arttırmakta mıdır?

## **Araştırmanın Önemi**

### **Sayıtlar**

Uygulanan Problemlili Cep Telefonu Bağımlılığı Ölçeği, UCLA Yalnızlık Ölçeği ve Utangaçlık Ölçeğine öğrencilerin doğru cevaplar verildikleri kabul edilmektedir.

### **Sınırlılıklar**

Bu araştırma Üniversite öğrencileri ile sınırlandırılmıştır.

## **YÖNTEM**

### **Araştırmanın Modeli**

Araştırma, Problemlili Cep Telefonu Kullanımının, seçilmiş bazı değişkenlerle olan ilişkisini açıklamaya dönük korelasyonel bir çalışmadır. Korelasyon desenlerinde aralarında ilişki olan üç değişken de birbiri için yordayıcı-bağımsız değişken konumundadır. Bu değişkenlerden hangisinin bağımsız değişken hangisinin bağımlı değişken olacağı, pratiğe ve araştırmanın amacına göre tayin edilir. Bu araştırmada değişkenlerden birinin bağımlı, diğerlerinin bağımsız olarak ele alındığı çoklu regresyon deseni kullanılmıştır. Çalışmada, üniversite öğrencilerinin Problemlili Cep

Telefonu Kullanım düzeyleri bağımlı (yordanan) değişken olarak alınmıştır. Öğrencilerin bağımlılık düzeyleri “Problemlı Cep Telefonu Kullanım Ölçeđi” inden elde edilen puanlarıdır. Öğrencilerin bağımlılıkları üzerinde etkisi araştırılan bağımsız değişkenler ya da faktörler aşağıda verilmiştir:

- Yalnızlık düzeyi. UCLA yalnızlık ölçeđi ile elde edilen puandır.
- Utangaçlık ölçeđi ile elde edilen puandır.

## Evren

Sakarya Üniversitesi öğrencileri oluşturmaktadır.

## Örneklem

Sakarya Üniversitesi Eğitim Fakültesi ve Fen Edebiyat Fakültesi öğrencileri oluşturmaktadır.

## Verilerin Toplanması

Araştırma verilerinin toplanması aşamasında 2012-2013 Eğitim ve Öğretim döneminde Sakarya Üniversitesi Eğitim Fakültesi ve Fen Edebiyat Fakültesi'nde öğrenim gören toplam 273 öğrenciye anket uygulanmıştır. Ankete katılanların %62.3'ünü kız öğrenciler, % 37.7'sini ise erkek öğrenciler oluşturmaktadır.

## Veri Toplama Araçları

Araştırmada Problemlı Cep Telefonu Kullanım Ölçeđi, UCLA Yalnızlık Ölçeđi ve Utangaçlık Ölçeđi kullanılmıştır.

## 1-Problemlı Cep Telefonu Kullanım Ölçeđi

Problemlı Mobil Telefon Kullanım Ölçeđi Bianchi ve Phillips tarafından geliştirilmiş ve ölçeđin geçerlik ve güvenilirliđi test edilmiştir (Bianchi ve Phillips 2005 ). Ölçek 27 madde olarak yayımlanmıştır. Ölçeđin özgün formunun iç güvenilirlik hesaplanmasında Cronbach's Alpha 0.93 olarak hesaplanmıştır. Bu sonuç ölçeđin oldukça yüksek bir güvenilirliğe sahip olduğunu, iç tutarlılık açısından seçeneklerin homojen olduğunu ve problemlı telefon kullanımı yapısıyla oldukça ilişkili olduğunu ortaya koymaktadır. Güvenirlikle ilgili başka bir çalışmada problemlı telefon kullanımıyla haftalık telefona harcanan zaman arasındaki ilişkiye bakılmıştır. Araştırmada kullanılan Pearson korelasyon katsayısı hesaplamasında korelasyon katsayısının  $r=0.45$ ,  $p<.001$  sonucu elde edilmiştir. Bu sonuç problemlı telefon kullanımıyla haftalık telefon için harcanan zaman arasında güçlü bir ilişki olduğu göstermektedir. Geçerlik ile ilgili çalışmada, problemlı telefon kullanımı ölçeđi geçerliđi ve güvenilirliđi yüksek olan başka bir mobil telefon bağımlılıđı ölçeđi ile birlikte kullanılmıştır. İki uygulama arasındaki korelasyon katsayısı  $r=0.34$ ,  $P<.001$  olarak hesaplanmıştır. Bu katsayı iki ölçek arasında güçlü bir ilişkinin olduğunu ortaya koyar. Ayrıca ölçeđin tek boyutlu olduğu ve 27 maddeden oluşan bu yapısı toplam varyansın %74,45'ini açıklamıştır (Bianchi ve Phillips 2005 ). Ölçeđin uyarılma çalışmalarının yapılabilmesi için gerekli izin, ölçeđi geliştiren Adriana Bianchi ve James G. Phillips' den e-posta yoluyla alındıktan sonra ölçekle ilgili uyarılma çalışmalarına başlanmıştır Problemlı Mobil Telefon Kullanım Ölçeđi 27 madde olarak oluşturulduktan sonra uzman görüşü alınarak gerekli düzeltmeler yapılmıştır. Ölçeđin doldurulma süresi yaklaşık 25 dakika sürmektedir. Ölçeđi dolduracak olan kişiler ölçekte yer alan her bir ifadeye ilişkin katılma düzeylerini; Beni hiç tanımlamıyor (1) ile beni çok iyi tanımlıyor (5) arasından işaretlemektedirler. İşaretlemede ölçekten en düşük 1, en yüksek 135 puan alınabilmektedir. Puanların yüksek oluşu problemlı mobil telefon kullanımının da yüksek olduğunu ortaya koyar. (Şar, A. H., Işıklar, A.. 2012).

Ölçeđin Türkçeye çevrilmesi işlemi araştırmacılar tarafından gerçekleştirilmiştir. Araştırmacılar tarafından yapılan çeviriden sonra özgün madde, çevrilen madde ve yapılacak öneriyi içeren bir yapı şekline çevrilen ölçek uzmanlara görüş almak için dağıtılmıştır. Uzman görüşü için Rehberlik ve psikolojik danışma (4), İngilizce (2), Türkçe (1), Bilgisayar ve Öğretim Teknolojileri (1) ve Ölçme Deđerlendirme (1) alanlarında çalışan 9 akademisyene sunulmuştur. Uzman görüşü için verilen formun her bir maddesi için uygun ve uygun deđil ifadesine yer verilmiş ve uzmanlardan her bir maddenin uygun olup olmadığı işaretlenmesi istenmiştir. Uzmanlar dil ve alan uzmanı olarak iki gruba ayrılarak görüşleri deđerlendirilmiştir. Her bir madde için %80 oranında uygunluk aranmış ve bu oranın altında olan maddeler uzmanlardan alınan öneriler doğrultusunda düzeltilmiştir. Ölçeđin yapısı Beni hiç tanımlamıyor (1), biraz tanımlıyor (2), oldukça iyi tanımlıyor (3), iyi tanımlıyor (4) ve çok iyi tanımlıyor (5) şeklinde hazırlanmıştır. Bu deđişikliklerden sonra ölçek aynı uzmanlara tekrar dağıtılarak görüşleri alınmış ve tüm maddelerin en az %80 oranında uygun olduğu sonucu elde edilmiştir. (Şar, A. H., Işıklar, A.. 2012).

## 2- UCLA Yalnızlık Ölçeđi

UCLA Yalnızlık Ölçeği (YÖ). Russel, Peplau ve Ferguson (1978) tarafından geliştirilmiş olan UCLA Yalnızlık Ölçeği (University of California Los Angeles Loneliness Scale), daha sonra Russel, Peplau ve Cutrona (1980) tarafından gözden geçirilmiş ve ölçeğin maddeleri yarısı olumlu, yarısı olumsuz olacak şekilde tekrar düzenlenmiştir (akt, Demir, 1989). Örneğin ölçek maddelerinden biri, “Kendimi çevredeki insanlarla uyum içinde hissediyorum” şeklindedir. Ölçeğin uyarlama çalışması Demir tarafından (1989) yapılmış, iç tutarlılık katsayısı  $\alpha = .96$ , test-tekrar test güvenilirliği  $r = .94$  olarak bulunmuştur.

UCLA yalnızlık ölçeği 10’u düz, 10’u ters yönde kodlanmış 20 maddeden oluşmaktadır. Bireylerden maddelerde yer alan durumları ne sıklıkla yaşadıklarını dörtlü Likert tipi ölçek üzerinde belirtmeleri istenmektedir. Ölçek olumlu yöndeki ifadeleri içeren maddelere, “hiç yaşamam” 4, “nadiren yaşarım” 3, “bazen yaşarım” 2, “sık sık yaşarım” 1 puan; olumsuz ifadeleri içeren maddelere ise bunun tam tersi olarak, “hiç yaşamam” 1, “nadiren yaşarım” 2, “bazen yaşarım” 3, “sık sık yaşarım” 4 puan verilerek puanlanmaktadır.

### 3- Utangaçlık Ölçeği

Öğrencilerin utangaçlık düzeyi, Güngör (2001) tarafından geliştirilen 20 maddelik “Utangaçlık Ölçeği” kullanılarak belirlenmiştir. Bireylerin utangaçlık düzeylerini ortaya koymak amacıyla orijinali Cheek ve Buss tarafından 1981 yılında 9 maddelik olarak geliştirilen ve daha sonra 1983 te Cheek tarafından madde sayısı 13 e çıkarılan utangaçlık ölçeği “Syness Scale” kullanılmıştır. Orijinal ölçeğin geçerlik çalışmasında ölçüt ölçek yöntemi seçilmiş ve ölçüt ölçek olarak Sosyal Kaygı Ölçeği kullanılmıştır. Sonuç olarak utangaçlıkla sosyal kaçınma arasında .77, sosyal kaygı arasında .86 korelasyon bulunmuştur. Ayrıca, bireylere “utangaçlık sizin için ne kadar problemdir?” sorusu sorulmuş ve alınan yanıtlarla utangaçlık ölçeği puanları arasında .68 korelasyon elde edilmiştir. Ölçeğin güvenilirlik çalışmasında iç tutarlılığı saptayabilmek için hesaplanan Cronbach alfa .90 olarak bulunmuştur. Ölçeğin güvenilirliğini saptamak için ikinci yöntem olarak test-tekrar test yöntemi kullanılarak ölçek 45 gün arayla iki kez uygulanmış ve iki uygulama arasındaki korelasyon .88 olarak bulunmuştur.

Türkiye’de utangaçlık ölçeği Güngör (2001) tarafından Türkçeye uyarlanmış, geçerlik ve güvenilirliği gerçekleştirilmiştir. Ölçeğin uyarlama çalışmalarında ilk basamak olarak ölçek önce Türkçeye çevrilmiş, çevirisi yapılan bu ölçekteki ifadelerin “utangaçlığı” yansıtmadığını ölçmek için uzman görüşüne başvurulmuştur. İkinci basamakta, 300 üniversite öğrencisine, kendilerini hangi durumlarda utangaç hissettiklerine? İlişkin açık uçlu bir soru sorularak bir liste oluşturulmuştur. Öğrencilerin verdikleri cevaplardan oluşturulan ve Cheek’in utangaçlık ölçeğindeki maddelerle aynı ya da benzer olan maddeler çıkartılmış ve öğrencilerin verdikleri cevaplardan elde edilen 7 madde, Cheek’in 13 maddelik ölçeğine eklenmiş 20 maddelik yeni bir ölçek oluşturulmuştur. Güngör, (2001) ölçeğin, testin tekrarı yöntemi ile elde edilen güvenilirlik katsayısını .83; iç tutarlılığı saptamak amacıyla hesaplanan Cronbach Alfa katsayısını .91 olarak bulmuştur. Ölçeğin geçerliği için “Benzer Ölçekler Geçerliği” yöntemi uygulanmış ve bu amaçla “Sosyal Durumlarda Kendini Değerlendirme

Envanteri” kullanılmış, aradaki ilişki .78 olarak bulunmuştur. Yapı geçerliği amacıyla yapılan faktör analizi, ölçeğin tek boyutlu olarak değerlendirileceği sonucuna varılmıştır. Utangaçlık ölçeği, 20 maddeden oluşan ve bireylerin kendilerini ne kadar utangaç olarak algıladıklarını ortaya koyabilecekleri duygu ve davranışlara yönelik ifadelerin yer aldığı 5’li likert tipi bir ölçektir. Ölçek, bireylerden ölçekteki ifadelerin karşısında bulunan “Bana Hiç Uygun Değil”, “Uygun Değil”, “Kararsızım”, “Bana Uygun”, “Bana Çok Uygun” seçeneklerinden birisini seçmeleri istenerek uygulanmaktadır. Utangaçlık ölçeği, “Bana Hiç Uygun Değil” seçeneğine 1 (Bir), “Uygun Değil” seçeneğine 2 (İki) “Kararsızım” seçeneğine 3 (Üç), “Bana Uygun” seçeneğine 4 (Dört), “Bana Çok Uygun” seçeneğine 5 (Beş) puan verilerek puanlanmaktadır. Ölçekten alınabilecek en yüksek puan 100, en düşük puan ise 20 dir. Bireyin puanının yüksek olması, kendisini “utangaç” olarak algıladığını göstermektedir.

### Verilerin Analizi

#### BULGULAR ve YORUMLAR

**Tablo 1.** Problemler Cep Telefonu Kullanımının Yordanmasına İlişki Çoklu Regresyon Analizi

| Değişken   | B     | Standart $\beta$<br>Hata | T    | P     | İkili<br>r | Kısmi<br>r |
|------------|-------|--------------------------|------|-------|------------|------------|
| Sabit      | 23,80 | 5,600                    | --   | 4,251 | ,00        | ---        |
| Utangaçlık | ,174  | ,062                     | ,175 | 2,795 | ,006       | ,232       |

|                       |       |                              |   |       |      |      |      |
|-----------------------|-------|------------------------------|---|-------|------|------|------|
| Yalnızlık             | ,,377 | ,144                         | ,164  | 2,618 | ,009 | ,225 | ,157 |
| R= ,278               |       | F <sub>(2-270)</sub> = 11,32 | Utangaçlık – Yalnızlık: r= 353                          |       |      |      |      |
| R <sup>2</sup> = ,071 |       | P=,001                       | Utangaçlık- Problemler Cihaz Telefonu Kullanma: r= ,232 |       |      |      |      |
|                       |       |                              | Yalnızlık - Problemler Cihaz Telefonu Kullanma: r= ,225 |       |      |      |      |

Araştırmada yordayıcı değişkenler olarak ele alınan utangaçlık ve yalnızlık korelasyonları incelendiğinde utangaçlık ve yalnızlık arasında (r=353) pozitif yönde anlamlı bir ilişki varlığı belirlenmiştir. Bunun anlamı utangaçlık arttığında yalnızlıkta artmaktadır. Utangaç olan bireylerin yalnızlığı tercih ettikleri arkadaş bulmakta ve o çevrede bulunmaktan uzak durdukları görülmektedir.

Utangaçlık ve Problemler Cihaz Telefonu kullanımı arasında (r=232) pozitif yönde anlamlı bir ilişki vardır. Bunun anlamı da utangaçlık arttığında problemler cihaz telefonu kullanımı da artmaktadır. Utangaç olan bireylerin sosyal ortamlarda bulunmaktan, zamanlarını grup içerisinde geçirmekten ziyade, problemler cihaz telefonlarına yöneltiler ve zamanlarını bu şekilde değerlendirdikleri görülmektedir.

Yalnızlık ve Problemler Cihaz Telefonu arasında da (r=225) pozitif yönde anlamlı bir ilişki bulunmaktadır.. Bu durum değerlendirildiğinde yalnızlık arttığında problemler cihaz telefonu kullanımı da artmaktadır. Verilerden elde edilen bulgulara göre genel olarak bakıldığında utangaçlık ve yalnızlık durumunun problemler cihaz telefonu kullanımını arttırdığı gözlenmektedir.

## SONUÇ VE ÖNERİLER

Tüm dünyada olduğu gibi Türkiye’de de bireylerin yaşadıkları utangaçlık duygusundan hoşnut olmadıkları bilinmektedir. Ergenlik dönemi utangaçlığın yoğun olarak görüldüğü ve utangaç bireylerin en çok etkilendiği dönemdir. Dolayısıyla ergenliğin son döneminde ve yetişkinliğin başlangıcında bulunan üniversite öğrencileri için utangaçlık oldukça ciddi bir sorundur. Yaptığımız araştırmada utangaçlık ve yalnızlık arasında, utangaçlık ve problemler cihaz telefonu kullanımı ve yalnızlık problemler cihaz telefonu arasında anlamlı ilişkiler belirlenmiştir. Kişilerde var olan yalnızlıkları ve utangaçlık durumlarının problemler cihaz telefonu kullanımını arttırdığı görülmektedir. Üniversite öğrencilerinin utangaçlık ve yalnızlık gibi olumsuz duyguların üstesinden gelebilmeleri, utangaçlığın ve yalnızlığın ortaya çıkmasını engelleyebilmeleri için, önce utangaçlığın ve yalnızlığın ne olduğunu ve yaşamlarını nasıl etkilediğini bilmeye ve bunun üstesinden gelebilmek için ne tür yardımlar alabileceklerini bilmeye gereksinimleri vardır.

Bu çerçevede, öğrencilerin bu olumsuzluklarla başa çıkabilmeleri için öncelikle psikolojik danışma ve rehberlik yardımı önerilebilir. Utangaçlık ve yalnızlık duygusunun artması ile birlikte problemler cihaz telefonu kullanımına yönelik bağımlılığın artması öğrencilerin zamanlarının büyük bir kısmını cihaz telefonu ile geçirdiklerini göstermektedir. Bu durum onların boş zamanlarını etkili ve verimli kullanmalarına engel olmaktadır. Aynı zamanda sosyalleşmesinin önünde önemli bir engel teşkil etmekte, öğrencilerin kitap okuma, spor yapma ve derslerine düzenli çalışmalarını da engellemektedir. Ülkemizde giderek yaygınlaşan mobil telefon kullanımı ilköğretim seviyesinde öğrencilere kadar inmiş durumdadır. Problemler cihaz telefonu kullanımına sınırlama getirilmesi gerekmektedir. Yükseköğretim kurumlarında öğrenim gören öğrencilerin sosyal etkinliklere katılmaları sağlanmalı, danışmanlık hizmetleri ile özellikle öğrenci kişilik hizmetlerinin sağlıklı bir şekilde yürütülmesi önerilmektedir.

Bundan sonra yapılacak araştırmalarda ise yükseköğretim kurumlarının bulunduğu iller, okulların konuşlandırıldığı kampüs alanları (İl-ilçe merkezi) ve üniversitelerin öğrenciye sağladığı olanaklar vb değişkenler ele alınarak, yalnızlık ve utangaçlık durumlarına etkisi araştırılmalı, bu değişkenlerin problemler cihaz telefonu kullanımını artırıp arttırmadığı incelenmesi önerilmektedir.

## TARTIŞMA

Ülkemizde ve dünyada yalnızlık ve utangaçlık üzerine yapılan çeşitli araştırmalarda önemli bulgular elde edilmiştir. Zimbardo (1977), utangaçlığın sosyal ilişkiyi etkileme biçimini açıklarken “Utangaçlık, net bir şekilde düşünmeyi ve etkili bir şekilde iletişim kurmayı güçleştirmektedir” şeklinde ifade etmektedir. Utangaç bireyler sosyal yaşantıda, içinde buldukları ortamla ya da diğer insanlarla değil, sürekli olarak kendi davranışlarıyla ilgilenirler. Kendilerine yönelik olumsuz inançlarını hatırlayınca iyice gerilirler ve utangaçlıkları artar (Carducci & Zimbardo 1995).

Bizim yaptığımız araştırmada utangaç öğrencilerin arkadaşları ile sosyal ortamları paylaşmaktan ziyade problemleri cep telefonuna yönelmeleri arkadaşları ile etkili bir şekilde iletişim kurmaktan kaçındıklarını göstermektedir. Elde ettiğimiz bu bulguda diğer araştırma bulgularını desteklemektedir.

(Kozanoğlu:2006). Sosyal beceri eğitim programının ergenlerin utangaçlık düzeyi üzerindeki etkisinin ele alındığı bir araştırmada utangaçlıkla baş edebilmede sosyal beceri eğitim programının ergenlerin utangaçlık düzeyleri üzerinde olumlu yönde etkili olduğu görülmüştür. Yapılan bu araştırma sonucuna bakıldığında yükseköğretim öğrencilerine yönelik sosyal beceri eğitimi programlarının hazırlanıp ve öğrencilerin programa katılmalarının sağlanması durumunda utangaçlık duygusu düzeylerinde önemli bir azalma olacağı düşünülmektedir. Bu durum aynı zamanda problemleri cep telefonuna bağımlılığı da azaltacaktır.

Lise öğrencisi ergenler arasında yalnızlık duygusu, başatma yöntemleri ve yalnızlığın intihar düşüncesi ve girişimi ile olan ilişkisini irdeleyen bir çalışmada gençler arasında yalnızlık duygularının oldukça yaygın olduğunu görülmektedir. Araştırmada “Kendinizi çok yalnız hissettiğiniz anlar oluyor mu?” sorusunu araştırmaya katılan öğrencilerin %65’i evet diyor diye yanıtladığı görülmüştür (Eskin:2001). Bizim araştırmamızda ergenlik ve yetişkinlik arasındaki bir dönemi yaşayan üniversite öğrencilerinde yalnızlık duygusunun devam ettiği görülmektedir.

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# IMPACT OF AIR POLLUTION ON THE LICHEN FLORA IN THE REGION OF ANNABA (EAST OF ALGERIA)

Serradj Ali Ahmed Monia, Boumedriss zine eddine, Slimani rachid

Laboratory of Plant Biology and Environment

Biology Department

BADJI Mokhtar University

Annaba, Algeria

Serradj.moniam@gmail.com

**Abstract:** The objective of our work is summarized on the study of the impact of air pollution on the lichen flora in the region of Annaba and more precisely at two areas isopollution whose purity index ranges from atmospheric 0.6 to 3, 8 to zone I and 3.9 to 8.3 for zone II. For this we used the technique of transplantation advocated by Deruelle and Semadi in 1993. The results we obtained following the assay of chlorophyll and protein in two species *Parmelia caperata* and *Parmelia perlata* transplant at six sites, as well as at the el Kala (taken like a witness), reflect the presence of nitrogen type of pollution in our region, which acts as a fertilizer on chlorophyll levels at the sites most frequented by traffic (S5 and S6) compared to the control and the other sites (S1 and S2) to low values, and appearance of a stress in relation with this pollution, which results in an increase in protein at the same sites

Observations in binocular and histological sections of the thallus of these transplants confirm our results also reflect the deterioration of our lichen flora under the influence of a cocktail of pollutants at the Annaba region

**Key words:** : Air pollution, lichen biomonitoring, impact, chlorophylls , proteins dosage

## Introduction:

The term pollution refers to all discharges of toxic compounds that man releases into the ecosphere, but also substances which, without being really dangerous to living organisms, have a disruptive influence on the environment. In other words, pollution is an adverse change in the natural environment, which can affect humans and plants. It can also affect by altering the physical environment, its recreational possibilities or disfiguring nature. (A. Semadi, 1989)

Since 2002 the Ministry of Spatial Planning and Environment installed at the city of Annaba (North-eastern Algeria) a system for monitoring the quality of air in urban areas. This control is called SAMA SAFIA generally provided by sensor networks physicochemical characteristics that measure concentrations of various pollutants. (Tlili N. et al, 2009)

The city of Annaba is one of the most polluted cities in Algeria due to the existence of large industrial complexes such as iron and steel complex of El Hajar and phosphate fertilizer complex. In addition, it is known for its dense road traffic and the overcrowding that has led researchers to study air quality and the effects of pollution in the region. (A. Semadi, 1986).

Several techniques have been implemented for the detection and evaluation of air pollution. Among these techniques, we note the physico-chemical techniques that continuously measure the concentrations of various pollutants the case of "SAMA SAFIA" and biological techniques that use the plant or plant part as a bio-indicator: eg lichens. (A. Semadi, 1989)

The high cost of measuring devices will never cover the whole territory. The use of living organisms and in particular for the assessment of air quality, the lichen biomonitoring should be a tool of choice. Lichens are found everywhere and their differences in sensitivity to pollutants we can use to assess the qualitative and quantitative development of many circles. (Gaveriaux J. P, 2005)

In the same context summarizes the purpose of our work is to study the impact of pollution on the lichen flora and thus the environment.

## Materials and Methods

### 1 - Presentation of the study area:

Annaba is a coastal town in northeastern of Algeria; it is bounded to the south, east and west respectively by the provinces of: Guelma, Skikda and El Tarf. . it covers a

Area of 1411.98 km (fig11)



**Figure 1: localization of wilaya of Annaba (Annaba State)**

Its industrial and its status as capital of steel, make it one of the most polluted areas of the country. (Chaffai and Mourdi, 2011)

## 2. Climatic data of Annaba:

Like other coastal areas of Algeria, Annaba this whole traits Mediterranean types with bioclimatic zones: sub humid and humid wich means a wet soft and moist dry season.

Some climatic parameters are considered in our study because they have a particularly important role in the diffusion and dilution of impurities (Table 3)

### 2-1 Temperature:

Annaba is characterized by mild temperatures in winter and hot in summer, with a maximum temperature average of 23.66 ° C and a minimum temperature average of 12.66 ° C during the period 2009-2012

### 2-2 Rainfall:

Rain, snow and other forms of precipitation realize washing, absorption and drive to the floor of impurities from the air, the average annual rainfall during the period 2009-2012 is 28.083%

The month of December is the wettest with a value of 46% while the minimum value was recorded in July with 5% (2009/2012)

### 2-3 Humidity:

In Annaba region the humidity is very high throughout the year, it is 74.083% during the period (2009-2012). (Website 9)

## 3 - Industry Sectors:

By its strategic position Annaba has a basic industrial processing of local raw materials such as iron ore, this is mainly based on the steel complex "metal steal" the largest steel complex in Africa largest phosphate fertilizer "ASMIDAL" and old metal processing workshops "ferrovial" then comes the comercial activity area, industrial areas, these bases are at the origin of several liquid effluents and atmospheric (Blida and Tiaïbia, 2011)

### 3-1 Releases complex "metal steel"

This complex discharges to particulates which are mainly iron oxides and silica compounds along with various rare metals such as thallium due to very high emissions deposited to Tunisia

The effluent gaseous products are comprised mainly of sulfur, oxides of carbon, nitrogen and trace fluorine (Table 1)

**Table 1: Emissions complex "metal steel"**

| Rejected products | Quantities tonne / year |
|-------------------|-------------------------|
| Organic materials | 35                      |
| ammonia           | 1220                    |
| Phenol            | 3000                    |
| Sulfur oxide      | 6000                    |
| Suspended solids  | 4100                    |
| Dust              | 6000                    |

### 3-2 Releases of phosphate fertilizer complex "ASMIDAL"

The complex phosphate fertilizer "Asmidal" rejects quantities of pollutants in the atmosphere; the nature of these pollutants is very varied according to each unit. These quantities estimated above pre-project of the World Bank (Table 2)

**Table 2: Discharge of Asmidal before the draft World Bank**

| Units            | Pollutants           | Quantities tonne / year    |
|------------------|----------------------|----------------------------|
| Nitrate          | No2                  | -                          |
| Sulfuric acid    | Nh3                  | 1188                       |
| Phosphoric acid  | So2                  | 2291                       |
| Phosphogypsum    | Npk                  | 90000                      |
| Ammonium nitrate | Fluorine<br>nitrates | 280000<br>88ug/m3<br>43000 |

**Table 3 : Rejections(discharges) of Asmidal " after the project of the World Bank (Serradj, 2007)**

| Unités             | Polluants                       | Quantités (tonne/an)   |
|--------------------|---------------------------------|------------------------|
| Nitrate            | No2                             | 275                    |
| Acide sulfurique   | Nh3                             | 45.6                   |
| Acide phosphorique | So2                             | 0                      |
| Phosphogène -      | Npk                             | -                      |
| Nitrate –ammonium  | Fluor<br>dust<br>nitrates (No3) | 10.5<br>50ug/m3<br>250 |

### 4-current of road traffic:

The wilaya of Annaba by its geographic position (a crossroads) and development was observed to this day a highly polarized traffic especially at the city and especially in the last years (see Annex) this we will confirm through recent statistics we have gathered at the direction of transport, these data represent a total of vehicles of any category increase from one year to another, was recorded in 2008 (110.897 vehicles ), 124.510 in 2009, 139.409 in 2010 and a total of 149.843 vehicles in 2011.

## 5 -Epidemiology:

According to a survey made by L. Belfarhi in 2011 in Annaba, the risk of asthma are largely due to: Air Pollution with 58% humidity (18%) and factors, tobacco (19%), Heredity (15%) and medical drugs (3%).

In our side, we could get this year very interesting statistics:

- Of cancer in our region that are listed in the Schedule in effect at the CHU of Annaba lung cancers affect individuals of different ages (2 years and 60 years) with a percentage of 100%.
- Of the estimated asthma attacks at the pediatric clinic Saint Thérèse see Annex during 2009 There are crises of 1235 and increased in 2010 to reach a value of 2029. (see appendix)

## 6 - Method of sampling:

### 6-1 Rootstock:

Bio-indicator species of low pollution, low resistance



*Parmelia caperata*



*Parmelia perlata* (Site web 1)

**Table 4: Systematic position of *Parmelia caperanta* and *Parmelia perlata***

| systematic position  |   |
|--|---|
| <i>Parmelia caperata</i>   | <i>Parmelia perlata</i>   |
| Phylum: Lichens<br>Class: Ascolichens<br>Order: lecanorales /<br>Cyclocarpales<br>Family: Parméliacées<br>Genre: <i>Parmelia</i><br>Species: <i>caperata</i> | Phylum: Lichens<br>Class: Ascolichens<br>Order: lecanorales /<br>Cyclocarpales<br>Family: Parméliacées<br>Genre: <i>Parmelia</i><br>Species: <i>perlata</i> |

### 6-2 Transplantation Technics:

The first transplantation of epiphytic lichens were made several years ago in the city of Munich Arnold (1991-1991), since both technics were used

- The first was developed by Brodo 1961.elle involves grafting a disc supporting a lichen on bark of the same species phorophyte
- The second is to present in polluted thallus branches covered with epiphytes (Semadi and Deruelle.1993)

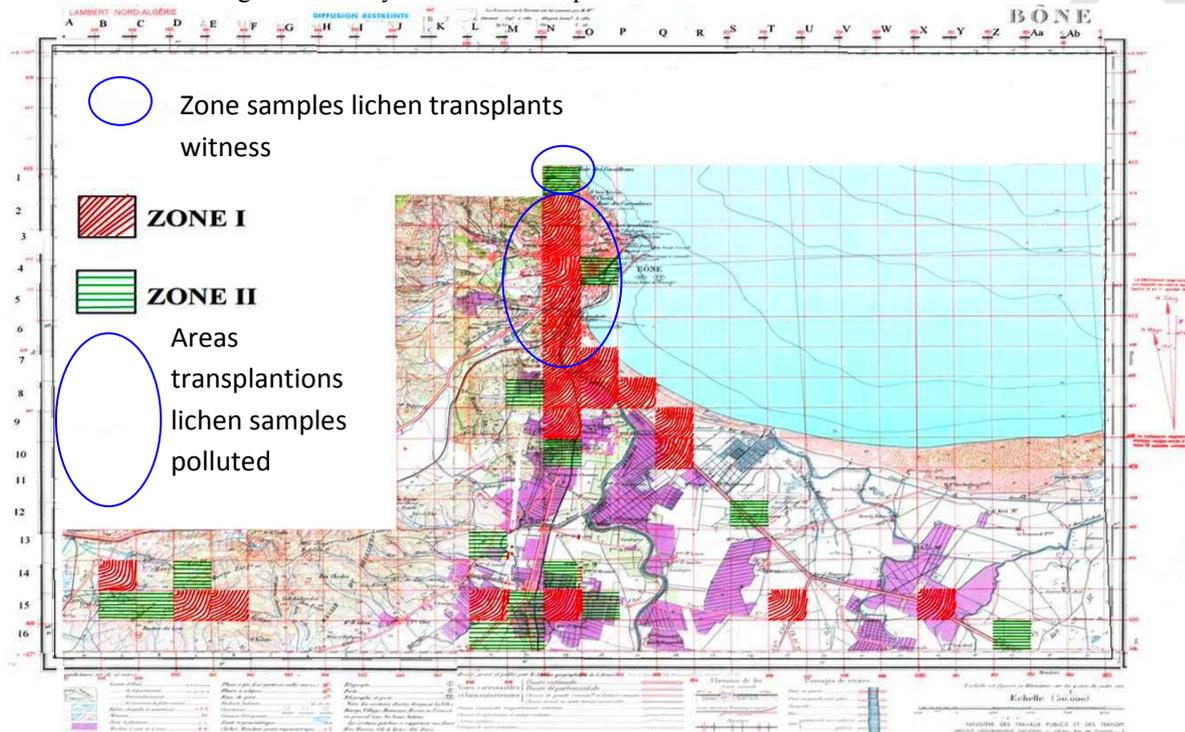
In our study we followed the second approach is to say we collected branches covered thallus of two species: *Parmelia perlata* *Parmelia caperata* and in their communities of origin ie drill bougous level of El Kala considered an

unpolluted area and we transferred at different sites already mentioned. These branches with a length of 10 cm A50 are set using a string to a height of 1.5 to 2 m above the ground for 4 months. The observation of transplanted epiphytes used to study the damage caused during the period of exposure to the polluted environment.

**6-3 Selection of sites:**

Following a study made by the IPA (Bengrait Lemboub S & N, 2011) which allowed us to have 2 iso pollution areas covering the North East Annaba (Fig 2), our sites studies are placed in these two areas as follows:

Transplants of our 2 lichen species (*Parmelia caperata* and *Parmelia perlata*) were placed at stations 1 and 2 are part of the area isopollution II by cons stations 3, 4, 5 and 6 are part of the isopollution zone I. without forgetting our control area or El Kala grow naturally our two lichen species



**Figure 2: Location of the study area (Bengrait Lemboub S & N, 2011)**

➤ **Zone I:**

IPA which varies from 0.6 to 3.8; This is the most polluted area occupies 18 stations (part of the city of Annaba and the town of El Bouni)

➤ **Zone II:**

IPA which ranges from 3.9 to 8.3 occupe17 stations (Hdjarediss western sector, and region of the common Mhidi Ben D'El Tarf)

We made so to have sites with a degree of traffic ranging from strong to weak and we selected six sites (Sidi Aissa, Road coral-Bay Bridge White City Are safsaf, Oued Forcha, City belaid belgacem in Oued Forcha) and Table (6) below shows the location of these sites

**Table 5: Different sites of transplantation**

| Sites                                  | Location   |
|--|--|
| Witness                                | El-kalla   |
| Site1<br>(Sidi Aissa)                  | Tree 1: In a garden of a small house and away from the road<br>Tree 2: located near a small yard<br>Tree 3: Same as the one tree on private property from the road |
| Site2<br>(Road of Baie of Coraillours) | Tree 1: the tree at the edge of a small road little frequented by vehicles   |

|   |  |
|---|--|
|   | Tree 2: found at a nearby construction site<br>Tree 3: Trees along a small road little frequented by vehicles  |
| Site 3<br>(Pont blanc)                          | Tree 1: located near the roundabout which is highly frequented by different vehicles)<br>Tree 2 are within the campus of the roundabout, but it does not exclude the large attendance of all types of vehicles in the<br>Tree 3: located in the University Hospital of the orangery, near the end of the establishment is facing a highly frequented road. |
| Site 4<br>(Es safsaf)                           | All transplants are placed on roadside trees are at the edge of a highway that crosses the station studied   |
| Site 5<br>(Oued forcha)                         | All transplants are placed along the roads that cross the study area   |
| Site 6<br>(City belaid belgacem in Oued forcha) | Transplants are placed on roadside trees are at the edge of a road that crosses the village studied, one tree is near a taxi rank  |

### 3 - Analytical methods:

#### 3-1 Determination of chlorophyll:

Extraction of chlorophyll in lichen thalli was performed according to the traditional method of Mackiney (1941), then improved by Holden (1975)

#### 3-2 Determination of protein:

We analyzed proteins in lichen thalli of the species according to the method of Bradford (1976).

#### 3-3 Observation in binocular species and transplanted according Clausade Ozanda, 1970

#### 3-4 Cups histological thalli transplanted according Clausade and Ozanda, 1970

### Results:

#### 1-Variations of the chlorophyll at the level of the transplants various:

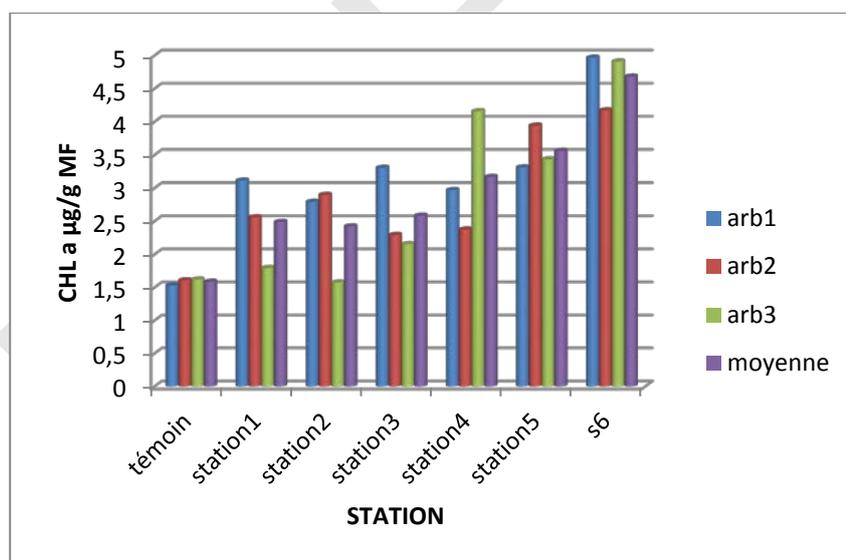


Figure3: spatial Variations of the rate of the chlorophyll (a) µg / g MF at *Parmelia caperata*

We find that the average Chl a increases from one site to another in relation to this witness confirmed the following values: 1,589< 2,491< 2,586< 3, 17 <3,565< 4, 68.

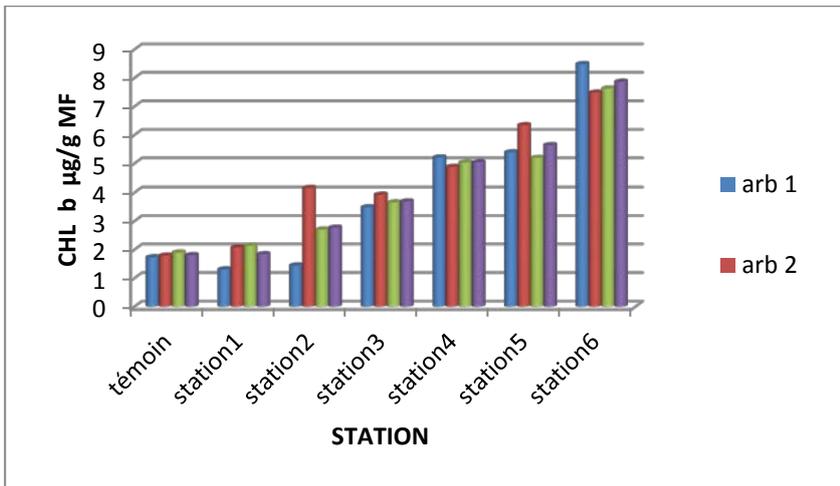


Figure 4: spatial Variations of the rate of the chlorophyll ( b )  $\mu\text{g} / \text{g MF}$  at *Parmelia caperata*

Also, we observe that the shape of the histograms of the Chl b presents the same tendencies as those of the Chl has in other words the values increase by a site to the other one this with regard to the witness.

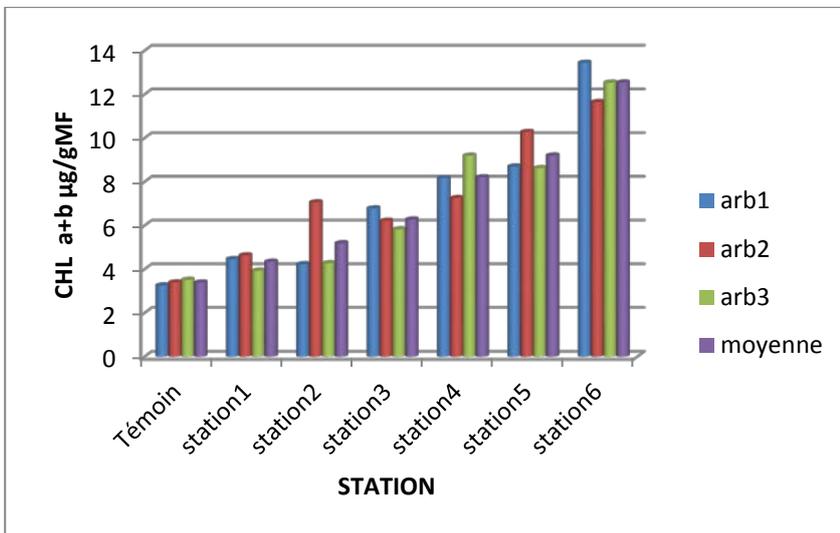


Figure 5: variation of rate of the chlorophyll a+b  $\mu\text{g} / \text{g MF}$  at *Parmelia caperata*

Also, the total Chl ( a+b ) is very high at the level of the site 6 with regard to the witness (12,54  $\mu\text{g} / \text{gMF}$  / 3,397 $\mu\text{g} / \text{GM}$ ), on the other hand site1 register very low values (4, 350 $\mu\text{g} / \text{gMF}$ ).

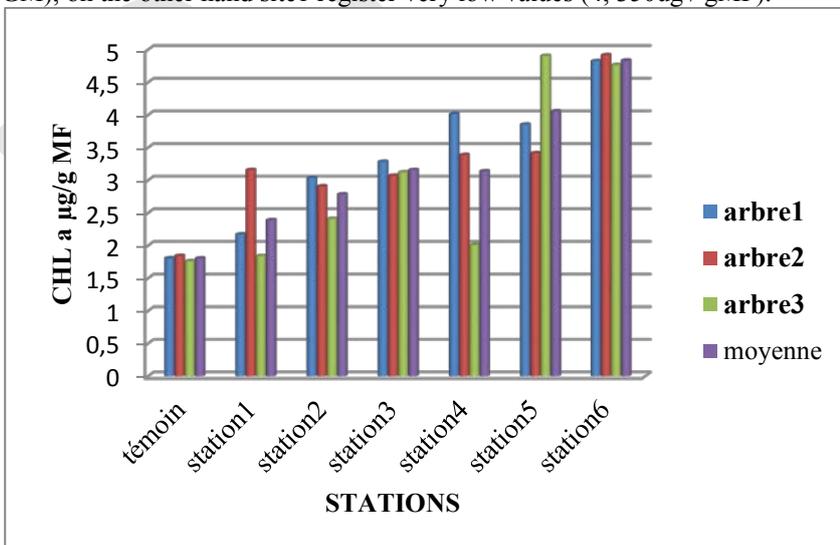
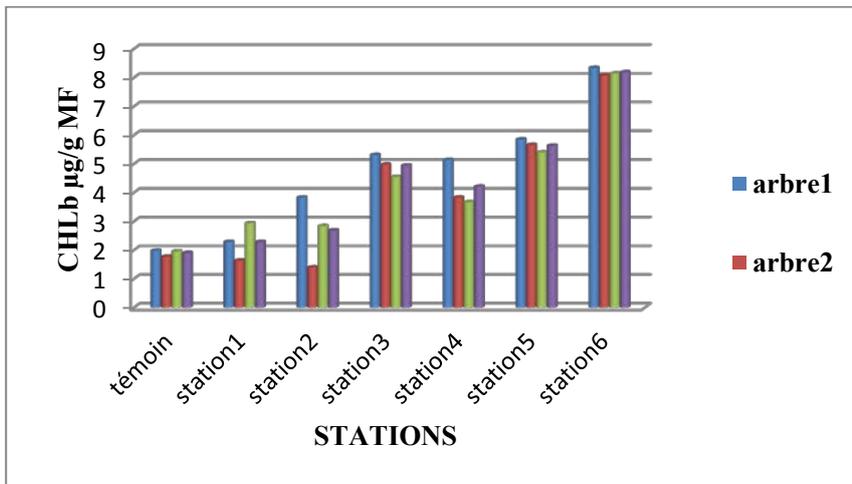


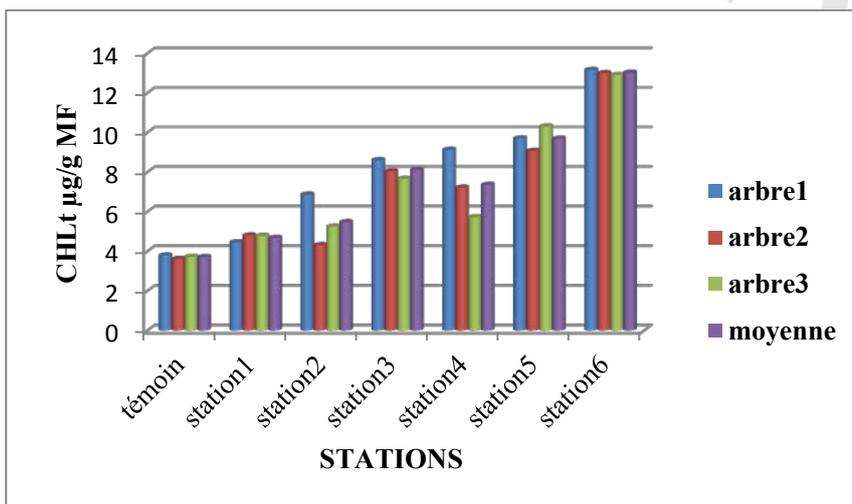
Figure 6: spatial Variations of the rate of the chlorophyll ( a )  $\mu\text{g} / \text{g MF}$  to *Parmelia perlata*

We register according to her it fig6 a low weak increase of the rates of Chl has in the first two stations with an average value between (2.392et 2.786  $\mu\text{g} / \text{g MF}$ ) this with compared with the witness (1.805  $\mu\text{g} / \text{g MF}$ ); on the other hand this increase seems very clear at the level of sites 3, 4, 5 and especially at the level of site 6 with an average value of 4,836  $\mu\text{g} / \text{g MF}$ .



**Figure 7: spatial Variations of the rate of chlorophyll ( b )  $\mu\text{g} / \text{g MF}$  to *Parmelia perlata***

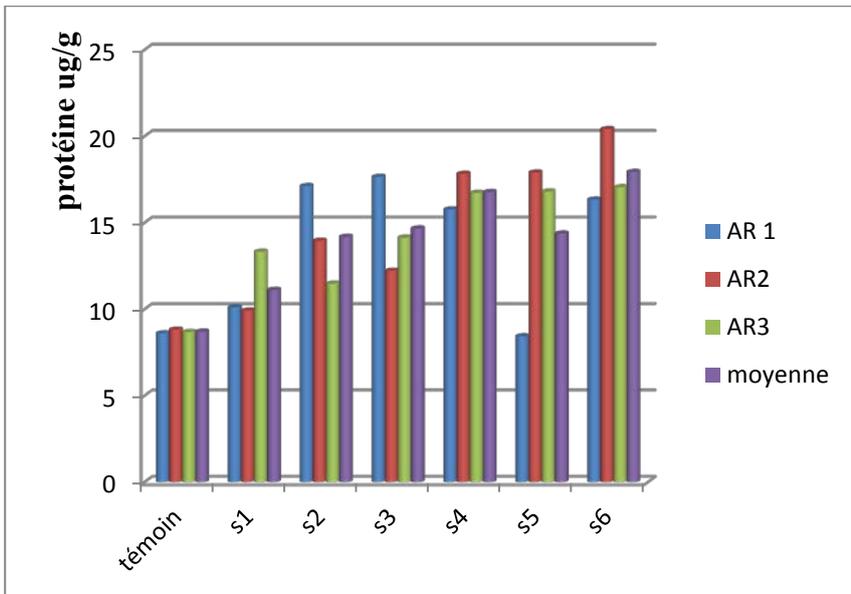
According to the fig 7, it seems that the values of the Chl b follow the same tendency as the Chl has, only with values more raised with compared with the witness (1.905  $\mu\text{g} / \text{g MF}$ ), the values of the site 3 are close to the site 4, on the other hand we notice a clear increase at the level of site6 with compared with all the sites (8.100  $\mu\text{g} / \text{gMF}$ )



**Figure 8: spatial Variations of the rate of chlorophyll (a+b)  $\mu\text{g} / \text{g MF}$  to *Parmelia perlata***

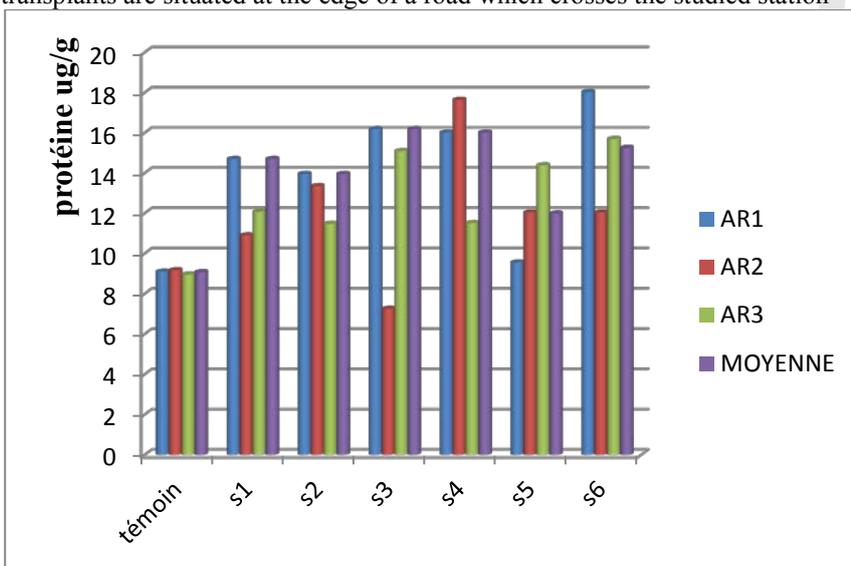
The fig 8 shows that the Chl ( a+b ) follows the same trend as that of the Chl has and the Chl b, the content always varies with an increase contrary to the witness (3.709 $\mu\text{g} / \text{g MF}$ ) the site 5 registers a value raised of (9,694  $\mu\text{g} / \text{gMF}$ ) as well as the even more raised site 6 (13,025 $\mu\text{g} / \text{g MF}$ ).

## 2 - Variations of proteins at the level of the transplants various



**Figure 9:** spatial variations of proteins at the level of the transplants of *Parmelia caperata*

According to the results profits illustrated in the fig 9 we let us register record an increase of the rate of protein at the level of all the sites with compared with the witness, we notice that the rate of protein is more raised in the station 6 with compared with the witness, with an average value of 17.93ug / g, contrary to the station 1 we notice a light increase with an average value del 1.11ug / g. The rate of protein is less raised in the station 1 because three trees are taken away from the influence of the road and more raised at the level of the station6 because trees carrying our transplants are situated at the edge of a road which crosses the studied station



**Figure10:** spatial variations of proteins at the level of the transplants of *Parmelia perlata*

According to the results illustrated in her fig10 we observe that the rate of protein is very high in all the stations is reach his maximum in the 3éme station (16,19ug / g), this with compared with the witness (9, 7 ug / g). The rate of protein is very high in the 3éme station because she presents a big attendance of vehicles of every types.

### 3-Variations of the various physiological parameters according to the test of ANOVA

**Table 6:** Variations of the physiological parameters in the transplant of *Parmelia caperata* according to the test of ANOVA  
*caperata* selon le test d'ANOVA

| Variable         | DDL | SCE     | CM            | F observé | P         |
|------------------|-----|---------|---------------|-----------|-----------|
| Chlorophylle a   | 6   | 17,7127 | 2,9521 14,881 | 8,25      | 0,001**   |
| Chlorophylle b   | 6   | 89,283  | 29,128 30,800 | 36,91     | 0,000***  |
| Chlorophylle a+b | 6   | 174,766 |               | 35,99     | 0,000 *** |

|                 |   |         |  |      |        |
|-----------------|---|---------|--|------|--------|
| <b>Protéine</b> | 6 | 184,802 |  | 4,46 | 0,010* |
|-----------------|---|---------|--|------|--------|

**Table 7: variations of the physiological parameters in the transplant of *Parmelia perlata* according to the test of ANOVA**

| Variable                | DDL | SC E    | CM            | F observé | P        |
|-------------------------|-----|---------|---------------|-----------|----------|
| <b>Chlorophylle a</b>   | 6   | 18,5587 | 3,0931 14,869 | 9,69      | 0,000*** |
| <b>Chlorophylle b</b>   | 6   | 89,2160 | 31,070        | 37,23     | 0,000*** |
| <b>Chlorophylle a+b</b> | 6   | 186,421 | 12,903        | 41,53     | 0,000*** |
| <b>Protéine</b>         | 6   | 77,4200 |               | 1,76      | 0,181    |

► Also the test of ANNOVA table shows that the variation of the **Chl a** at the level of the species *Parmelia caperata* is highly significant ( $p = 0,001$  \*\*) and that the variations of the **Ch b** and **Chl ( a+b )** at the level of the same species is very highly significant ( $p = 0,000$  \*\*\*).

Also the test of ANNOVA table shows that the variations of the **Chl a**, **Chl b** and **Chla+b** at the level of the species *Parmelia perlata*, are very highly significant ( $p = 0,000$  \*\*\*).

► **Proteins** measured at the level of the transplants of *Parmelia caperata* show a not significant variation table; on the other hand the variation of the contents of proteins of *Parmelia perlata* is only significant ( $p = 0,01$  \*)

#### 4-Spatial Comparisons of the various physiological parameters according to the test of Dunnett

##### ► Chlorophyll

**Table 8: Tests of simultaneity of Dunnett for the Chlorophyll has at *Parmelia caperata***

| Station  | Moyenne     | Différence des moyennes avec le témoin | T observé | Valeur ajusté de P |
|----------|-------------|--|-----------|--------------------|
| <b>1</b> | 2,491333333 | 0,9020                                 | 1,846     | 0,3086             |
| <b>2</b> | 2,424333333 | 0,8350                                 | 1,709     | 0,3763             |
| <b>3</b> | 2,586666667 | 0,9973                                 | 2,041     | 0,2285             |
| <b>4</b> | 3,170000000 | 1,5807                                 | 3,235     | 0,0273*            |
| <b>5</b> | 3,565000000 | 1,9757                                 | 4,044     | 0,0059**           |
| <b>6</b> | 4,685000000 | 3,0957                                 | 6,336     | 0,0001**           |

The test of Dunnett **tab 8** shows that only the difference of average of the **Chl a** in the transplants of *Parmelia caperata* at the level of the site 6 with compared with the witness is highly significant ( $p = 0,001$  \*\*)

**Table 9: tests of simultaneity of Dunnett for the Chlorophyll b at *Parmelia caperata***

| Station  | Moyenne     | Différence des moyennes avec le témoin | T observé | Valeur ajusté de P |
|----------|-------------|--|-----------|--------------------|
| <b>1</b> | 1,844000000 | 0,03467                                | 0,0669    | 1,0000             |
| <b>2</b> | 2,772666667 | 0,96333                                | 1,8582    | 0,3032             |
| <b>3</b> | 3,692666667 | 1,88333                                | 3,6329    | 0,0128             |
| <b>4</b> | 5,046666667 | 3,23733                                | 6,2447    | 0,0001***          |
| <b>5</b> | 5,646000000 | 3,83667                                | 7,4008    | 0,0000***          |
| <b>6</b> | 7,869666667 | 6,06033                                | 11,6902   | 0,0000***          |

The same test **tab 9** indicates that the difference of average of the **Ch b** in the transplants of *Parmelia caperata* at the level of the site 4, 5 and 6 with compared with the witness is very highly significant ( $p = 0,000$  \*\*\*).

**Table 10: tests of simultaneity of Dunnett for the Chlorophyll a+b at *Parmelia caperata***

| Station | Moyenne     | Différence des moyennes avec le témoin | T observé | Valeur ajusté de P |
|---------|-------------|--|-----------|--------------------|
| 1       | 4,349666667 | 0,9523                                 | 1,296     | 0,6281             |
| 2       | 6,123000000 | 2,7257                                 | 3,710     | 0,0111*            |
| 3       | 6,283333333 | 2,8860                                 | 3,929     | 0,0073**           |
| 4       | 8,213333333 | 4,8160                                 | 6,556     | 0,0001***          |
| 5       | 9,208000000 | 5,8107                                 | 7,910     | 0,0000***          |
| 6       | 12,55000000 | 9,1527                                 | 12,460    | 0,0000***          |

At the level of the **tab10** the test of Dunnett shows that the difference of average of the **Chl ( a+b )** in the transplants of *Parmelia caperata* at the level of the site 2 with compared with the witness is only significant (**p = 0,01 \***), on the other hand she is very highly significant at the level of sites 4, 5 et 6 (**p = 0,000 \*\*\***)

**Table 11: tests of simultaneity of Dunnett for the Chlorophyll has at *Parmelia perlata***

| Station | Moyenne     | Différence des moyennes avec le témoin | T observé | Valeur ajusté de P |
|---------|-------------|--|-----------|--------------------|
| 1       | 2,392000000 | 0,5870                                 | 1,273     | 0,6439             |
| 2       | 2,786000000 | 0,9810                                 | 2,127     | 0,1991             |
| 3       | 3,160333333 | 1,3553                                 | 2,939     | 0,0476*            |
| 4       | 3,140000000 | 1,3350                                 | 2,894     | 0,0517*            |
| 5       | 4,059666667 | 2,2547                                 | 4,888     | 0,0012**           |
| 6       | 4,836666667 | 3,0317                                 | 6,573     | 0,0001***          |

**The same test indicates** that the difference of average of the **Chl a** in the transplants of *Parmelia perlata* is highly significant at the level of the site 5 and very highly significant at the level of the site 6 (**p = 0,000 \*\*\***).

**Table 12: tests of simultaneity of Dunnett for the Chlorophyll b at *Parmelia perlata***

| Station | Moyenne     | Différence des moyennes avec le témoin | T observé | Valeur ajusté de P |
|---------|-------------|--|-----------|--------------------|
| 1       | 2,287666667 | 0,3827                                 | 0,7416    | 0,9386             |
| 2       | 2,690333333 | 0,7853                                 | 1,5219    | 0,4831             |
| 3       | 4,946000000 | 3,0410                                 | 5,8931    | 0,0002***          |
| 4       | 4,214666667 | 2,3097                                 | 4,4759    | 0,0026             |
| 5       | 5,638666667 | 3,7337                                 | 7,2354    | 0,0000***          |
| 6       | 8,192666667 | 6,2877                                 | 12,1848   | 0,0000***          |

Also this test shows **tab12** that the difference of average of the chl b to *Parmelia perlata* is very highly significant at the level of sites 3, 5 and 6 with (**p = 0,000 \*\*\***).

**Table 13: tests of simultaneity of Dunnett for the Chlorophyll a+b at *Parmelia perlata***

| Station | Moyenne     | Différence des moyennes avec le témoin | T observé | Valeur ajusté de P |
|---------|-------------|--|-----------|--------------------|
| 1       | 4,678333333 | 0,9693                                 | 1,372     | 0,5780             |
| 2       | 5,474333333 | 1,7653                                 | 2,500     | 0,1057             |
| 3       | 8,105666667 | 4,3967                                 | 6,225     | 0,0001***          |
| 4       | 7,357000000 | 3,6480                                 | 5,165     | 0,0007***          |
| 5       | 9,694666667 | 5,9857                                 | 8,475     | 0,0000***          |
| 6       | 13,02533333 | 9,3163                                 | 13,191    | 0,0000***          |

this test shows **tab13** that the difference of average of the chl a+b to *Parmelia perlata* is very highly significant at the level of sites 3, 4,5 and 6 with ( $p = 0,000 ***$ ).

### ► Proteins

**Table 14: Tests of simultaneity of Dunnett for proteins at *Parmelia caperata***

| Station | Moyenne     | Différence des moyennes avec le témoin | T observé | Valeur ajusté de P |
|---------|-------------|--|-----------|--------------------|
| 1       | 10,91390000 | 2,213                                  | 1,032     | 0,7988             |
| 2       | 14,14023333 | 5,440                                  | 2,536     | 0,0990             |
| 3       | 14,70066667 | 6,000                                  | 2,798     | 0,0618             |
| 4       | 16,84456667 | 8,144                                  | 3,797     | 0,0094             |
| 5       | 14,47676667 | 5,776                                  | 2,693     | 0,0747             |
| 6       | 17,89613333 | 9,195                                  | 4,288     | 0,0037             |

**Table 15: tests of simultaneity of Dunnett for proteins at *Parmelia perlata***

| Station | Moyenne     | Différence des moyennes avec le témoin | T observé | Valeur ajusté de P |
|---------|-------------|--|-----------|--------------------|
| 1       | 12,55690000 | 3,478                                  | 1,571     | 0,4533             |
| 2       | 12,82680000 | 3,478                                  | 1,693     | 0,3846             |
| 3       | 12,95233333 | 3,874                                  | 1,750     | 0,3551             |
| 4       | 15,16576667 | 2,892                                  | 2,750     | 0,0674             |
| 5       | 11,97076667 | 6,086                                  | 1,307     | 0,6213             |
| 6       | 15,16486667 |  | 2,750     | 0,0674             |

According to the test of Dunnett, **tab 14-15** there's not in any significant difference of proteins in the transplants of *Parmelia caperata* and *Parmelia perlata* at the level of all the sites with compared with the witness.

## Discussions

During development of the lichen thallus, both partners undergo a complex series of morphological, biochemical and physiological changes, resulting in a new organism with novel features (**Chapman and Margullis, 1998; Barreno, 2004**).

Lichen absorbs water and nutrient passively from their environment. Because of this lichens are particularly sensitive to environmental factors such as temperature, water availability, and air pollutants and/or Lichens are also suitable biomonitors due to their sensitivity to pollution. Several factors contribute to this sensitivity. Water and gas are exchanged over the entire lichen thallus. Because they lack roots, lichens do not have access to soil nutrient pools and must depend on deposition, water seeping over substrate surfaces, atmospheric and other comparatively dilute sources of nutrients. Thus, their tissue content largely reflects atmospheric sources of nutrients and contaminants. Lichens also lack the protective tissues or cell types necessary to maintain constant internal water content.

Many lichens pass through multiple wetting and drying cycles during a day. When hydrated, nutrients and contaminants are absorbed over the entire surface of the lichen

(**Jenifer et al., 1996**).

The substances accumulate in lichen from the environment through variety of mechanisms including particulate trapping, ion exchange, extracellular electrolyte adsorption, and hydrolysis and intra cellular uptake. (**Nieboer et al., 1978**).

Currently Lichen transplants are used to assess air quality in areas where lichens are absent or sparse. (**Richardson,1992; Pearson ,1993**).

According to, **Arora and al ., on 2002**, pollutants such as: the ozone ( O<sub>3</sub>), the nitrogen oxide ( NO<sub>x</sub>) and the sulphuric dioxide ( SO<sub>2</sub>) participate actively in the formation of the free radicals, in other words favor the oxidizing stress. The Biomarkers of oxidizing stress are the chlorophyll, the proteins and the enzymes.

In the optimal conditions of growth of vegetables, numerous processes metabolic produce reactive species of the oxygen (ERO) but with a rate of low production. This formation of ERO is a normal consequence of the metabolism to

the photosynthetic cells which produce and consume permanently of the dioxygene. The system of transport of electrons in the membrane of thylakoides is a major source of ERO (Lagadic and al ., on 1997).

The oxidizing stress appears in a cell when the balance between the ERO and the antioxidant defense systems is broken in favor of the oxidizing state. **(Goudable and Favier, on 1997)**. An imbalance between the production of ERO and the mechanisms of antioxidantizing defense Leads to an oxidizing stress which can pull molecular and cellular changes **(Goudable and Favier, on 1997; Blokhina and al., on 2003)**.

In our study we used as biomarkers the chlorophyll and the proteins and resultats registered at the level of tables 6-15 indicates a high concentration of chlorophyll a, b and a+b, mainly at the level of sites situated at the level of the zone of isopollution I and this zone of which the IPA varies from 0.3 to 3.8 is subject in fact to diverse sources of pollution such as: the urbanization, the industrialization presented by the discharges of the complex of phosphated fertilizers ASMIDAL as well as u n road traffic intense at the level of the urban area of Annaba, while the degradation of the chlorophyll is generally correlated in the intensity of the pollution **(Garty and al ., on 2001)** and concentrations raised by sulfate **(Garty and al ., 1997)**

Similar results were observed at the level of the other species of Parmelia, it is an etude which was made by Von Arb and Brunold in 1990 the content in chlorophyll of Parmelia sulcata near Bienne, Switzerland and in the North of Switzerland was more raised in samples being in the polluted urban zones that in the remote zones. The same year in 1990 Søchting surveyed the tissue nitrogen content of reindeer lichens in Denmark. In unpolluted areas, tissue levels were 0.26-0.49 % while in areas of wet deposited acidity, values were 0.70- 0.73 % and visible injury could be found. The nitrogenous component of acid rain can produce a fertilizer effect on lichens and cause floristic changes.

Another more recent study made in the United States indicates that the absence of lichens sensitive to the pollution in the polluted sites is in clear contrast with the visible improvement of the physiological state of the tolerant lichens for the pollution, but compatible with the high load of tissues in nitrogen and in sulfur at the level of these polluted sites. **(H.S.Y. Ra, L.H. Geiser, R.F.E. Crang, 2004)**.

Also proteins as bio markers register very high values at the level of all the sites with compared with the witness this reflects very well the existence of a general stress at the level of our transplants licheniques **(Faburé, 2009)**.

Indeed, the study which was made in 2007 by **Serradj Ali Ahmed** on the estimation of the acid pollution at the level of the region of Annaba by using several parameters such as; measures of the SO<sub>2</sub> and NO<sub>x</sub> in the atmosphere, the pH of rains, pH of the barks of *Fraxinus angustifolia* and *Xanthoria parietina* as bio indicators, indicates that our region is indeed subject to an acid pollution caused by sulfur dioxides and nitrogen oxides and that these last years the broadcasts of nitrogen oxides exceed from a great distance those of sulfur dioxides this is certainly of for the road traffic the intensity of which deteriorates in the daytime in day.

### 3-Morphological Descriptions of the various transplanted species

#### Air pollution effects on the transplants of *Parmelia caperata* and *Parmeelia perlata*



**SITE 3 TREE 2**

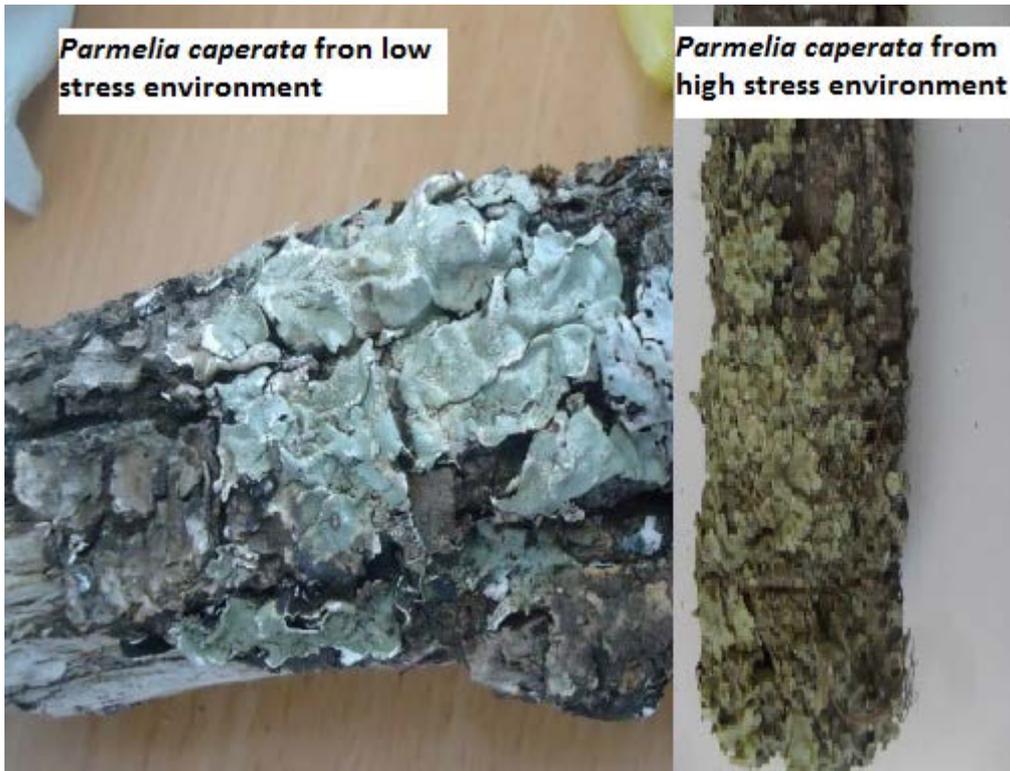
With regard to the witness the thallus of the transplants of these sites does not undergo a lot of modification except an absence of some parts and the presence of one or two dense spots, because they are situated far from roads or meadows but little frequented by let convey



**SITE 3 TREE 3**

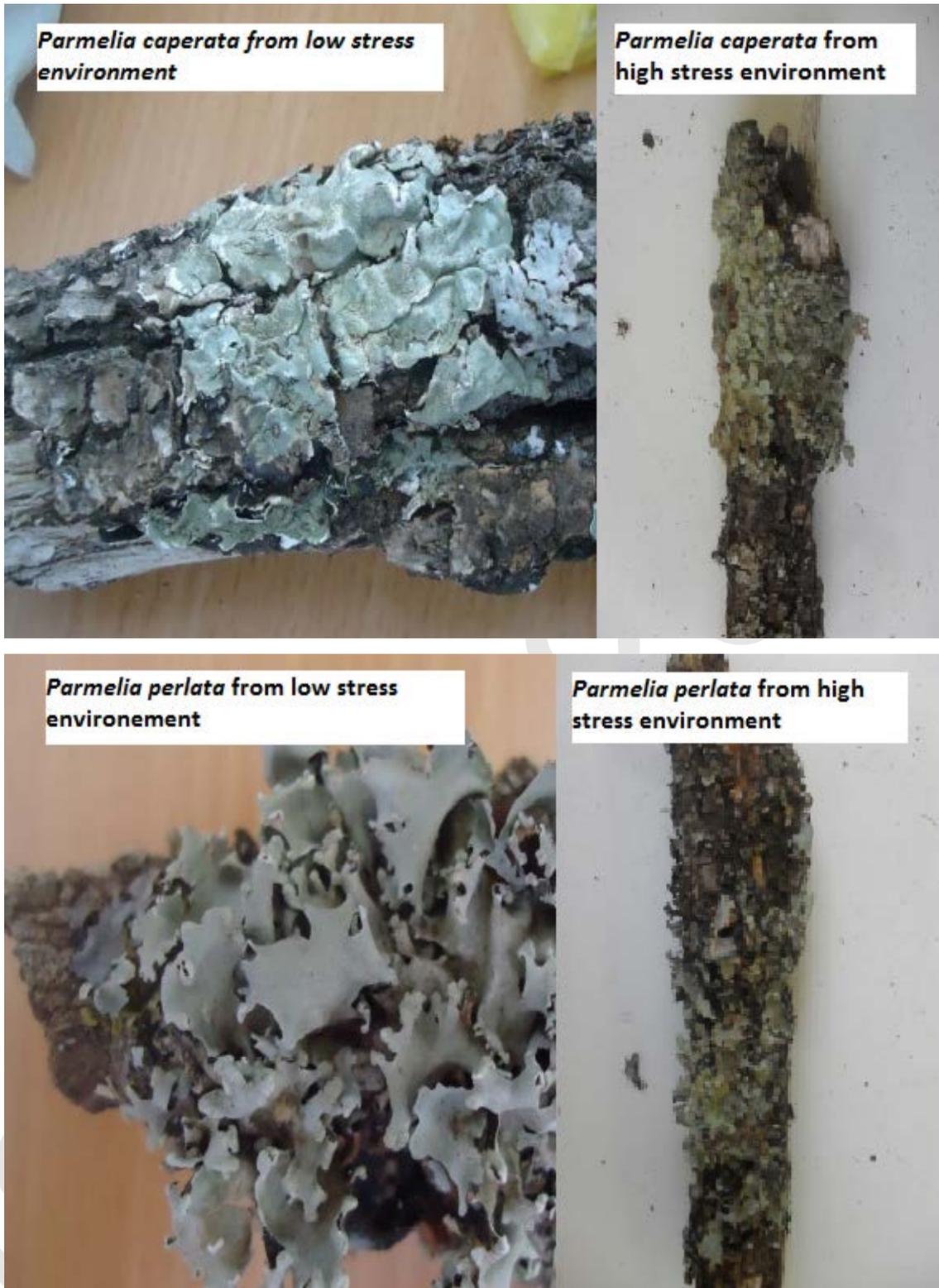
We observe an unsticking of the thallus of *Parmelia caperata*, presence of fine wrinkles; the thallus becomes so fragile and breakable, color darker with brown presence of spots, absence of soralie.

*Parmelia perlata* thallus color darker than the control, the almost total absence of reproductions bodies: the soralies.

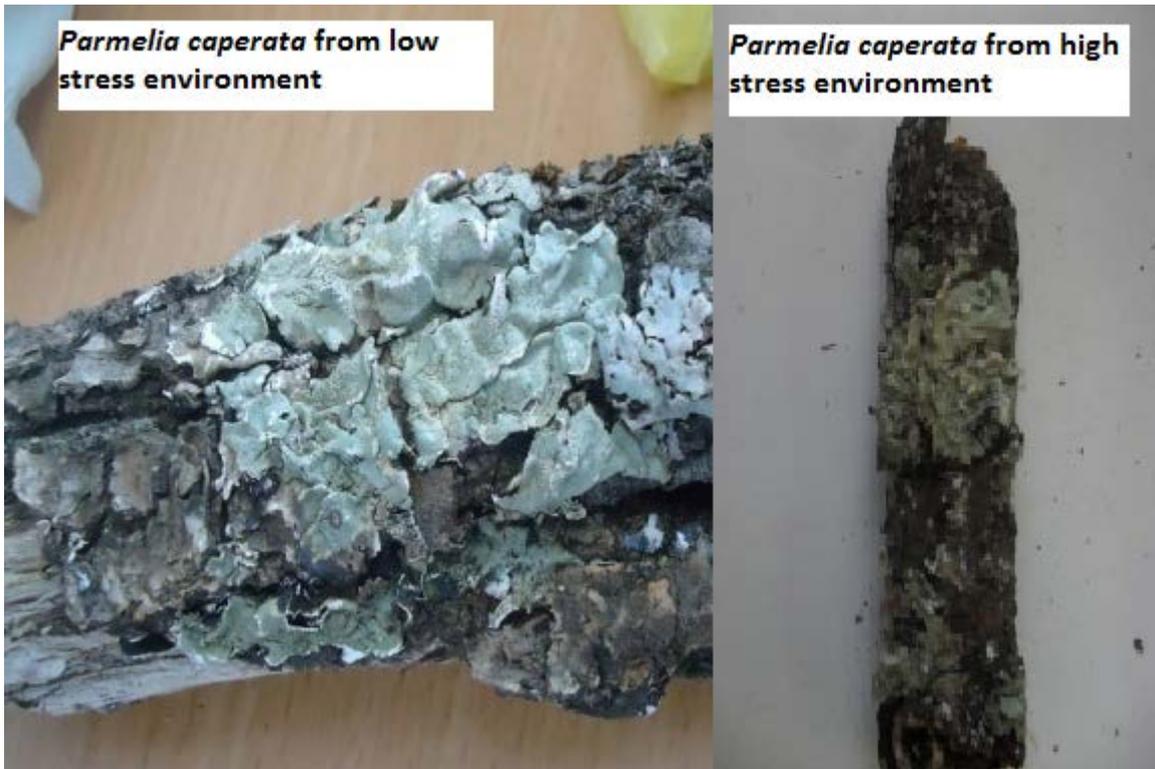


**SITE 4 TREE 1**

At the level of these sites 3 and 4 *Parmelia perlata* is very dark and the *caperata* becomes drier and unstuck from the support these sites are affected by a road high traffic.



**SITE 4 TREE 2**



**SITE 5 TREE 2**



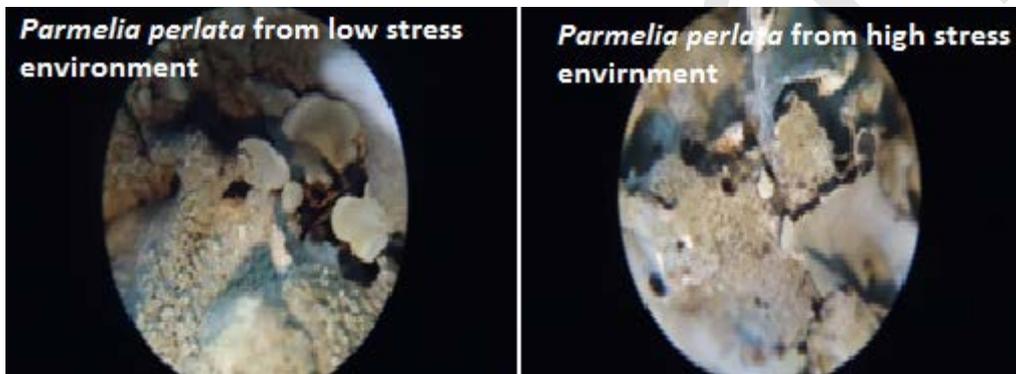
**SITE 6 TREE 1**

Stations 5 and 6 represent a site to very high road movement, discoloration of transplants  
 A myriad of pollution effects on lichens have been described. At the level of the whole plant, investigators have described decreases in thallus size and fertility (DeWit 1983, Kauppi 1983, Sigal & Nash 1983), bleaching and convolution of the thallus (Sigal & Nash 1983), restriction of lichen occurrence to the base of vegetation (Sigal & Nash 1983, Neel 1988), and mortality of sensitive species (DeWit 1983, Denison & Carpenter 1973).

**4-Observations under binocular microscope:**



Marginal Presence of reproductive organs the soralies which are very developed training an edge rolled up in the shape of pearl reaches by the thallus of *Parmelia caperata* and *perlata* witness.

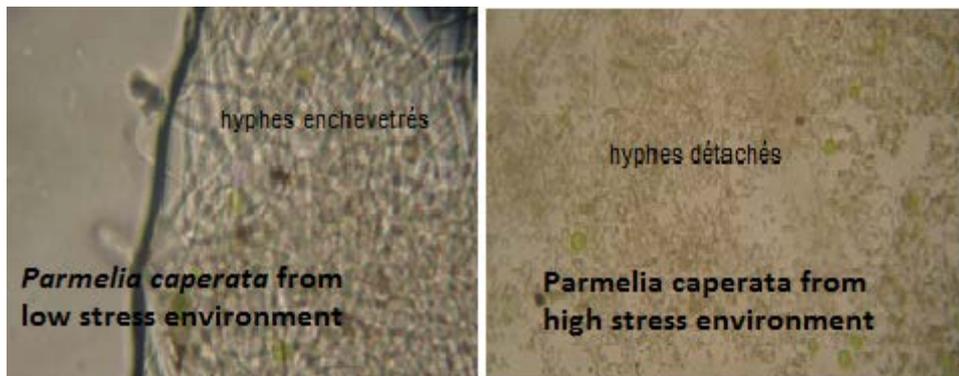


Almost total absence of soralies on the thalle of especes situated at the level of the Site 6



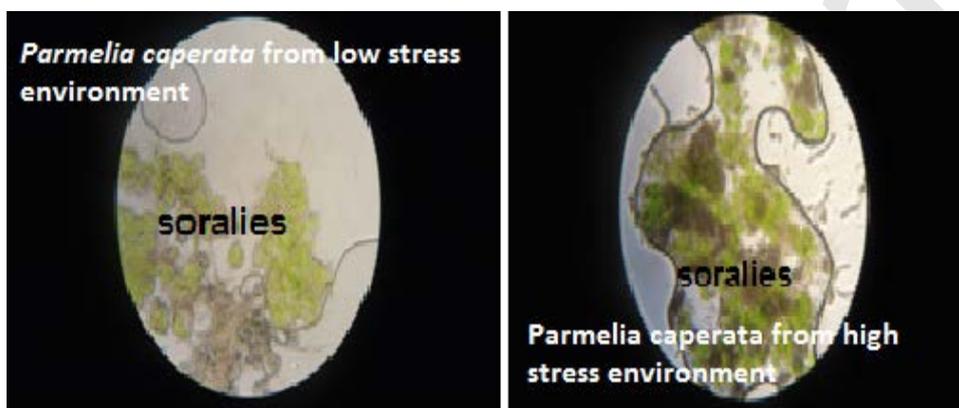
Suckers of *Parmelia caperata* and *Perlata* temoin fixed well to the trunk grace in rhizines  
 Sucker of necrosed *Parmelia caperata* and carrying deformations in the form of fine wrinkles Site 6

#### 4- Histological Cups



Crossde section of *Parmelia Caperata* control x10

crossde section of *Parmelia caperata* polluted x10



Crossde section of soralies of *Parmelia caperata* control x40

Crossde section of soralies of *Parmelia caperata* polluted x40



Crossde section of *Parmelia perlata* control x40

Crossde section of *Parmelia perlata* polluted x40

According to these histological cups(cuttings) we notice that the structure of the thalle of 2 licheniques sorts(species) developing naturally at the level of el kala ( temoin ) constituent very developed hyphes a mycélium muddled, on the other hand the sorts(species) transplanted at the level of the site 6 for example presents a hétéromère structure with presence of gonidies and, presents a relaxation(slackening) of hyphes and a light decrease of length, otherwise said hyphes becomes very short and so the thalle loses its initial structure.

Also for organs of vegetative reproductions soralies is necrosed by the effect of the pollution.

Microscopic effects described include reduction in the number of algal cells in the thallus (Holopainen 1984), ultrastructural changes of the thallus (Hale 1983, Holopainen 1984, Pearson 1985).

## Conclusion:

The alteration of the air and the transformation of the environment related activities. Man is increasingly at the heart of the concerns of government agencies responsible for environmental protection

This study aims to characterize the impact of pollution atmospheric lichen flora of regions d'Annaba, which resulted in a stress.

Generally, the content of chlorophyll in transplants of *Parmelia perlata caperata* and tends to increase at the most polluted stations (S3, 4,5 and 6), the same increase in protein levels at the same transplants contaminated sites is due to the excessive presence of NO<sub>x</sub> and SO<sub>2</sub> generated by different sources of pollution such as high urbanization, industrialization and even the intensity of traffic at the town of Annaba.

The effect of pollution on lichens results in a change in morphology and histology. These changes are due to pollution. There is a strong air pollution in the region of Annaba and especially at the city and Wadi fourcha by cons, at Sidi Aissa pollution is very low. We found it useful to suggest some measures to address this serious problem of air pollution in this case:

- Prioritize other cleaner energy
- Reduce the impacts due to road transport
- Improve the design of cars
  - Treat exhaust
- Improve fuels and their use
  - Accentuate the polluter pays principle
- Ensure proper functioning of continuously monitoring stations of the air quality and the right location .

## Acknowledgements.

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# IMPACT OF ROAD TRAFFIC NEAR THE ROADS ON THE CYPRESS IN THE REGION OF ANNABA ALGERIA

Maizi Naila, Alioua Amel & Tahar Ali  
Department of Biology, Faculty of Science  
University Center - El-Tarf - P.O. Box 73, 36000 El-Tarf, ALGERIA

E-mail : maizi\_naila@hotmail.com

**Abstract :** Air pollution especially of lead has steadily evolved over time, due to the increase in the number of vehicles on the market. Our research is based primarily on the use of a species phanérogamique "*Cupressus sempervirens*" as bioindicator of air pollution on the three major highways serving the city of Annaba. An appropriate sampling strategy, a spatio-temporal monitoring and measurement of physiological parameters by the combined determination of lead allowed us to assess not only the state of air quality but also the impact of this pollution generated by heavy traffic in this region.

Statistical analysis of results brings up correlations ranging from significant to very highly significant between the measured parameters and lead levels in the bio indicator by site and months of experimentation..

**Key words:** pollution, lead (shot), *Cupressus sempervirens*, bio indication, bio accumulation, road traffic, Annaba.

## Introduction

The air pollution arouses since a few years an interest growing as well among the leaders as within the population. The technological progress and the development of the branch of industry by way of the fast push of the urbanization are at the origin of a ceaselessly increasing infringement towards the air quality. Among the sources (springs) of pollution, we can quote the means of transportation, in particular the motor vehicles.

In Algeria and especially in the region is from the country, there is for several years a progressive problem of atmospheric pollution in particular plombique bound to important road networks (Semadi et Decormis, 1986 ; Maizi, 2006). In the region of Annaba, it is easy (well-to-do) to notice that we have a real problem of pollution on one hand because of the existence of a very important motor vehicle population (car fleet) with regard to the crossed distances, and on the other hand certain topographic and climatic characteristics which create a climate convenient to the development of the pollution (Alioua, 2001 ; Bouregghda, 2004). Since the seventies of numerous searches (researches) were led on the use of the indicator and organic vegetables as the bio accumulators of the pollution in particular that some heavy metals (Semadi et Deruelle, 1993; Alioua et al., 2008). Our search on the study of the pollution plombique of automobile origin in the region of Annaba by using in a relevant way bio-indicators, in particular cypress in the objective to characterize the environmental state of the environment studied by bringing to light a plombique pollution bound to the road traffic, to study the impact of this last one on the morphology and the physiology of the used vegetable and to propose bio relevant indicators of this pollution.

## Materials and methods

The city of Annaba is considered as being one of the cities the most polluted on the national territory and in the North of Africa, the main broadcasting(issuing) source(spring) of the lead(shot) is the road traffic which evolves in a disturbing rhythm.

The problem of the atmospheric pollution to Annaba bound(connected) to the presence of several industrial units and to the intense road traffic is deteriorated(aggravated) by its geographical position (in basin), factor(mailman) which favors the accumulation and the stagnation of atmospheric pollutants and exposes(explains) consequently the inhabitants to a sanitary risk.

The city is structured around a main center, the city center. This last one desired by the citizen, as well as by the planner is the space the most frequented by the city. The central space of the city does not take care only of the population of Annaba but also the populations of the bordering urban areas(conglomerations), all the activities are there present of

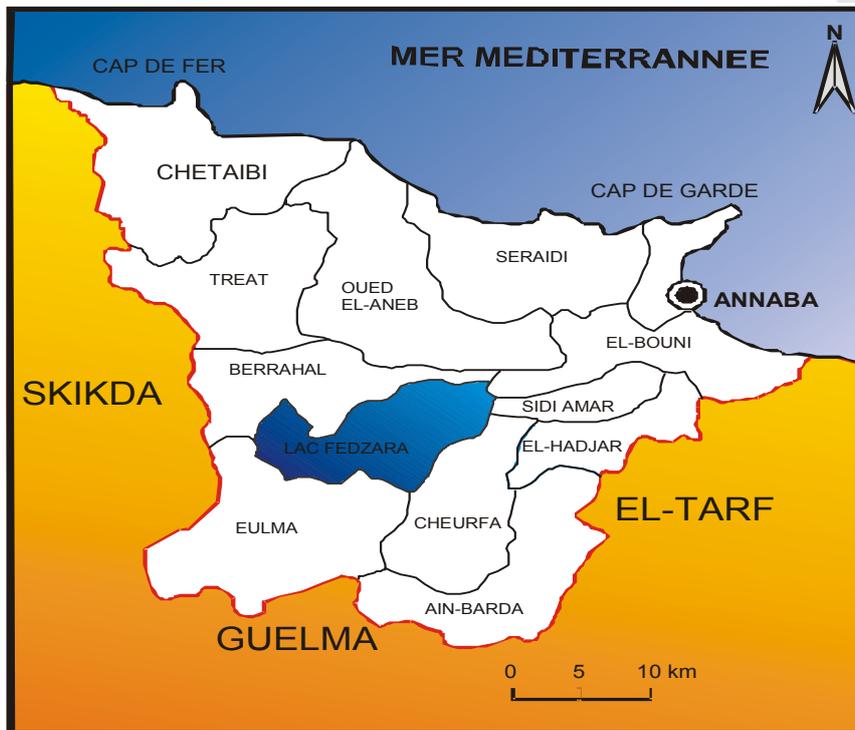
businesses, presence of markets (walked/worked) El Hattab) presence of offices(desks), presence of stations(resorts) of taxis, presence of station(resort) of public transportation (Hacini-Chikh, 2008).

The population of the wilaya of Annaba did not stop increasing during these last years to reach(affect) 650 000 inhabitants where we register(record) moreover an annual average of growth closely 1,01 % and an irregular distribution of the population with a variation of the density from a municipality to the other one. The axis Annaba - Sidi Amar and El Bouni represents the sites where the majority of the population are concentrated (44, 65 % to Annaba, 20, 04 % to El Bouni and 12, 80 % to Sidi Amar).

The socioeconomic characteristics (commercial, industrial, university pole and the quality of the services are factors limiting some distribution of the population (P.D.A.U., 2008).

Nowadays we find an automobile city, the annual growth rate of car registration documents is only increasing year by year especially between year 2002 and 2003 or the rate increases considerably 0,92 it passes in 3,57 (Hacini-Chikh, 2008). In 2005, the vehicle of tourism is 68 % with regard to the other ways of transportation. Compared with the other Algerian wilayas Annaba is classified second after the capital with a park automobile reaching(affecting) 100 000 vehicles (P.D.A.U., 2008), With 94 passenger cars for 1000 inhabitants and exceed(overtake) widely Constantine and Oran which(who) are respectively 79 and 81 cars for 1000 inhabitants (Semaly – Transurb in Hacini-Chikh, 2008). Since 2003 we would have an acceleration of motorization (+ 9 %), this acceleration rose during the last years when we registered respectively an increase (+ 14 %) in 2004 and (+ 42 %) between years (on 2004 and 2008).

### 1- Presentation of the zone of study:



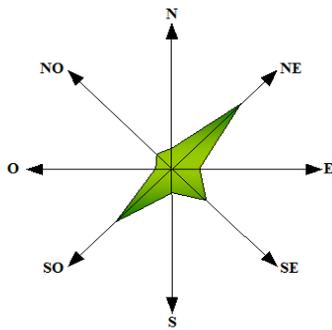
The city of Annaba is situated east of Algeria between the latitudes (36 30) the North and (37 30) the North, and the longitudes (07 20) is and (08 40) is, with 12 municipalities of a total surface of 1411.98 Km<sup>2</sup>. She is limited by the Mediterranean Sea to the North, the wilaya of Skikda on the West, that of Guelma to the South and El Tarf in the East (Figure 1).

Figure 1: Geographical localization of the region of study ( Annaba).

### 2- The climatic parameters::

Certain climatic parameters are considered in our study because they have a role particularly mattering in the distribution and the dilution of the impurities.

- The city of Annaba presents in general Mediterranean features of type with bioclimatic floors sub humid and wet.
- She(it) is characterized by soft temperatures in winter, warm in summer with an annual average temperature of 17.89°C, an annual average maximal temperature of 23.78°C and finally an annual minimal temperature of 12.76°C and plentiful precipitation, the annual pluviometry is of 654,64mm.
- The wind rose allowed us to bring to light a dominant direction of the Southwest North-East wind (Figure 2).



**Figure 2:** The wind rose of Annaba established on an average of 10 years (on 1999 - 2008).

### 3- Choice of the sites of surveillance and the bio accumulators of the pollution:

#### 3.1- Choice of sites

Generally, for better connaitre the levels of pollution, it is important to set up networks of taking, by trying to choose well exposed sites, in number sufficient(self-important). The analysis of the built-up area of Annaba allows to distinguish in the global scale three expanding main trunk roads of growths and development and which converge on the city center of Annaba:

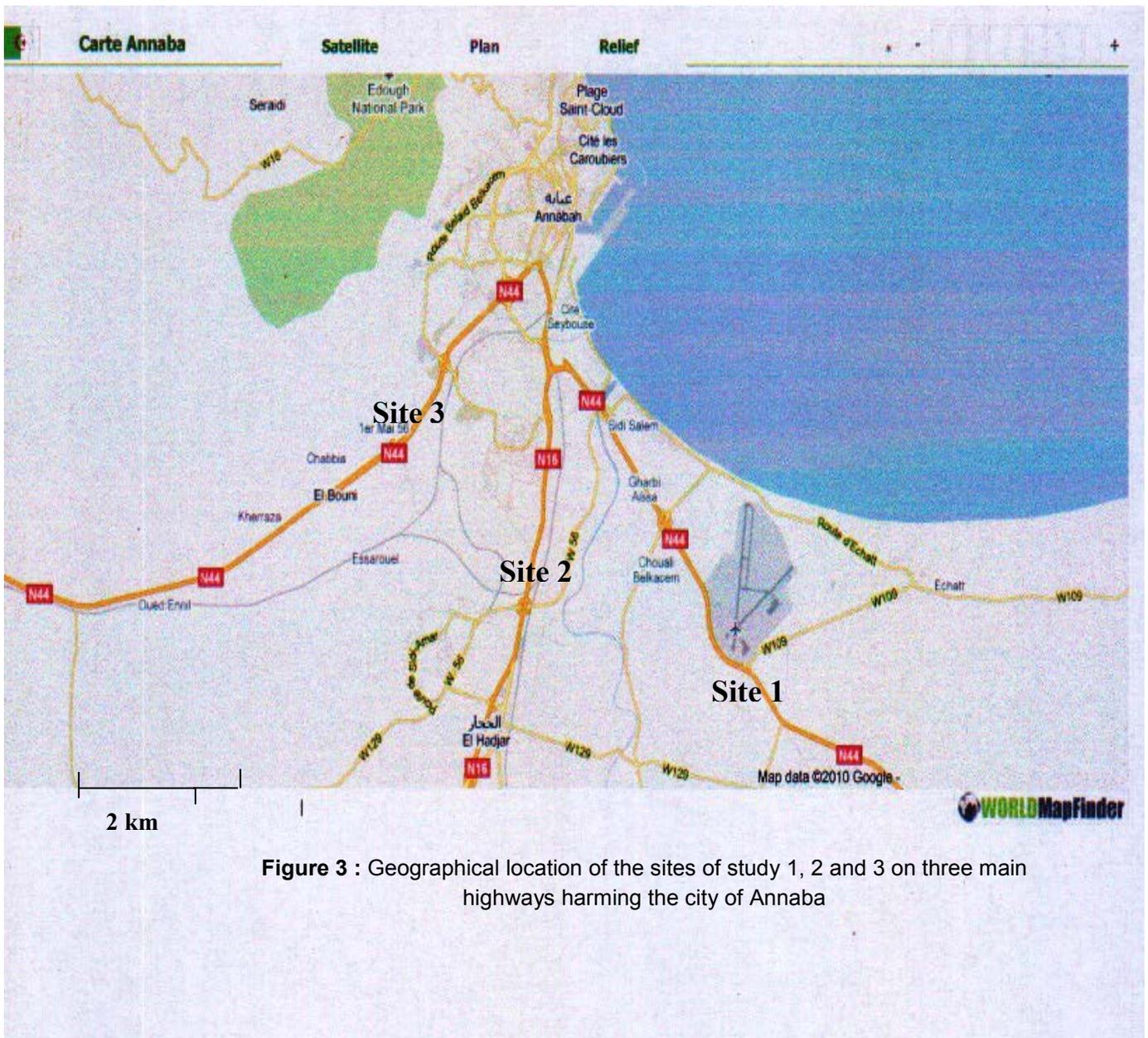
- The axis RN 16 which connects the big and former(ancient) two poles Annaba and El Hadjar,
- The axis RN 44 - is connecting Annaba with El Tarf,
- The axis RN 44 - the West connecting Annaba to Constantine.

The road stitch of the urban area is marked by three radial roads, the RN44 which goes on the scale of the city center by penetrating the West and the RN 16 which goes on by the North-south axis and The RN 44 - is.

The evaluation of the levels of pollution near the axes of traffic is a complex exercise, considering the numerous factors to be considered in this scale. The concentrations in pollutants registered in border of way indeed depend on local emissions generated by the car traffic (depending themselves on conditions of traffic and on the composition of the motor vehicle population parameters influencing the dispersal of pollutants (local meteorology and configuration of public road network(garbage dump)) and levels of thorough concentration of the surrounding zones.

We chose three sites localized on three main highways harming the urban area of Annaba (**Figure 3**):

- Site 1: (R.N. 44): Annaba-El Tarf, he is approximately 4 km in the Southeast of Annaba.
- Site 2: (R.N. 16): Annaba-EL Hadjar. He was chosen in 5 km in the South of Annaba.
- Site 3: (R.N. 44): Annaba-Constantine: he was realized in 3 km in the Southwest of Annaba.



**Figure 3 :** Geographical location of the sites of study 1, 2 and 3 on three main highways harming the city of Annaba

### 3.2- Choice of the botanical species:

Our choice concerned a phanérogamique sort “in situ “, it is about the cypress (*Cupressus sempervirens*), it is the most representative vegetable of the region. This vegetable is homéohydre, that is the moisture content of the vegetable remains relatively constant during all its existence, whatever are the variations of the hygrometric state of the air(sight) and the moisture content of the ground (Gorenflot, 1998).

### 4- Appreciation of the road traffic:

The counting of vehicles was made at the level of our three sites of study in the region of Annaba. We chose a site of just counting of vehicles next to the phanérogamique sort chosen, object of our study. This counting was thus made at the rate of three times a day, once quite week, the monthly average being taken into account and it during 07 months as from the month of Mars 2008.

### 5- Technique of takings of samples:

To realize our sampling, we operated at a height varying 1, 50 m and 2 m of the ground. We took, every time 10 in 20 sepals around of the tree at the level of man to have a homogeneous average sample.

The taken samples are placed in plastic labeled bags carrying all the indications (in particular date and place of taking), closed by means of an elastic(rubber band) to limit the losses of water by evapotranspiration until the arrival to the laboratory.

## 6- Analytical techniques:

- After drying of samples in the steam room in 105°C, they are carefully crushed, put in piluliers where they are treated by the peroxide of hydrogen (hydrogen peroxide) until complete mineralization. The recent dosages of the lead were made by using the technique of spectrophotometry of atomic absorption ( S.A.A). The measures were made from the solutions of 20ml of nitric acid for 2 %. For the same solution, three measures are made, the average being considered. Before proceeding to the dosage of the lead in samples, it is necessary to establish at first a curve of calibration from the solutions of lead known concentrations. The results are directly read on the device if it is preset according to the indications of the builder or on the curve of calibration in microgram of lead. The used device is a spectrophotometry (Perkin-Elmer model 400) - For the dosage of the chlorophyll, we used the method proposed by (Rao & Le Blanc, 1965), the used device is the spectrophotometer in two wavelengths 645nm and 663nm (GenesysTM 8).

- The method used for the dosage of the proline is the one (Troll & Lindsley, 1955) Simplified, finalized by (Dreier & Göring, 1974). The used device is the spectrophotometer in the wavelength 528nm (GenesysTM 8).

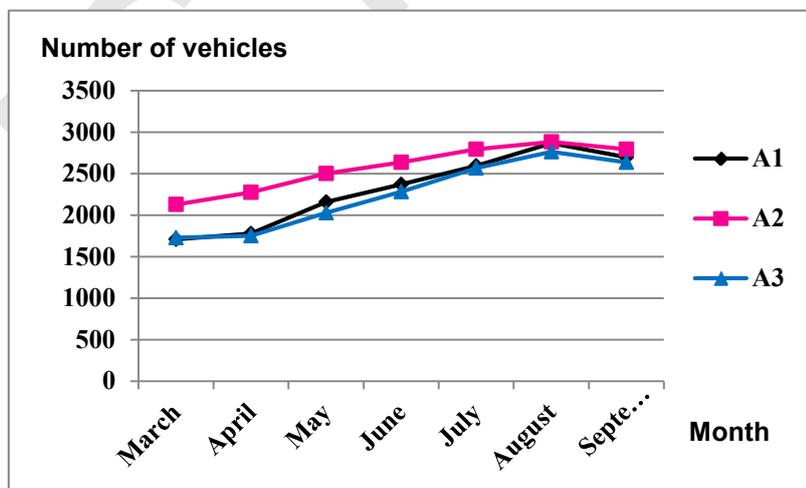
- Having taken the fresh samples, we weighed 1.5gr of fresh material then put in the steam room in 105 °C during 72 hour to determine the dry material. So the report M.F. / M.S. An idea onto the purity of the air of the site in question, more is defined to give us the air is pure is more the development of the vegetable is normal that is the Fresh material is in its optimum on the other hand if the air is polluted it entrained of the demonstrations of chloroses, necroses to the detriment of the Fresh material (Semadi, 1983).

## 7- Statistical analysis of the data:

The tests of analysis of the variance in two criteria of classification were used to make a comparison for every characteristic between sites on one hand and between months of experiment on the other hand (Dagnelie, 1999). All the calculations were realized by the command of stepwise of the software MINITAB.

## Results

### 1- Variation of the monthly average of the road traffic during rush hours near 03 main highways.



Especially at the level of the axis 2 (Fig. 4). This is bound to the environment of the axis and to its characteristics (surrounded with several important equipment's: commercial, industrial, urban areas etc.), thus the axis 2 seems the most frequented.

The analysis of the variance in two criteria of classification relative to the spatiotemporal variation of the road traffic at the level of three axes harming the urban area of Annaba during rush hours shows that this last one is significant in the space ( $p = 0,000 ***$ ) and in the time ( $P = 0,000 ***$ ).

**Figure 4:** Variation of the monthly average of the road traffic at the level of three axes harming the urban area of Annaba during rush hours by *Cupressus sempervirens*

## 2- Results obtained to the bio indicator:

### 2-1- Lead

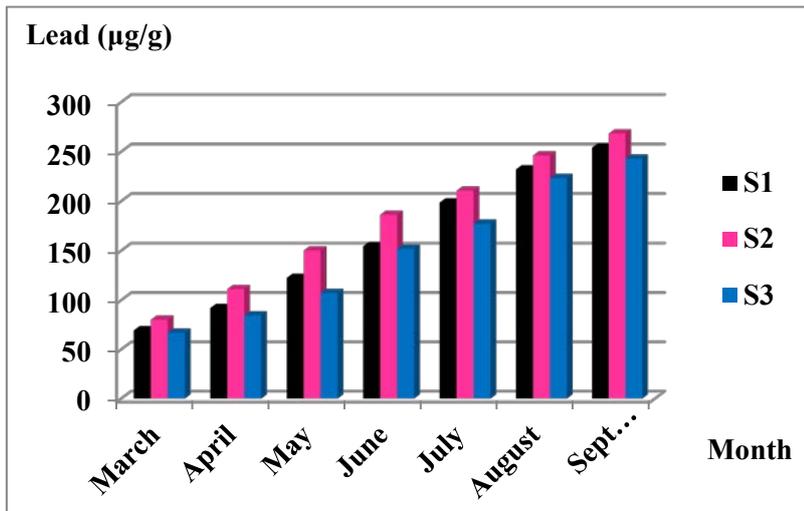


Figure 5: Spatiotemporal variation of the lead accumulated by *Cupressus sempervirens*

### 2.2- The chlorophyll:

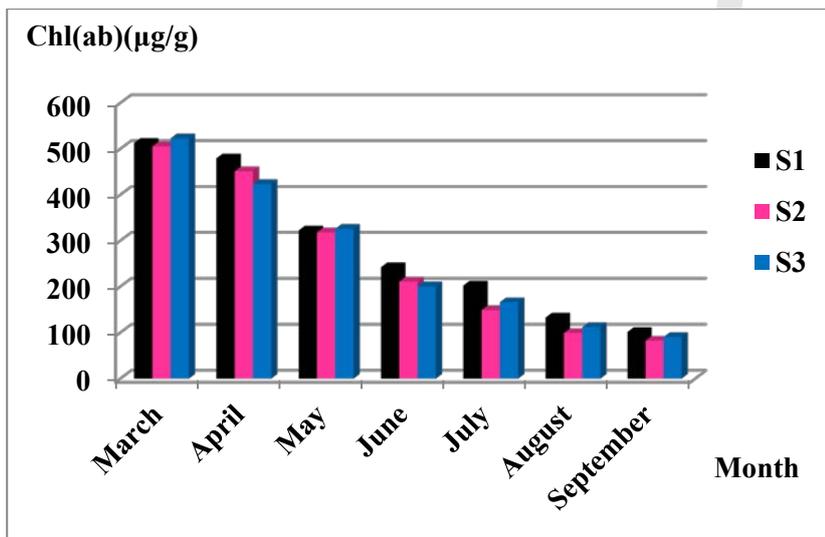


Figure 6: Spatiotemporal variation of the chlorophyll (ab) at *Cupressus sempervirens*

For the cypress, the accumulation of the lead is very clear some is the site; it increases gradually between June and September (Fig. 5). Although at the level of the site 2 the vegetable seems to accumulate more lead, this is certainly connected to the volume of road traffic as well as has the environment of the site.

The analysis of the variance in two criteria of classification relative to the spatiotemporal variation of the lead(shot) accumulated by *Cupressus sempervirens* show that this last one is very highly significant in the time(weather) ( $p = 0,000 ***$ ) but it is only significant in the space ( $p = 0,011 *$ ).

Further to the results obtained as regards the average content of the chlorophyll ( ab ) at *Cupressus sempervirens* and represented by the fig. 6, we notice a fluctuating variation during the months of study by all the sites.

It's the same for the comparison of the spatiotemporal variation of the chlorophyll (ab) at *Cupressus sempervirens* who shows that there is a very highly significant variation in the space ( $p = 0,000 ***$ ) and in the time ( $0,000 ***$ ). That is the content in chlorophyll to the vegetable depends on the position of the site and on the time of exposure although the more the time of exposure is long and the more the content in chlorophyll is less.

### 2.3- La proline :

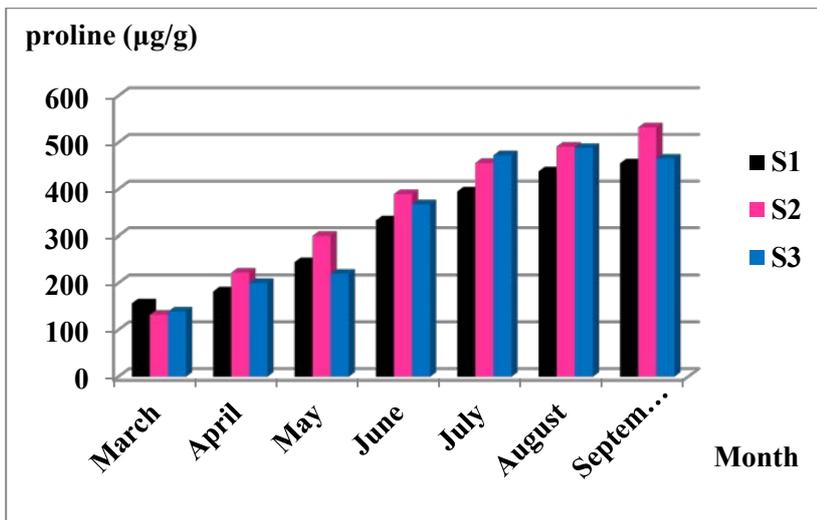


Figure 7 : Variations spatiotemporal of the proline at *Cupressus sempervirens*

According to the results illustrated in the **fig. 7**, we notice that the rate of the proline at *Cupressus sempervirens* increases from the first taking, this increase persists until the seventh taking; this is probably due to the stress of the vegetable provoked by the accumulation of pollutants.

The comparison of the content average of the proline at *Cupressus sempervirens* shows that the variation of the proline is very highly significant in the time ( $p = 0,000 ***$ ) when in the space ( $p = 0,000 ***$ ), stalled means that the contents it proline vary according to time and of the

#### 2.4- MF/MS :

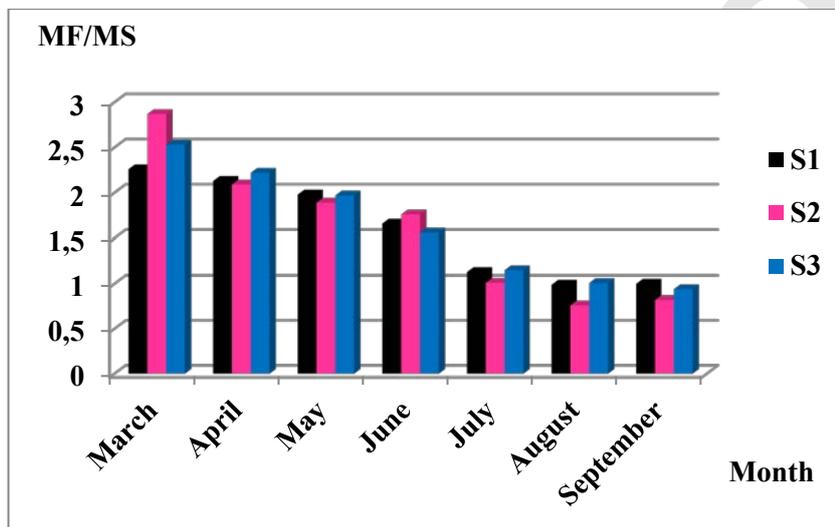


Figure 8 : Variations spatiotemporal of the report MF / MS at *Cupressus sempervirens*.

**La figure 8** show that the report MF / MS at present *Cupressus sempervirens* of the fluctuations from March till June then stabilizes the rest of the months of study. We also notice that there is no big variation between both sites 1 and 3. This is doubtless due to the sustainability of the always green sort.

As regards the comparison of the spatiotemporal variation of the relationship MF / MS at *Cupressus sempervirens*, we notice that it is not significant in the space ( $P = 0,220$ ) whereas it is very highly significant in the time ( $p = 0.000 ***$ ).

## Discussion

Considering its geographical position (in basin), Annaba is a coastal city characterized by a high rate of humidity throughout the year, an important pluviometry with the risks of temperature inversion which create a climate convenient to the development of the pollution.

Concerning the relative results in bio surveillance of the pollution plombique near main highways, we notice that: by comparison of the volume of traffic long-distance truck driver at the level of three axes for the same schedules of counting, we notice at first by the sites 1 and 3 that there is so difference according to the schedules of counting, on the other hand the difference is smelt at the level of the site 2 where the road traffic seems more intense during rush hours. Indeed this site harms the city El Bouni, the urban areas of El Hadjar, Sidi Amar, Chaïba, the University and the steel-making Complex as well as the other destinations towards Guelma and Souk Ahras; this is understandable by the importance of these urban areas and infrastructures harmed by these strongly frequented roads.

Concerning the accumulation of the lead(shot), the results(profits) which we obtained demonstrate well the presence of a strong plombique pollution of automobile origin, revealed to the cypress (*Cupressus sempervirens*) at the level of the

site 2, where the road traffic is the most intense, *Cupressus sempervirens* accumulates 268,33  $\mu\text{g} / \text{g}$  the September. These results denote a strong accumulation to the sorts in the persistent foliage.

This is approved by (Madany and al., 1990) which demonstrate that the emitted particles are better got by the rough surfaces where embossed and the presence of a pilosity which favors their retention that by the smoother skins where covered with cuticles for the same site and the same exposure in the automobile pollution. So (Little and Martin, 1974), notice that the rough sheets can collect ten times more lead(shot) than the smoother sheets. Par ailleurs, nous enregistrons une accumulation temporelle nette de plomb entre le mois de mai et le mois de septembre, soit pendant la période de sécheresse. Nous considérons en général que les précipitations durant le mois de mars et avril ont tendance à lessiver les polluants particuliers au niveau du feuillage, ce qui va influencer la concentration en plomb accumulé.

Thus dusts, containing heavy metals, accumulate on the air parts, particularly the sheets. This deposit of surface of leaves can be qualified as latent pollution because the cuticle is considered as a waterproof barrier which opposes to the penetration in leaves. (Arvik et Zimdahl, 1974) Showed that very fine lead particles could penetrate into stomate, but it is improbable that big lead quantities penetrate in this way and this process can be responsible only for a low part of the contamination of leaves by the lead.

However, when leaves age, the efficiency of this barrier is distorted, it appears microphone cracks and pollutants which remain normally on-surface can easily penetrate. Therefore, lead particles put deposited on the surface of leaves do not practically penetrate inside and can be easily washed.

This upper vegetable indeed shows of the air quality thanks to its power accumulator. However this last rest always function of the nature of the species (its morphology, its vegetative cycle), of the exposure time, the intensity of the pollution, and to the environmental factors such as the direction of winds, the precipitation, the humidity .etc. The spatiotemporal follow-up of the moderate physiological parameters (content in chlorophyll, it proline and the report MF / MS), indeed testifies of the air quality of every site.

The follow-up of the counting of vehicles on three road main trunk roads harming(serving) the urban area(conglomeration) of Annaba demonstrated well to us the volume of road traffic the most marked on the R.N.16Annaba - El-Hadjar and not insignificant on the other axes. The statistical processing allowed well us to classify its main highways.

## Conclusion

The explanation of all these results integrates all the parameters of the environment, susceptible to influence on one hand the dispersal of pollutants such as the topography of sites, the direction and the wind speed, the situation of the road: the case of the axis 2, where the road is taken by the urban areas of El Bouni and Sidi Amar, the infrastructures of the industrial park thus pollutants tend to stagnate around the road. So the presence of trees near the road is also a factor of retention of pollutants. And on the other hand, the variation of the physiological parameters of the used vegetables of which the lead is a part but is not the only person in charge, so the other pollutants can interferences view the presence of several polluting infrastructures. However, all the species of a perimeter affected by a pollution do not react in the same way to pollutants. They are intrinsic factors in plants, morphological where physiological, which determine the resistance, the tolerance where the sensibility of plants. Other factors bioticks aged-related, at the physiological stage can intervene in the sensibility of vegetables in this plumbique pollution.

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# IMPACT OF SODA LIME GLASS BY SAND PARTICLES

C. Bousbaa\*, T. Mahdaoui and N. Bouaouadja

Laboratory of Non Metallic Materials, Institut of Optics & Precision Mechanics,  
University of Setif, 19000 Algeria.

(\*) e-mail address: [cbousbaa@yahoo.fr](mailto:cbousbaa@yahoo.fr)

**Abstract:** In order to find a solution to the problem of windshields damaged by sandstorms in the Saharan regions of Algeria, sandblasting tests were conducted in laboratory on a soda lime glass in its as-received state and when strengthened by thermal treatment. The sand particles were projected by an air flow with a speed of 56 Km/h and a sand mass flow of 10 g/min. The impact angle was maintained at 90°. The erosion tests show that the roughness Ra for the as received glass increases until a maximal value of 2.95 µm after being eroded with a mass of 200 g. of sand. The strengthened glass roughness reaches the same value (2.97 µm) but using a mass twice higher (400 g). The optical transmission decreases sharply for the as received glass from 92% to 10% after being eroded with 200 g of sand. The strengthened glass reaches the same level of the optical transmission, but after being eroded with a mass of 600 g. Microscopic observations show that the induced damage is similar to that of the windshields exposed to real situations in the Sahara. The erosion is of brittle kind and the material removal mechanism is in form of chipping or craters. The morphology of this chipping corresponds to that is usually observed on glass when submitted to Vickers indentation.

**Key Words:** Sandblasting, glass, erosion, roughness, optical transmission.

## 1. INTRODUCTION :

The usual way used for reducing impact damage on glass is to put its surface in compression. This can be achieved by thermal tempering, ion-exchange, vitreous enamelling or by cladding with a material of lower thermal expansion [1]. The thermal tempering or cladding methods give a relatively thick compressive surface layer in comparison with the two other methods. It was shown that the compressive surface stress field produced by thermal glass tempering does not improve significantly the glass erosion resistance to sharp particles [2] as was noticed in sand blasting or by Vickers indentation, but it could certainly improve the material erosion resistance caused by Hertzian cracking. The extent of the lateral cracks produced by Vickers indentation can be more pronounced if the glass is thermally tempered [3]. Other studies showed that glass tempering can have a small effect on its hardness and its elasticity modulus by reducing them while the fracture toughness seems to remain unchanged.[4, 5] This effect is due to the more open structure of the glass obtained by rapid cooling.

Ion-exchange is a chemical treatment which consists of exchanging small ions by larger ions in the glass surface using a molten salt bath. The expansion of the glass structure generates a compression at the surface and a balancing tension in the interior. This treatment is simple but costly when used industrially. According to I. W. Donald [6] the thickness of the compressive layer varies from a few micrometers up to several hundreds micrometers in dependence of the glass composition, the treatment conditions and the sample thickness. Among the main advantages of this treatment is that we can obtain higher mechanical strengths and avoid glass distortion since it is usually made at a temperature lower than the transition point. To our knowledge, the effects of structural changes obtained by chemical strengthening or by coating techniques on the mechanical properties ( $K_{IC}$ , Hv, E) and thus on the glass erosion resistance, are not completely established [7, 8].

## 2. EXPERIMENTAL PROCEDURE:

**2.1. Characteristic of the glass and sample preparation:** A 5 mm thick soda lime-silica flat glass was used in our tests. It was delivered by Algerian company of glass (glass-Africa, Jijel). The samples were cut from the same plate. The following tables show the average chemical composition of glass used and some physical properties.

**Table 1.** Mean chemical composition of the glass used

| Oxides   | SiO <sub>2</sub> | CaO  | Na <sub>2</sub> O | MgO  | Al <sub>2</sub> O <sub>3</sub> | Fe <sub>2</sub> O <sub>3</sub> | Others |
|----------|------------------|------|-------------------|------|--------------------------------|--------------------------------|--------|
| Mass (%) | 72.56            | 7.92 | 12.73             | 4.11 | 1.42                           | 0.095                          | 1.162  |

**Table 2.** Some of the physical glass properties.

| Properties                              | Values                      |
|---|-----------------------------|
| Thermal dilatation coefficient $\alpha$ | $8.410^{-6} \text{ K}^{-1}$ |
| Young modulus E                         | 72 GPa                      |

|                              |                        |
|------------------------------|------------------------|
| Poisson's coefficient $\nu$  | 0.22                   |
| Density $\rho$               | 2.49 g/cm <sup>3</sup> |
| Transition temperature $T_g$ | 532 °C                 |

### 3. RESULTS AND DISCUSSION

#### 3.1 Influence of thermal quenching on the erosion resistance.

We have, thermally hardened the samples at the Algerian company of glass (glass-Africa, Jijel) using a horizontal tempering furnace. The tempering temperature (680 °) was followed by rapid cooling with compressed air. In this industrial furnace, the minimum dimensions required for quenching are 250x40 mm<sup>2</sup>. Mass loss for samples thermally toughened was found insignificant according to the balance used. The samples are better suited for strength tests. That is why we determined the bending strength.

#### 3.2 Strength of thermally tempered glass

In order to examine the effect of thermal quenching behavior of the mechanical strength, four-point bending tests were conducted on two sets of respectively annealed and heat treated samples. These tests were performed on a Shenck type tensile testing machine. The average tensile strength obtained from a batch of fifteen samples was respectively  $\sigma = 65 \pm 23$  MPa and  $\sigma = 217.5 \pm 9$  MPa for annealed and tempered glass.

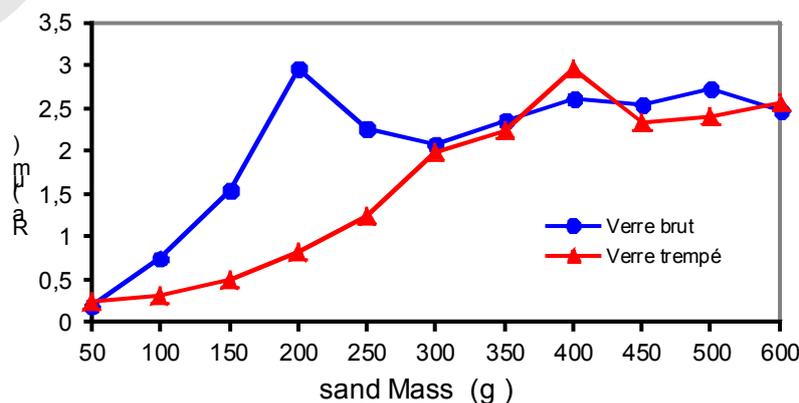
Subsequently, we conducted a shock test of a falling steel ball of mass 220 g from a height of 2 m. In fact ISO 3537 recommends a steel ball of 227 g and a drop height of 2 or 2.50 m. We found that crack initiation starts within the ball-target contact area and then propagate in all directions forming a large number of small non-sharp fragments. The fragmentation occurs throughout all the glass volume. This is one of the advantages of thermally tempered glass which protects vehicle drivers following accidents that happen so sudden and unexpected. In terms of comparison, Takahashi [9] found an average strength of 172 MPa and an apparent toughness 5.2 MPa√m on a 10 mm thickness thermally tempered glass.

Counting the number of fragments per unit area, we found an average of 270 fragments per 25 cm<sup>2</sup>. According to ISO 3537 on car windows, it is recommended a number of fragments between 40 and 450 per 25 cm<sup>2</sup> for a good quality of thermal quenching, provided that no fragment exceeds an area of 3.5 cm<sup>2</sup> and a length of 7.5 cm. Zarzycki [10] had reported that the degree of fragmentation depends on the density of elastic energy stored in the thermal quenching. Indeed, a high degree of thermal quenching leads to further fragmentation.

#### 3.3 - Roughness:

Figure 1 shows the average roughness  $R_a$  versus the projected mass of sand (not cumulative). It is found that the peak of  $R_a$  for annealed glass is about 2.95 microns. This value is reached for 200 g projected mass of sand. While for a glass reinforced thermal quenching, the curve of the roughness  $R_a$  is practically below that of the annealed condition and reached its peak of 2.97 microns for 400 g projected mass of sand. For comparison, Buijs [11] found an average roughness  $R_a = 3$  microns and a maximum roughness  $R_t = 15$  m for a speed of 300 m / s and a size of 30 microns of the particles.

When the peaks are reached, the roughness drops slightly and continues to oscillate as a sine wave of small amplitude around this level. This probably corresponds to the creation of a new rough surface layer. The optical quality is highly dependent on this new layer. Those defects govern the geometric surface light scattering and transmission loss

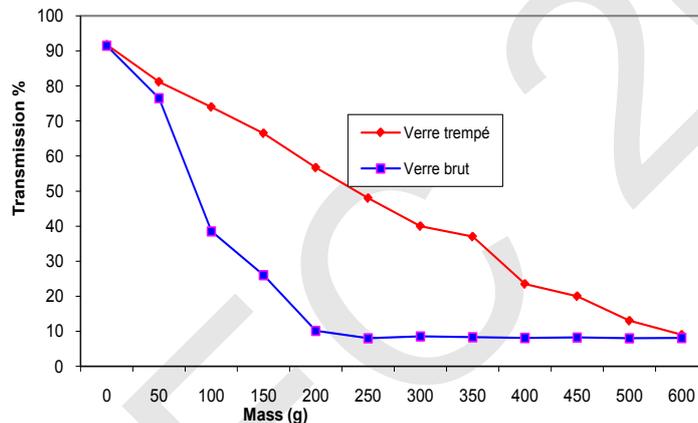


**Figure 1:** Variation of the roughness Ra (microns) of annealed glass and thermally toughened glass versus the projected mass of sand

### 3.4 Optical Transmission:

Parallel to the measurement of roughness, we measured the loss of transmission by using a light beam of length 550 nm. Figure 2 shows the difference between the transmission curve of an annealed glass and that of a thermally tempered glass. The transmission loss of an annealed glass fell from 92% to 10% at 200 g of projected sand, then it goes to a level that reflects the state of saturation. This bearing is contributing to the transmission loss curve of a thermally tempered glass at the point corresponding 600 g of projected sand. This is a good index, which reflects the positive contribution of thermal quenching and its ability to prolong the service life of a glass eroded by sand particles projected. Wilantewicz et al. [12] reported that the lateral cracks that govern the optical quality of glass are longer for a chemically tempered glass as a heat tempered glass. These authors added that after sandblasting glass-reinforced thermal tempering, annealing and chemical, mechanical strength determined for thermally tempered glass fell about 50% of its initial value, but remains higher than that of a chemically tempered glass (compressed layer = 150 microns) and an annealed glass, which fell by 70% and 80% of their initial values.

In the same field Telling et al. [13] found, for ceramic materials used as infrared windows in aeronautics and reinforced by a layer of ZnS, the transmission loss is about 60%. This loss is proportional to the size and speed of erosive particles. Another confirmation made by Jilbert [14] which indicated that the transmission loss of windows ZnS eroded sand particles of 10 microns at a speed of 30 m/s during 50 seconds was about 50%. While this loss is 7% for a speed of 10 m/s. So speed is the most relevant parameter to the erosion of materials by solid particles.

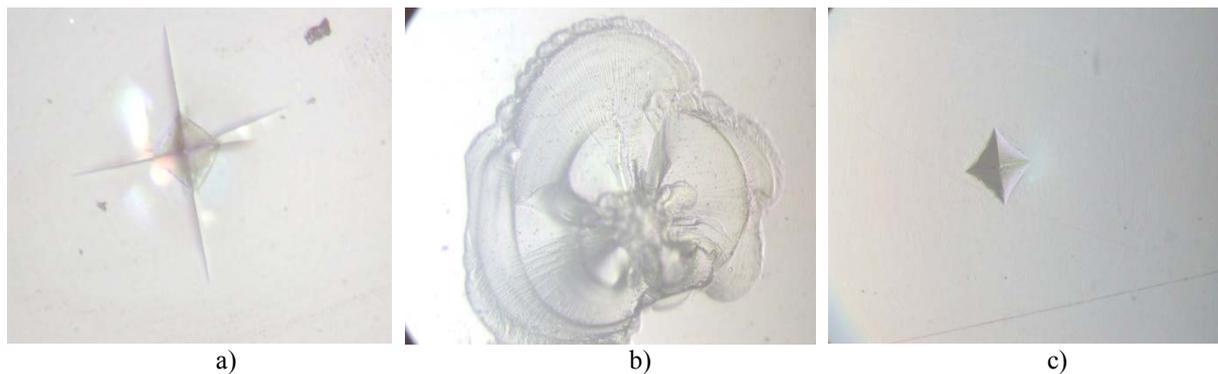


**Figure 2:** Comparison of transmission loss of two glasses treated by annealing and thermally tempered

### 3.5 Effect of fracture toughness

In this study, we compared the lengths of cracks produced for the same charge and under the same conditions. Figure 3 shows that up to a load of 9.8 N, radial or lateral cracks were not observed for thermally tempered glass. The initiation of cracks occurs for loads slightly higher than 9.8 N. This shows that the resistance to cracking and erosion resistance are significantly improved. In the case of chemically tempered glass, there is formation of radial cracks and lateral cracks followed by chipping for loads below 9.8 N. This strongly affects the optical quality and aesthetics of the glass. Although for an annealed glass, there is formation of radial cracks without rapid development of lateral cracks leading to chipping. This much influence on the mechanical strength of glass. From these micrographs, it seems clear that the thermal quenching treatment is best suited to resist the initiation and propagation of radial cracks and lateral to moderate loads. Therefore, it preserves the mechanical strength and optical quality by reducing the size of the defect.

This result is in good agreement with that of Holtmann et al. [15] which indicated that the thermally tempered glass is more resistant against erosion because of its high apparent toughness. Wellman [16] also reported that erosion is not governed by the relative hardness of the particle erosion and the target, but by their relative tenacity. Evans and Wiederhorn [17] both found that the toughness of a material is the most important factor influencing the resistance to erosion. According to Wilantewicz et al. [12], this very positive behavior of the thermally tempered glass with respect to resistance to erosion is attributed to the depth of the layer compression remains an essential element in the process of tearing material.



**Figure 3:** Micrographs showing three glasses indented by the same load 9.8 N  
 a) annealing, b) chemically toughened, c) thermally toughened ( photos 230  $\mu\text{m}$  x215  $\mu\text{m}$ )

### CONCLUSION:

In conclusion, from the experimental results, it appears that the hardness has no positive effect for holding against erosion. The fracture toughness remains a key parameter that governs the resistance to cracking and erosion.

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# IMPACT OF TREATED WATER ON A FEW NATURAL SUBSTANCES IN THE ONION: *ALLIUM CEPA*.

Yazid BEDOUH<sup>1</sup> and Fatiha BEKHOUCHE<sup>2</sup>

<sup>1</sup> Cellular Toxicology Laboratory, Department of Biology, Faculty of Sciences, University Badji Mokhtar of Annaba, Annaba, Algeria.

<sup>2</sup> Laboratory of Plant Biology and Environment, Department of Biology, Faculty of Sciences, University Badji Mokhtar of Annaba, Annaba, Algeria.  
y\_bedouh@yahoo.fr

**Abstract:** In this work we have realized a test on onion (*Allium cepa*) in order to check the effects of treated water on some natural substances. Two treatments were chosen, firstly irrigation by treated wastewater, compared to a second one which is with treated water as a “check”. The tests concerned the chlorophyll content, soluble sugar and proline. We have found that, the total chlorophyll content has been superior in the treated plants. This shows the ability of plants to react favourably under worn water irrigation. The soluble sugars, were often taken as reference's tolerance, to abiotic stress, were accumulated more than at leaves and roots level of the treated plants. The content of proline at the leaves and roots of the treated plants were superior to check, leading to the probable explanation that there is an ability of the cultivars to sustain abiotic conditions. Eventhough the results that have been obtained are somewhat positive in the expression of the varieties, a wareness has to be considered. Numerous studies and experiments have permitted these last decades, to establish standards more and more precise when it comes to deal with treated wastewater in agriculture purpose.

**Key words:** Treated water, Chlorophyll, Soluble sugar, Proline, Abiotic stress, Tolerance.

## Introduction

Nowadays water is beaming more and more rare and especially in African countries that's why we are supposed to conserve it and to use it with more care; but unfortunately people have found a new source for their needs even if it is a wrong one which is “untreated wastewater” used in irrigation of crops by 10%worldwide, according to a first study on irrigation wastewater (Scott et al, 2004).

This practice is often hidden and which is banned in many countries. But Algeria has experienced in recent decades, rapid population growth, massive urbanization and development of industrial activities, which generated significant production of wastewater, especially in urban centers. The volume of wastewater discharged through the sewer is estimated at nearly 660 million m<sup>3</sup> per year; only 18% undergo a purification process part (Bouziani, 2000).

The wastewater is a significant potential resource, are totally lost every year and almost no strategy is developed for recovery. Capacity for wastewater treatment is very low. The agglomerated population connected to a sewage treatment plant is only 8% in Algeria (INESGA, 1994).

There is a significant shortfall in provision of infrastructure purification (Bent, 1996). In consequence the lack of drinking water would push farmers to use wastewater from urban development, agriculture and industry for irrigation of vegetable crops, including onions, in the region of Guelma (Eastern Algeria).

This study aims to determinate the impact of wastewater on some physiological and biochemical parameters of onion (*Allium cepa*).

## Materials and methods

In order to dose: the DBO<sub>5</sub>, DCO, MES, orthophosphates, nitrates and nitrites: Cereals onion are planted in pots 8at 9 plants / pot are irrigated with wastewater from the city of Guelma. Nine other pots were, prepared under the same conditions, are irrigated with tap water and used as check. Irrigating place every 3 days at a rate of 300 ml of water per each pot.7 leaf stages, samples of leaves, stems and roots are made for different analysis: Soluble sugars, proline and total protein.

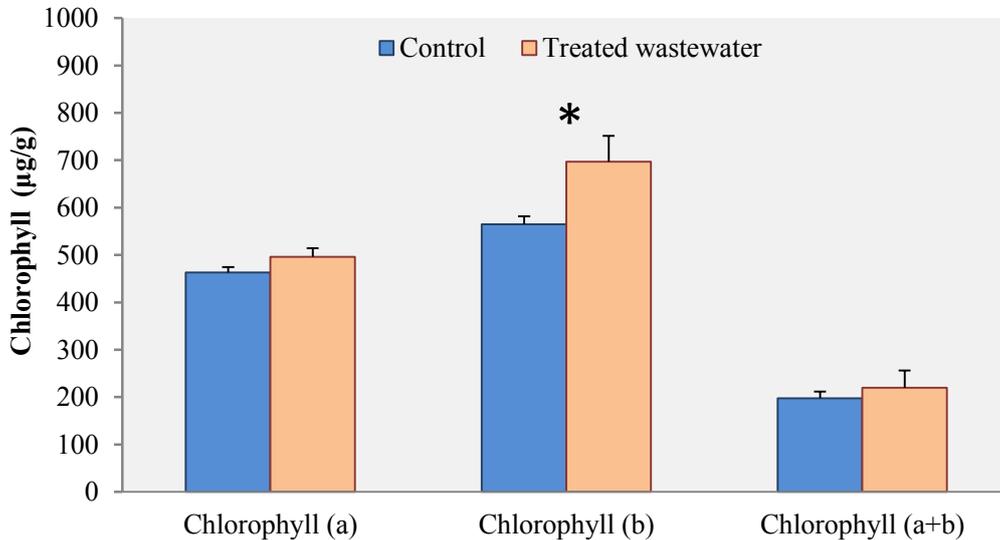
Chlorophyll contents were spectrophotometrically determined. For this purpose, onion leaves were cut into small pieces with a shredder. Then 1 gram shredded sample was taken and pest led in 80% of acetone and filtered with coarse filter paper. This liquid was completed up 10 ml with 80% of acetone. Then these samples were placed in a spectrophotometer (Arnon 1949).

The determination of soluble sugars was carried out using the method of (Schields and Burnett 1960), it is also called the method of anthrone in sulfuric acid medium. Proline was quantified using the technique of Troll and Lindsley (1955) simplified and developed by Dreier (1973) and amended by Monneveux and Nemmar (1987). The total proteins

were assayed by the method of Bradford (1976).

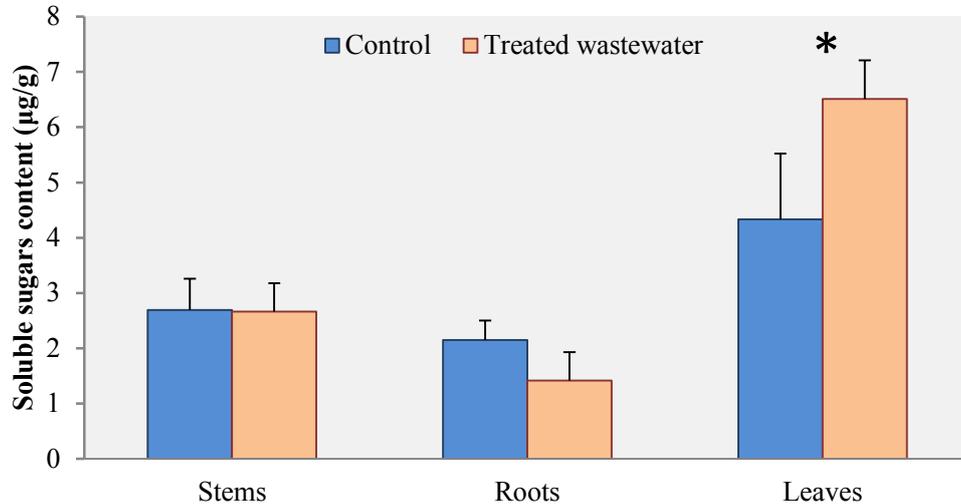
All collected data in this study were subjected to analysis of variance (ANOVA) appropriate for a split plot design. Mean separation of treatments was accomplished using Least Significant Difference (LSD) test. Probability levels lower than 0.05 or 0.01 were held to be significant. MSTAT-C statistical analysis software was used to analyze data (Dagnelie, 1998).

## Results



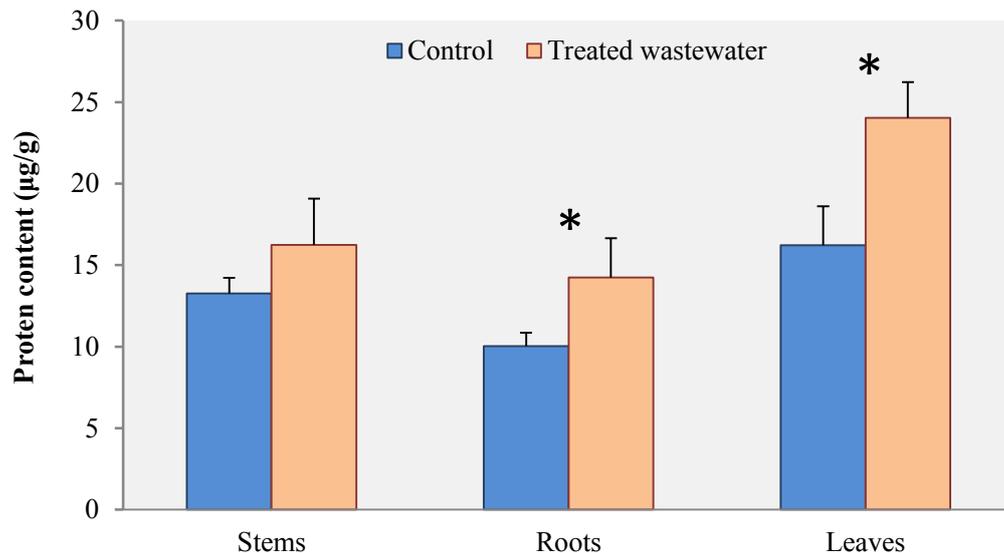
**Figure 1:** Effects of treated wastewater on chlorophyll (a), (b) and (a + b) in Cotyledon fall stage.

- The mean levels of chlorophyll (a), chlorophyll (b) and chlorophyll (a + b) are less important in the control plants than plants treated with sewage.



**Figure 2** Effects of wastewater on the content of soluble sugars in Cotyledon fall stage.

- The average content of soluble sugars in the control is higher than that of plants irrigated with water from the city of Guelma.



**Figure 3:** Effects of wastewater on the total protein content of onion in Cotyledon fall stage.

- For total protein, in the leaves, it was recorded a higher content in plants treated with wastewater compared to control plants.

## Discussion

The physico-chemical analyses of wastewater from the city of Guelma have shown that some of the results meet usually accepted.

According to Slater (1974), pollution by sewage increases the resistance to penetration of molecules of the atmosphere. On the other hand, soluble sugars play a protective role. These simple sugars are involved in the mechanisms of adjustment and stress tolerance.

Proline is an amino acid in water and soluble in alcohol and readily oxidized by ninhydrin. It accumulates in the plant when metabolic control is disrupted by adverse environmental conditions. Proline is known as a biomarker (Lagadic et al., 1997). Its content varies depending on the species and can be accumulated at high levels in tolerant species (Driouich et al., 2001). We observed an increased rate of proline in stems and roots in plants irrigated with wastewater, compared to the control ones. In contrast, in leaves, proline content is higher in the control.

The total proteins in stems show a higher content in plants treated with wastewater compared to control plants. In this case, the amount of protein increases to form the enzymes that play a fundamental role in the attack of pollutants in the cell (the role of self-defense).

According to Senderman (1982), in the presence of external factors such as water, the plant increases its protein synthesis, particularly phytochelatin, whose role is detoxification. In contrast, in stems and roots, total protein content is high for the plants watered with wastewater compared to those irrigated with tap one.

## Conclusion

Soluble sugars, are used as a repository of abiotic stress tolerance, they have been accumulated much more in plants irrigated with tap water. For total protein content is higher in treated plants compared to the control level of the stems. The proline content is higher in plants irrigated with water from the city of Guelma compared to the control level of stems and roots.

Osmoprotectors, such as free proline and soluble sugars have increased with abiotic stress. This enables us to confirm tolerance role or adaptative pathway.

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# IMPROVED EXPONENTIAL ESTIMATORS IN DOUBLE SAMPLING

Hulya Cingi and Nilgun Ozgul

Hacettepe University, Department of Statistics, Beytepe, 06800, Ankara, Turkey.

e-mails : [hcingi@hacettepe.edu.tr](mailto:hcingi@hacettepe.edu.tr);

[nozgul@hacettepe.edu.tr](mailto:nozgul@hacettepe.edu.tr)

**Abstract:** The use of auxiliary information in sample survey results in considerable improvement in the precision of estimators of population mean. Many sampling schemes depend on the population information about the auxiliary variable. When information on the auxiliary variable is not available, double sampling scheme is used. When obtaining information on the auxiliary variable, this sampling method is cost-effective and more preferable in application. In this paper we propose exponential estimators using auxiliary variable(s) for estimating the finite population mean in double sampling. The mean square error (MSE) equations of the proposed estimators are obtained and comparison is made with some of existing estimators in both simple random and double sampling. We find theoretical conditions that the proposed estimators are more efficient than the other estimators. In addition, these conditions are supported by a numerical example. In numerical example, Ministry of National Education data is used. Study variable is the number of students who achieved to enter the university by OSS exam in 2006, first auxiliary variable is the number of high schools and second auxiliary variable is the number of preparation courses for OSS exam.

**Key words:** Double Sampling, Auxiliary variable, Exponential estimation, Efficiency.

## Introduction

In the sampling theory, it is very common to use of auxiliary information to increase the precision of estimators. The ratio and regression methods have been widely used when auxiliary information is available. In the literature, a number of authors introduced many ratio and regression type estimators by using general linear transformation of auxiliary variable. For recent development, exponential estimators are widely studied by authors. Bahl and Tuteja(1991) introduced the exponential ratio and product-type estimators.

However the knowledge on population mean of the auxiliary variable can not be available in every study. When the absence of the knowledge on the auxiliary variable two-phase (double)sampling is the alternative sampling scheme. The two-phase sampling is a powerful and cost effective (economical) procedure for finding the reliable estimate in first phase sample for the unknown parameters of the auxiliary variable  $x$ . Recently, Singh et al(2007) adapted the exponential ratio and product-type estimators in double sampling. We here give the notations about double sampling and various ratio and product estimators of population mean in Section 2. We propose generalized exponential ratio type estimator and regression estimator in Section 3. In Section 4, The proposed estimators are compared with other existing estimators in the literature and the we obtain certain conditions that proposed estimators found to be more efficient than their competitor estimators. In Section 5, the theoretical results are supported by a numerical example. In Section 6, we give conclusions.

## 2. Notations and Various Existing Estimators

Consider a finite population  $U = U_1, U_2, \dots, U_N$  of size  $N$  units. Let  $y$  denotes the study variable taking the values  $y_i$  on the unit  $U_i$  ( $i=1, 2, \dots, N$ ) and  $\bar{Y}$  be its unknown population mean. Let  $(x, z)$  denote the auxiliary variables taking the values  $(x_i, z_i)$  on the unit  $U_i$  ( $i=1, 2, \dots, N$ ) positively correlated with  $y$  and  $(\bar{X}, \bar{Z})$  be its unknown population means.

Its well known that when the population mean of the auxiliary variable is not known double sampling is used. Double sampling is consist of two phase. In the first phase, a sample  $s'$  of fixed size  $n'$  is drawn by random sampling without replacement (SRSWOR) from the finite population to estimate the mean of auxiliary variable. The sample is drawn in the first phase is named primary sample and expressed by  $s'$ . The usual practise is to estimate mean of auxiliary variable by the sample mean. But second auxiliary variable can be used to estimate the mean of auxiliary variable. In this case, both  $x$  and  $z$  are estimated in primary sample. In the second phase, a sample  $s$  ( $s \subset s'$ ) of fixed size

$n$  is drawn SRSWOR from the primary sample( $s'$ ) to estimate the mean of study variable. The sample is drawn in the second phase is named sub sample and expressed by  $s$ .

When information is not available on the auxiliary variable,  $x$ , that is positively correlated with the study variable,  $y$ , the classical ratio estimator is a widely used estimator to estimate the population mean,  $\bar{Y}$ , in two phase sampling as follows:

$$\bar{y}_R = \bar{y} \frac{\bar{x}'}{\bar{x}} \quad (1)$$

Where  $\bar{x}'$  is the primary sample mean of auxiliary variable,  $\bar{y}$  and  $\bar{x}$  are the sub sample mean of study and auxiliary variables, respectively. It is well known that the MSE equation of the classical ratio estimator is given by

$$MSE(\bar{y}_R) \cong \bar{Y}^2 [\lambda C_y^2 + \lambda^* C_x^2 (1 - 2K_{yx})] \quad (2)$$

where  $K_{yx} = \rho_{yx} \frac{C_y}{C_x}$ ,  $\lambda = \frac{1}{n} - \frac{1}{N}$ ;  $\lambda^* = \frac{1}{n'} - \frac{1}{n}$ ,  $n'$  is the primary sample size;  $n$  is the sub sample size,  $N$  is the number of units in the population,  $\rho_{yx}$  is the population correlation coefficient between the auxiliary and the study variables,  $C_x$  and  $C_y$  are the population coefficients of variation of auxiliary and study variables, respectively.

When auxiliary variable,  $x$ , is negatively correlated with the study variable,  $y$ , the product estimator is used to estimate the population mean,  $\bar{Y}$ , in double sampling as follows:

$$\bar{y}_P = \bar{y} \frac{\bar{x}}{\bar{x}'} \quad (3)$$

It is well known that the MSE equation of the product estimator is given by

$$MSE(\bar{y}_P) \cong \bar{Y}^2 [\lambda C_y^2 + \lambda^* C_x^2 (1 + 2K_{yx})] \quad (4)$$

Bahl and Tuteja(1991) suggested the following exponential ratio estimator

$$\bar{y}_{BTR} = \bar{y} \exp\left(\frac{\bar{X} - \bar{x}}{\bar{X} + \bar{x}}\right) \quad (5)$$

and the exponential product estimator

$$\bar{y}_{BTP} = \bar{y} \exp\left(\frac{\bar{x} - \bar{X}}{\bar{X} + \bar{x}}\right) \quad (6)$$

where  $\exp$  is the exponential function. The  $MSE$  equations of these estimator can be given by respectively

$$MSE(\bar{y}_{BTR}) \cong \lambda \bar{Y}^2 \left( C_y^2 - C_{yx} + \frac{1}{4} C_x^2 \right) \quad (7)$$

$$MSE(\bar{y}_{BTP}) \cong \lambda \bar{Y}^2 \left( C_y^2 + C_{yx} + \frac{1}{4} C_x^2 \right) \quad (8)$$

Singh and Vishwakarma (2007) suggested the following modified exponential ratio estimator in double sampling

$$\bar{y}_{SR} = \bar{y} \exp\left(\frac{\bar{x}' - \bar{x}}{\bar{x}' + \bar{x}}\right) \quad (9)$$

and the modified exponential product estimator in double sampling

$$\bar{y}_{SP} = \bar{y} \exp\left(\frac{\bar{x} - \bar{x}'}{\bar{x}' + \bar{x}}\right) \quad (10)$$

The MSE equations of these estimator can be given by respectively

$$\text{MSE}(\bar{y}_{SR}) \cong \bar{Y}^2 \left[ \lambda C_y^2 + \lambda^* (C_x^2 - C_{yx}) \right] \quad (11)$$

$$\text{MSE}(\bar{y}_{SP}) \cong \bar{Y}^2 \left[ \lambda C_y^2 + \lambda^* (C_x^2 + C_{yx}) \right] \quad (12)$$

In sampling literature, the authors rarely consider the exponential estimators in double sampling scheme. For this reason, we improved the exponential estimators proposed in double sampling using the ratio and regression methods in this study.

### 3. Suggested Exponential Estimators in Double Random Sampling

We improve new exponential estimators in double sampling. Firstly, we propose generalized exponential ratio estimator in double sampling using Singh and Vishwakarma(2007) estimators. Secondly, we propose exponential regression estimator with using two auxiliary variables in double sampling.

#### 3.1. Suggested Generalized Exponential Ratio Estimator in Double Random Sampling

Replacing generalized ratio estimator instead of sample mean and combining Singh and Vishwakarma(2007) estimators, given in (9) and (10) we improved a generalized exponential ratio estimator as follows

$$\bar{y}_{CNI} = \bar{y} \left( \frac{\bar{z}'}{\bar{z}} \right)^\gamma \left[ \gamma \exp\left(\frac{\bar{z} - \bar{z}'}{\bar{z} + \bar{z}'}\right) + (1 - \gamma) \exp\left(\frac{\bar{z}' - \bar{z}}{\bar{z}' + \bar{z}}\right) \right] \quad (13)$$

Where  $\gamma$  is any known constant and  $z$  is a transformation of the auxiliary variable  $x$  as  $z = \alpha x + \beta$ .

So we have

$$\left. \begin{aligned} \bar{z}' &= \alpha \bar{x}' + \beta \\ \bar{z} &= \alpha \bar{x} + \beta \end{aligned} \right\} \quad (14)$$

Here  $\alpha (\neq 0)$  and  $\beta$  are either any known constants or functions of any known population parameters of auxiliary variable  $x$  such as standard deviation, coefficient of variation, coefficient of skewness, coefficient of kurtosis, coefficient of correlation, etc.

To obtain the MSE equation for the proposed estimator, we write

$$\bar{y} = \bar{Y}(1 + e_0), \quad \bar{x} = \bar{X}(1 + e_1), \quad \bar{x}' = \bar{X}'(1 + e_1') \quad (15)$$

such that

$$\begin{aligned}
 E(e_0) = E(e_1) = E(e'_1) = 0; E(e_0^2) = \lambda C_y^2, E(e_1^2) = \lambda C_x^2, E(e'_1{}^2) = \lambda' C_x^2 \\
 E(e_0 e_1) = \lambda \rho_{yx} C_y C_x, E(e_0 e'_1) = \lambda' \rho_{yx} C_y C_x, E(e_1 e'_1) = \lambda' C_x^2
 \end{aligned}
 \tag{16}$$

Where  $\lambda' = \frac{1}{n'} - \frac{1}{N}$

Expressing (13) in terms of e's we have

$$\begin{aligned}
 \bar{y}_{CNI} &= \bar{Y}(1 + e_0) \left( \frac{1 + \theta e'_1}{1 + \theta e_1} \right)^\gamma \left[ \gamma \exp\left( \frac{\alpha \bar{X}(e_1 - e'_1)}{\alpha \bar{X}(e_1 + e'_1 + 2) + 2\beta} \right) \right. \\
 &\quad \left. + (1 - \gamma) \exp\left( \frac{\alpha \bar{X}(e'_1 - e_1)}{\alpha \bar{X}(e_1 + e'_1 + 2) + 2\beta} \right) \right] \\
 &= \bar{Y}(1 + e_0)(1 + \theta e'_1)^\gamma (1 + \theta e_1)^{-\gamma} \left[ \gamma \left( 1 + \theta(e_1 - e'_1) + \frac{\theta^2}{2}(e_1^2 - e'_1{}^2) \right) \right. \\
 &\quad \left. + (1 - \gamma) \left( 1 - \theta(e_1 - e'_1) - \frac{3\theta^2}{2}(e_1^2 - e'_1{}^2) \right) \right]
 \end{aligned}
 \tag{17}$$

Where  $\theta = \frac{\alpha \bar{X}}{\alpha \bar{X} + \beta}$

Assuming  $|e_1| < 1$ , expanding the right hand side of (17) and retaining terms up to second degree of e's and we have

$$\begin{aligned}
 \bar{y}_{CNI} - \bar{Y} &= \bar{Y} [e_0 - \theta(1 - \gamma)(e_1 - e'_1) - \theta(1 - \gamma)(e_0 e_1 - e_0 e'_1) - \theta^2 \gamma^2 e_1 e'_1 \\
 &\quad \left\{ \frac{3\theta^2}{2}(1 + \gamma^2) + \theta \gamma \left( \gamma + \frac{5\theta}{2} \right) \right\} e_1^2 + \left\{ \frac{3\theta^2}{2}(1 - 2\gamma) - \theta^2 \gamma \left( \frac{5}{2} \gamma + \frac{1}{2} \right) \right\} e_1'^2]
 \end{aligned}
 \tag{18}$$

Squaring both sides of (18), retaining terms of e's up to second degree and taking expectation, we get the MSE of  $\bar{y}_{CNI}$  to the first degree of approximation, as

$$\begin{aligned}
 \text{MSE}(\bar{y}_{CNI}) &\cong E(\bar{y}_{CNI} - \bar{Y})^2 \\
 &\cong \bar{Y}^2 \left[ \lambda C_y^2 + \lambda^* \theta (\gamma - 1) (\theta (\gamma - 1) C_x^2 - 2C_{yx}) \right]
 \end{aligned}
 \tag{19}$$

Setting  $\frac{\partial \text{MSE}(\bar{y}_{CNI})}{\partial \gamma} = 0$ , we get the optimum value of  $\gamma$  as

$$\gamma = 1 - \frac{K_{yx}}{\theta}, \tag{20}$$

By this way, when  $\gamma$  is replaced in (19), the minimum MSE of the proposed estimator can be written as

$$\text{MinMSE}(\bar{y}_{CNI}) \cong \bar{Y}^2 C_y^2 (\lambda - \lambda^* \rho^2_{yx}) \tag{21}$$

### 3.2. Suggested Exponential Regression Estimator in Double Random Sampling

Replacing regression estimator instead of sample mean and using Singh and Vishwakarma(2007) estimators, given in (9) we improved a exponential regression estimator as follows

$$\bar{y}_{CN2} = [\bar{y} + \gamma_1(\bar{x}' - \bar{x})] \exp\left(\frac{\gamma_2(\bar{z}' - \bar{z})}{\bar{z}' + \bar{z}}\right) \quad (22)$$

Where  $\gamma_1$  and  $\gamma_2$  are any known constants.  $\bar{x}'$  and  $\bar{z}'$  are the primary sample mean of first and second auxiliary variables respectively;  $\bar{y}$  is the sub sample mean of study variable,  $\bar{x}$  and  $\bar{z}$  are the sub sample means of auxiliary variables.

Expressing (22) in terms of e's we have

$$\bar{y}_{CN2} = [\bar{Y}(1 + e_0) + \gamma_1 \bar{X}(e'_1 - e_1)] \exp\left(\frac{\gamma_2 \bar{X}(e'_1 - e_1)}{\bar{X}(e'_1 + e_1 + 2)}\right) \quad (23)$$

Expanding the right hand side of (23) and retaining terms up to second degree of e's and we have

$$\begin{aligned} \bar{y}_{CN2} - \bar{Y} \cong & \bar{Y} \left[ e_0 + \gamma_2 \theta (e'_1 - e_1) + \gamma_2 \theta (e_0 e'_1 - e_0 e_1) + \frac{\theta^2}{2} (\gamma_2^2 + 2\gamma_2) (e_1^2 - e_1'^2) \right] \\ & + \gamma_1 \bar{X} \left[ (e'_1 - e_1) + \gamma_2 \theta (e_1^2 - e_1'^2) \right] \end{aligned} \quad (24)$$

Squaring both sides of (24) and taking expectation, we get the MSE of  $\bar{y}_{CN2}$  to the first degree of approximation, as

$$\begin{aligned} \text{MSE}(\bar{y}_{CN2}) &= E(\bar{y}_{CN2} - \bar{Y})^2 \\ &\cong \bar{Y}^2 \left\{ C_y^2 + \lambda \gamma_2^2 \theta^2 C_x^2 - 2\lambda \gamma_2 \theta K_{yx} C_x^2 \right\} + \lambda \gamma_1^2 \bar{X}^2 C_x^2 \\ &\quad - 2\lambda \gamma_1 \bar{X} \bar{Y} K_{yx} C_x^2 \end{aligned} \quad (25)$$

To minimize  $\text{MSE}(\bar{y}_{CN2})$ , we have the following equations:

$$\frac{\partial}{\partial \gamma_i} \{ \text{MSE}(\bar{y}_{CN2}) \} = 0; \quad i = 1, 2 \quad (26)$$

Solving these two equations simultaneously, the optimum values of  $\gamma_1$  and  $\gamma_2$  are respectively,

$$\gamma_1 = \frac{\bar{Y} K_{yx} - K_{yz} K_{zx}}{\bar{X} (1 - \rho_{xz}^2)} \quad (27)$$

$$\gamma_2 = \frac{K_{yz} - K_{yx} K_{xz}}{(1 - \rho_{xz}^2) \theta} \quad (28)$$

Where  $K_{yx} = \rho_{yx} \frac{C_y}{C_x}$ ,  $K_{yz} = \rho_{yz} \frac{C_y}{C_z}$ ,  $K_{xz} = \rho_{xz} \frac{C_x}{C_z}$ ,  $K_{zx} = \rho_{xz} \frac{C_z}{C_x}$ .

By this way, when  $\gamma_1$  and  $\gamma_2$  are replaced in (25), the minimum MSE of the proposed estimator can be written as

$$\text{MinMSE}(\bar{y}_{CN2}) \cong \bar{Y}^2 C_y^2 (\lambda - \lambda^* R^2_{x,yz}) \quad (29)$$

where  $R^2_{x,yz} = \frac{\rho_{yz}^2 + \rho_{yx}^2 - 2\rho_{yx}\rho_{yz}\rho_{xz}}{1 - \rho_{xz}^2}$ .

#### 4. Efficiency Comparisons in Double Sampling

In this section, we obtain the efficiency conditions for the proposed estimators by comparing the MSE of the proposed estimators with the MSE of the sample mean, traditional ratio estimator, product estimator and the ratio and product estimators suggested by Bahl and Tuteja (1991) and Singh and Wishvakarma(2007).

We first compare the MSE of the proposed estimator  $\bar{y}_{CNI}$ , given in (21), with MSE of the existing estimators  $\bar{y}$ ,  $\bar{y}_R$ ,  $\bar{y}_P$ ,  $\bar{y}_{BTR}$ ,  $\bar{y}_{BTP}$ ,  $\bar{y}_{SR}$ ,  $\bar{y}_{SP}$ .

It is well known that under simple random sampling without replacement (SRSWOR) the variance of the sample mean is

$$V(\bar{y}) = \lambda \bar{Y}^2 C_y^2. \quad (30)$$

From (30) and (21), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CNI}) &< V(\bar{y}) \\ \lambda^* \bar{Y}^2 C_y^2 \rho_{yx}^2 &> 0 \end{aligned} \quad (31)$$

The condition (31) is always satisfied, the proposed estimator  $\bar{y}_{CNI}$  is always more efficient than the sample mean.

From (2) and (21), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CNI}) &< \text{MSE}(\bar{y}_R) \\ \lambda^* \bar{Y}^2 (C_x - \rho_{yx} C_y)^2 &> 0 \end{aligned} \quad (32)$$

The condition (32) is always satisfied, the proposed estimator  $\bar{y}_{CNI}$  is always more efficient than the classical ratio estimator  $\bar{y}_R$ .

From (4) and (21), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CNI}) &< \text{MSE}(\bar{y}_P) \\ \lambda^* \bar{Y}^2 (C_x + \rho_{yx} C_y)^2 &> 0 \end{aligned} \quad (33)$$

The condition (33) is always satisfied, the proposed estimator  $\bar{y}_{CNI}$  is always more efficient than the product estimator  $\bar{y}_P$ .

From (7) and (21), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CNI}) &< \text{MSE}(\bar{y}_{BTR}) \\ \lambda^* K_{yx}^2 &> \lambda \left( K_{yx} - \frac{1}{4} \right) \end{aligned} \quad (34)$$

When the condition (34) is satisfied, the proposed estimator  $\bar{y}_{CNI}$  is more efficient than Bahl and Tuteja(1991) exponential ratio estimator  $\bar{y}_{BTR}$ .

From (8) and (21), we have the condition

$$\text{MSE}(\bar{y}_{CNI}) < \text{MSE}(\bar{y}_{BTP})$$

$$\lambda^* K_{yx}^2 > \lambda \left( K_{yx} + \frac{1}{4} \right) \quad (35)$$

When the condition (35) is satisfied, the proposed estimator  $\bar{y}_{CN1}$  is more efficient than Bahl and Tuteja(1991) exponential product estimator  $\bar{y}_{BTP}$ .

From (11) and (21), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN1}) &< \text{MSE}(\bar{y}_{SR}) \\ (\rho_{yx} C_y - C_x)^2 + \rho_{yx} C_y C_x &> 0 \end{aligned} \quad (36)$$

The condition (36) is always satisfied, the proposed estimator  $\bar{y}_{CN1}$  is always more efficient than Singh and Vishwakarma(2007) exponential ratio estimator  $\bar{y}_{SR}$ .

From (12) and (21), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN1}) &< \text{MSE}(\bar{y}_{SP}) \\ (\rho_{yx} C_y + C_x)^2 - \rho_{yx} C_y C_x &> 0 \end{aligned} \quad (37)$$

The condition (37) is always satisfied, the proposed estimator  $\bar{y}_{CN1}$  is always more efficient than the Singh and Vishwakarma(2007) exponential product estimator  $\bar{y}_{SP}$ .

We now compare the MSE of the proposed estimator  $\bar{y}_{CN2}$ , given in (29), with MSE of the existing estimators  $\bar{y}$ ,  $\bar{y}_R$ ,  $\bar{y}_P$ ,  $\bar{y}_{BTR}$ ,  $\bar{y}_{BTP}$ ,  $\bar{y}_{SR}$ ,  $\bar{y}_{SP}$ .

From (30) and (29), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN2}) &< V(\bar{y}) \\ \lambda^* \bar{Y}^2 C_{y,x,yz}^2 &> 0 \end{aligned} \quad (38)$$

The condition (38) is always satisfied, the proposed estimator  $\bar{y}_{CN2}$  is always more efficient than the sample mean.

From (2) and (29), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN2}) &< \text{MSE}(\bar{y}_R) \\ \rho_{x,yz}^2 + (1 - 2K_{yx}) C_x^2 &> 0 \end{aligned} \quad (39)$$

When the condition (39) is satisfied, the proposed estimator  $\bar{y}_{CN2}$  is more efficient than the classical ratio estimator  $\bar{y}_R$ .

From (4) and (29), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN2}) &< \text{MSE}(\bar{y}_P) \\ \rho_{x,yz}^2 + (1 + 2K_{yx}) C_x^2 &> 0 \end{aligned} \quad (40)$$

When the condition (40) is satisfied, the proposed estimator  $\bar{y}_{CN2}$  is more efficient than the product estimator  $\bar{y}_P$ .

From (7) and (29), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN2}) &< \text{MSE}(\bar{y}_{BTR}) \\ \rho_{x,yz}^2 + \left(\frac{1}{4} - K_{yx}\right) C_x^2 &> 0 \end{aligned} \quad (41)$$

When the condition (41) is satisfied, the proposed estimator  $\bar{y}_{CN2}$  is more efficient than Bahl and Tuteja(1991) exponential ratio estimator  $\bar{y}_{BTR}$ .

From (8) and (29), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN2}) &< \text{MSE}(\bar{y}_{BTP}) \\ \rho_{x,yz}^2 + \left(\frac{1}{4} + K_{yx}\right) C_x^2 &> 0 \end{aligned} \quad (42)$$

When the condition (42) is satisfied, the proposed estimator  $\bar{y}_{CN2}$  is more efficient than Bahl and Tuteja(1991) exponential product estimator  $\bar{y}_{BTP}$ .

From (11) and (29), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN2}) &< \text{MSE}(\bar{y}_{SR}) \\ \rho_{x,yz}^2 + (1 - K_{yx}) C_x^2 &> 0 \end{aligned} \quad (43)$$

The condition (43) is satisfied, the proposed estimator  $\bar{y}_{CN2}$  is more efficient than Singh and Vishwakarma(2007) exponential ratio estimator  $\bar{y}_{SR}$ .

From (12) and (29), we have the condition

$$\begin{aligned} \text{MSE}(\bar{y}_{CN2}) &< \text{MSE}(\bar{y}_{SP}) \\ \rho_{x,yz}^2 + (1 + K_{yx}) C_x^2 &> 0 \end{aligned} \quad (44)$$

The condition (44) is satisfied, the proposed estimator  $\bar{y}_{CN2}$  is more efficient than Singh and Vishwakarma(2007) exponential product estimator  $\bar{y}_{SP}$ .

Thus, finally we conclude from the efficiency comparisons that the generalized exponential ratio estimator  $\bar{y}_{CN1}$  is always more efficient than the estimator  $\bar{y}$ ,  $\bar{y}_R$ ,  $\bar{y}_P$ ,  $\bar{y}_{SR}$ ,  $\bar{y}_{SP}$ ; also more efficient than the estimator  $\bar{y}_{BTR}$ ,  $\bar{y}_{BTP}$  on certain conditions. The exponential regression estimator  $\bar{y}_{CN2}$  is also more efficient than the existing estimators on certain conditions.

## 5. Numerical Example

We use data taken from Ministry of National Education to compare efficiencies between the existing and proposed estimators in the simple and double random samplings, respectively. The data set consists of 923 districts of Turkey. This data set concerns the number of students who achieved to enter the university by OSS exam in 2006 as

the study variable, the number of high schools as the first auxiliary variable and the number of preparation courses for OSS exam as the second auxiliary variable.

In Table 1, we give some values about the population.

**Table 1** Population Values concerning Y: the number of students who achieved to enter the university by OSS exam in 2006, X: the number of high schools, Z: the number of preparation courses for OSS exam (N=923)

|                    |                     |                     |
|--------------------|---------------------|---------------------|
| $\bar{Y} = 729,46$ | $\bar{X} = 8,30$    | $\bar{Z} = 2,87$    |
| $S_y^2 = 2808381$  | $S_x^2 = 148,908$   | $S_z^2 = 113,236$   |
| $C_y = 2,2973$     | $C_x = 1,4699$      | $C_z = 3,7073$      |
| $\rho_{yx} = 0,93$ | $\rho_{yz} = 0,733$ | $\rho_{xz} = 0,667$ |

We compute the MSE values of sample mean, classical ratio estimator, Bahl-Tuteja(1991) estimator, Singh and Vishwakarma(2007) estimator and proposed estimators using the equations (2), (7), (11), (21) and (29) respectively. We could not compute the MSE values of product estimators  $\bar{y}_p, \bar{y}_{BTP}, \bar{y}_{SP}$  because of the positive correlation between the study variable and auxiliary variable. Using these MSE values we compute the relative efficiency for the estimators, say  $\hat{Y}$ , with respect to the sample mean by

$$RE(\hat{Y}) = \frac{MSE(\bar{y})}{MSE(\hat{Y})}, \quad \hat{Y} = \bar{y}, \bar{y}_R, \bar{y}_{BTR}, \bar{y}_{SR}, \bar{y}_{NC1}, \bar{y}_{NC2} .$$

These relative efficiency values are shown in Table 2. Applying double sampling, we use various sample sizes to see the relative efficiency values of the estimators related to sample size.

We observe that the most efficient estimator is the proposed exponential regression estimator and after the most efficient estimator is proposed exponential ratio estimator. In addition, we should denote that we use various sample sizes for computing the relative efficiency of estimators and the relative efficiency of proposed estimators increases when the sample size is larger.

**Table 2** Relative efficiency of estimators in double sampling.

| Estimators                               | n'=506 |       | n'=765 |       |
|--|--------|-------|--------|-------|
|  | n=182  | n=350 | n=200  | n=447 |
| sample ( $\bar{y}$ )                     | 100    | 100   | 100    | 100   |
| Classical Ratio ( $\bar{y}_R$ )          | 78     | 110   | 116    | 286   |
| Bahl-Tuteja ( $\bar{y}_{BTR}$ )          | 60     | 133   | 60     | 197   |
| Singh and Vishwakarma ( $\bar{y}_{SR}$ ) | 36     | 75    | 37     | 118   |
| Proposed Est.1 ( $\bar{y}_{NC1}$ )       | 103    | 118   | 166    | 358   |
| Proposed Est.2 ( $\bar{y}_{NC2}$ )       | 108    | 121   | 188    | 384   |

## 6. Conclusion

We improve new ratio and regression estimators using exponential function for the population mean in double sampling using the estimators suggested in Singh and Vishwakarma(2007). Theoretically and numerically, we demonstrate that the proposed estimators in double sampling have the smallest MSE values in certain conditions and for

a specific data set. These proposed exponential estimators also would be adapted to stratified random sampling and the other sampling methods.

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## INDIRECT FIELD ORIENTED CONTROL OF INDUCTION MOTOR (IM) DRIVE USING FUZZY LOGIC CONTROLLER (FLC)

Soud Elabed. H.  
Department of Electrical and  
Electronic Engineering, Faculty of  
Engineering, Almergeb University

Mailef Ali. M.  
General Electrical  
Company of Libya  
(GECOL)  
Misurata-Libya

Abdulmalek Jamal. S.  
Department of Electrical and  
Electronic Engineering, Faculty  
of Engineering, Misurata  
University.

Abdulmalek Jamal. S.  
Department of Electrical and  
Electronic Engineering,  
Faculty of Engineering,  
Misurata University.

**Abstract:** The aim of this paper is to present a new control technique for an induction motor (IM) drive by using fuzzy control. The configuration and design of a fuzzy logic controller of indirect field oriented control of induction motor is investigated. The fuzzy logic controller (FLC) is employed in the outer loop. Different experiments using MATLAB/SIMULINK are demonstrated to achieve the best controller. The performances of the proposed FLC-based IM drive are investigated and compared to those obtained from the conventional PI controller-based drive at different dynamic operating conditions such as sudden change in command speed, step change in load, etc., in order to verify the robust of the fuzzy logic controller.

## INFLUENCE OF (PB-FNSB) ON MECHANICAL PROPERTIES OF PZT CERAMICS

H. Allal<sup>1,2\*</sup>, I. Boudraa<sup>1</sup>, C. Benhamideche<sup>1,2</sup> & M. Poulain<sup>3</sup>

<sup>1</sup>Unité de Recherche Chimie de l'Environnement Moléculaire et Structurale (URCHEMS), Université de Mentouri-Constantine, Route Ain El Bey, Constantine (25000)- ALGERIE.

<sup>2</sup>Département des sciences de la Matière (<sup>2</sup>\*Département de Technologie), Université 20 Aout 1955 Skikda, BP 26 Route d'El-Hadaiek-Skikda, ALGERIE.

<sup>3</sup>Lab. Matériaux Photoniques, Université de Rennes 1, Campus Beaulieu, F-35042 Rennes, FRANCE.

**Introduction:** Lead zirconate titanate  $Pb(Zr_xTi_{1-x})O_3$  piezoelectric ceramics are one of the most used industrial piezoelectric materials. The compositions close to the morphotropic phase boundary (MPB) have been extensively exploited [1]. The excellent piezoelectric properties make it a promising material for ferroelectric memory, actuator, optoelectronic, and electromechanical transducer applications. However, these extensive properties are dependent primarily, on their chemical composition and, in particular, on the Zr/Ti concentration ratio and the presence of impurities (Doping), such additions improve the properties of PZT and in some cases decrease their aging effect, the ions of  $Pb^{+2}$ ,  $Zr^{+4}$  and  $Ti^{+4}$  were partly substituted by other ions. Today, industry is increasingly focusing on micro devices we need information on the mechanical properties, such as the Young's modulus [2]. The goal of our investigation was to study the effect of doping on the elastic properties.

The general formula of the materials studied was  $Pb(Zr_xTi_{1-x})O_3 - 0.1Pb(Fe, Ni, Sb)O_3$  or PZT-PbFNSb, with  $x = 0.47, 0.46, 0.45, 0.44, 0.43, 0.41$  and  $0.39$ . Reagent-grade oxide powders,  $Pb_3O_4$ ,  $ZrO_2$ ,  $TiO_2$ ,  $Fe_2O_3$ ,  $NiO$  and  $Sb_2O_5$  among the given composition, were weighted by mole ratio and the powders were mixed using a conventional method of sintering. This process is similar to those employed in the preparation of the perovskite-like PZT-PFNSb powders as described [3], The powders were pressed into 12 mm in diameter and 1.5 mm thick pellets under 150 MPa, which were sintered at various temperatures from 950°C to 1180 °C for 3<sup>h</sup> in lead-protected atmosphere.

The densitie of sintered samples were measured by helium pycnometer (AccuPyc 1330 Micromeritics). The crystallographic structure of the samples was examined by powder X-ray diffraction (XRD). The average of PZT grain size was determined by the linear intercept method from the SEM image of the surfaces of thermally etched samples. The Fourier

Transform Infrared Spectroscopy (FTIR) was used in order to identifying types of chemical bonds. We have analyzed by acoustic microscopy, the longitudinal and transverse velocity to reach the elastic properties (Young's modulus, Poisson's coefficient, Compressibility and coefficient of Columbus) of PZT-PbFNSb material.

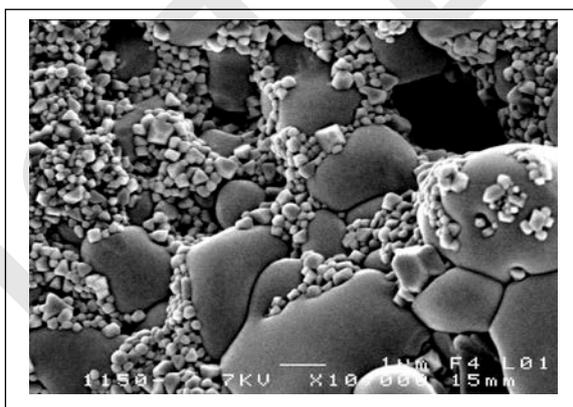


Figure : Microstructure of PZT-PbFNSb ceramic.

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# INFLUENCE OF FERMENTATION CONDITION & ALKALI TREATMENT ON THE POROSITY AND THICKNESS OF BACTERIAL CELLULOSE MEMBRANES.

Elham Esmael Al-Shamary

Amir Khalaf Al-Darwash

Department of Food Science, College of Agriculture, University of Baghdad, Baghdad, Abu-Ghraib,

Contact person: e-mail: amirkaldarwash@yahoo.com

**Abstract:** The object of the present study was to produce bacterial cellulose (BC) membranes and studying the effect of carbon source, time and conditions of inoculation, type of alkali used for purification and the method of drying on its porosity and thickness of the resultant membranes. *Acetobacter xylinum* was isolated from local rotten juice, and used for membrane production.

The highest porosity was attained when sucrose was used as a source of carbon compared to glucose, fructose and glycerol. However, fructose, glucose and glycerol resulted in higher pH value for the medium used as medium for bacterial growth. Using glycerol as the sole carbon source gave the highest bacterial cellulose and biomass (g/l) as compared to glucose, fructose and sucrose. Small inoculation led to high porosities and lowest thickness of the resultant membranes. Porosity of membranes was affected by the type of alkali used for the purification of the membranes. Application of  $K_2CO_3$  for purification gave the highest porosity while NaOH gave the lowest porosity. Hot air-drying of the membrane resulted in the lowest porosity as compared with freeze drying method which did not cause any damage to the porosity of the membrane.

**Key words:** Bacterial cellulose membrane, Thickness and porosity, *Acetobacter xylinum*

## Introduction:

Bacterial cellulose is a promising natural polymer belongs to specific products of primary metabolism (Retegi *et al.* 2010). Cellulose is synthesized by bacteria belongs to the genera of *Acetobacter*, *Rhizobium*, *Agrobacterium*, *Pseudomonas* and *Sarcina* (Vu *et al.* 2008). Many strain of *A. xylinum* are capable of producing cellulose in varying amounts and growing on wide varieties of substrates like glucose, sucrose, fructose, invert sugar, ethanol and glycerol (White and Brown 1989). Cellulose production by *A. xylinum* had been noted both in static as well as agitated cultures (Chao *et al.* 2000). The most efficient producer is gram-negative and acetic acid bacteria, *Acetobacter xylinum* (reclassified as *Gluconobacter xylinum*) (Yamanaka *et al.* 2000). The bacteria was applied as a model microorganism for basic and applied studies on cellulose. *Acetobacter xylinum* is widely distributed in nature and is a common contaminant in the industrial production of vinegar by *Acetobacter aceti*. *Acetobacter xylinum* has been isolated from rotting fruits, vegetables and by fermenting coconut water (Jagannath *et al.* 2008).

Presently BC is receiving great attention and being widely investigated as a new type of scaffold material due to its fine fiber net work, biocompatibility, high water holding capacity, high tensile strength (Putra *et al.* 2008), high crystalline, high degree of polymerization, high purity, elasticity, durability, non-toxic and non-allergic (Hei, 1999, Backdahl *et al.* 2006, Sherif and Kazuhiko 2006, El-Saied *et al.* 2008, Liet *et al.* 2009, Marzieh and Ali 2010, Denise *et al.* 2011).

In food applications the BC was used as an additive, emulsifier, dietary fiber, edible preservative and as a barrier against bacterial growth (Pacheco *et al.* 2004, Denise *et al.* 2011). Recently, BC is used in many special applications such as a scaffold for tissue engineering of cartilages and blood vessels (Yamanaka *et al.* 1990, Klemm *et al.* 1999, 2001), as well as for artificial skin for temporary covering of wounds (Krystynowicz and Bieleck 2001). Purified and dried BC was converted to a membrane to be used in the separation processes such as ultrafiltration, gas permeation and vapor permeation, and used in paper manufacture (Luz *et al.* 2006, Kuan *et al.* 2009). We believe that culture conditions such as type of strain, temperature of growth, carbon source, pH and the method of gel purification whether it is done by chemical agent, concentration, temperature or exposition time possibly affected the physical properties of the resultant membranes.

The aim of the present work was to evaluate the effect of growth conditions and the methods of purification on some of physio-chemical and transparent properties of the resultant membranes.

## Materials and Methods:

### 1- Stock culture

The organism exploited for the production of cellulose in this study was a strain of *Acetobacter xylinum* AJ<sub>3</sub>, which was isolated from local rotten apple juice. The cultures were maintained on tomato agar slants and were reactivated every month.

Tomato medium was composed of 50 g/l glucose, 5g/l peptone, 5g/l yeast extract and 10% by volume tomato juice at pH 6.8. Stock cultures were stored at 5°C according to Marzieh and Ali (2010).

### 2- Inoculums preparation

A culture medium composed of 5% glucose, 0.5% peptone, 0.5% yeast extract, 0.27% sodium phosphate monobasic and 0.12% citric acid. This medium was autoclaved at 121°C for 15 minutes. After cooling to room temperature, the medium was inoculated with 2.5 ml of the stock culture and incubated in a shaker incubator with the use of 200 rpm set at 30°C for 24h and pH 6.8. The organisms were harvested by centrifugation at 10000 rpm for 30 min and re-suspended in liquid medium to prepare the suspension of bacteria.

### 3- Membranes formation

Membranes were prepared using different carbon sources including glucose, fructose, sucrose or glycerol (35g/l) with 10g/l yeast extract, 7.5g/l peptone, 10g/l disodium phosphate and 10 ml/l acetic acid. The media was autoclaved at 121°C for 15 minutes, inoculated with 6% of the previously prepared bacteria and incubated at 30 °C for 8 days.

The effect of incubation period was studied using mediums contained glucose as carbon source using 6% of inoculation volume from the fermentation medium after (2, 4, 6, and 8) days. Membranes were also prepared using different percentages of inoculums (2, 4, 6, and 8%). Yield of cellulose, porosity and thickness of the resultant bacterial cellulose membranes were studied. The pH values for each medium were measured during fermentation.

### 4- Purification

After 8 days of cultivation, BC was harvested and purified by soaking in a solution of 0.5N NaOH at 90°C for 1h to remove the bacterial cell and other medium components. Then after, membranes were purified by Sodium hydroxide, potassium hydroxide, sodium carbonate or potassium carbonate to study its effect on porosity of membranes. The purified bacterial cellulose membranes were then dried either in an air- drying oven at 80°C or by freeze- drying. Porosities of the dried bacterial cellulose membranes were determined, for membranes dried by either hot air or freeze drying methods.

## Analytic methods:

### 1- Measurement of biomass

After the incubation periods, the culture broth was centrifuged at 3000 g for 20 min. The bacterial cellulose pellets were added to 90ml (0.1M) potassium acetate buffer (pH 5). Ten ml of 20% cellulose solution was added and incubated at 50°C with shaking at 100 rpm for 2h to hydrolyze BC (Kouda *et al.* 1997). Then, the resultant solution was centrifuged at 3000 g for 20 min. The precipitate was dried in an oven at 80°C over night and then weighted to determine the biomass.

### 2- Porosity

Porosity was calculated using the equation of Kidaoka *et al.* (1997):-

$$\text{Porosity}\% = (\text{wet weight} - \text{dry weight}) / (\text{wet weight} - \text{weight in water}) \times 100.$$

Dried bacterial cellulose membranes were soaked in deionizer water for more than 12h at room temperature, and the weight in water was measured by harnessing the sample in advice which suspended the sample in water (Mancini *et al.* 2001).

### 3- Thickness

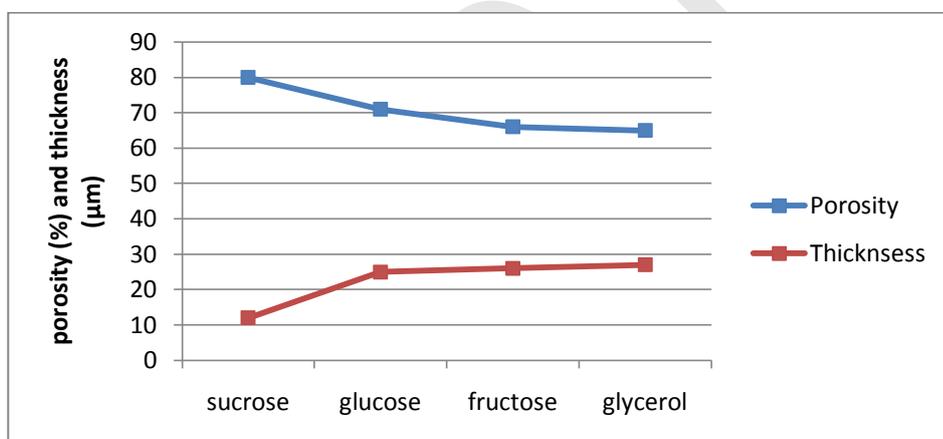
Thickness of each bacterial cellulose membrane was measured at ten different positions by a thickness gauge, and the values were averaged.

## Results and discussion:

### Effect of carbon sources on porosity of bacterial cellulose membranes

Figure (1) showed that the highest porosity (80%) of BC membrane was attained when sucrose was used as a source of carbon as compared to glucose, fructose and glycerol which gave lower percentage of porosity 70%, 66% and 65%, respectively. Nakai et al.(1991) warranted that because *A. xylinum* has no sucrose synthetase, therefore, at least four enzymatic steps in the path way from sucrose to get UDP- glucose. On the other hand using sucrose as the sole of carbon source led to limited growth of bacteria as compared to glucose (Table 1). Fewer amounts of microfibrils were produced, which explains the least cell mass, the lowest thickness with highest porosity. Bacterial cellulose membrane had the lowest porosity when glycerol was used as the sole carbon source. Table (1) showed that the lowest pH was attended when sucrose was used as a carbon source. However, fructose, glucose, and glycerol resulted higher pH values proportionally.

When glycerol was used as a source of carbon there might be no gluconic acid production during glycerol metabolism (Jonas and Farah 1998). It was found that when glycerol was used as the sole carbon source, the BC and biomass (g/l) were higher as compared with other carbon sources. The fibrils of BC from glycerol medium were entangled with each other resulting in a denser reticulated structure than those obtained from glucose medium (Jung *et al.*2010). When glucose was used as the sole carbon source, the BC yield and biomass were higher than that for other remaining carbon source. Due to these results and due to the availability of glucose, it was used as the sole carbon source during the following steps of this study.



**Fig.1 Effect of Carbon source on porosity and thickness of Bacterial Cellulose membrane produced after 8 days of cultivation with 5% (v/v) inoculation Volume .**

Table 1. The effect of carbon source on bacterial cellulose yield and biomass of *Acetobacter xylinum*.

| Carbon source | Bacterial cellulose Yield(g/l) | Biomass (g/l) | Final pH |
|---------------|--------------------------------|---------------|----------|
| Sucrose       | 4.23                           | 2.10          | 3.9      |
| glucose       | 7.52                           | 3.24          | 4.5      |
| fructose      | 7.21                           | 3.10          | 4.1      |
| glycerol      | 8.52                           | 4.50          | 5.2      |

#### Effect of inoculation volume on porosities and thickness of bacterial cellulose membranes

The effect of inoculation size on porosities and thicknesses of BC membranes is shown in figure 2. Small inoculation led to high porosities and lowest thickness of BC membranes. The results showed that the porosities of bacterial cellulose membranes dropped from 78% to 60% with increasing inoculation volume (v/v) from 2 to 8%. The results showed that the cell growth increased with increasing size of inoculums and that led to increasing BC production. Generally, the production of large number of micro fibrils often led to a compact structure and lower porosity for the BC membrane. This indicated the possibility of production of BC membrane which have wide range of porosity depending on the purpose of BC membrane applications.

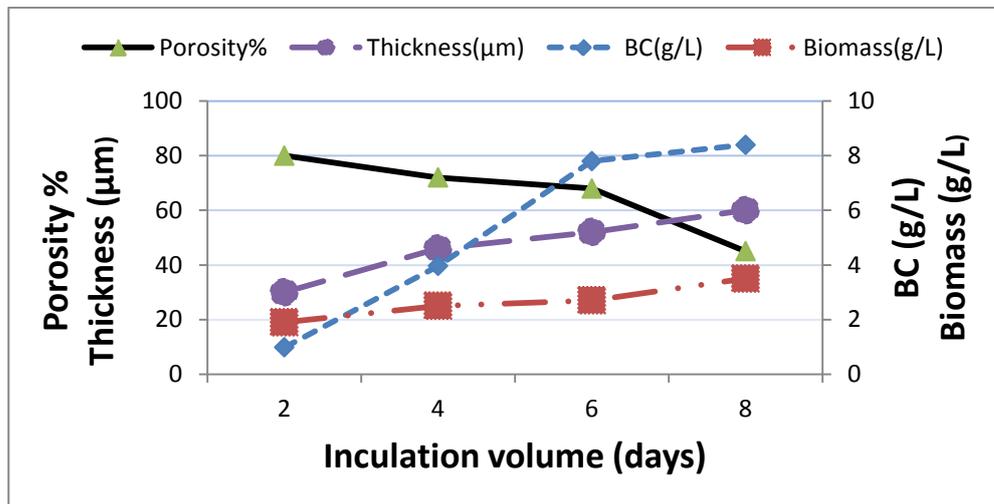


Fig. 2 Effect of inoculation volume on cell growth (Biomass) of *A. xylinum*, porosity, thickness and yields of the bacterial cellulose membranes.

#### The Effect of culture time on porosity and thickness of bacterial cellulose membrane.

Figure 3 showed the effect of culture time on the porosity and thickness of bacterial cellulose membrane. In the first day of cultivation there was no cellulose production. During cultivation, the porosities of bacterial cellulose were decreased successively from the second day to the end of incubation period of 8 days. During cultivation, the yield of BC, cell mass and thickness were increased with increasing time of culture growth, but porosities were decreased due to the accumulation of more fibrils. The secreted cellulose was randomly deposited behind the moving micro-organism to produce certain porosity of cellulose membranes with three-dimensional network. The movement of single cells was caused by the inverse forces of the secretion of cellulose nano fibers. (Hesse and Kondo 2008).

Watanabe and Yamanaka (1995) found that oxygen tension in the gaseous phase under static culture conditions affected network formation of BC, and the density of network in the gelatinous membrane could be controlled. Then by changing oxygen tension we can produce bacterial cellulose membranes with the desired porosities for various applications.

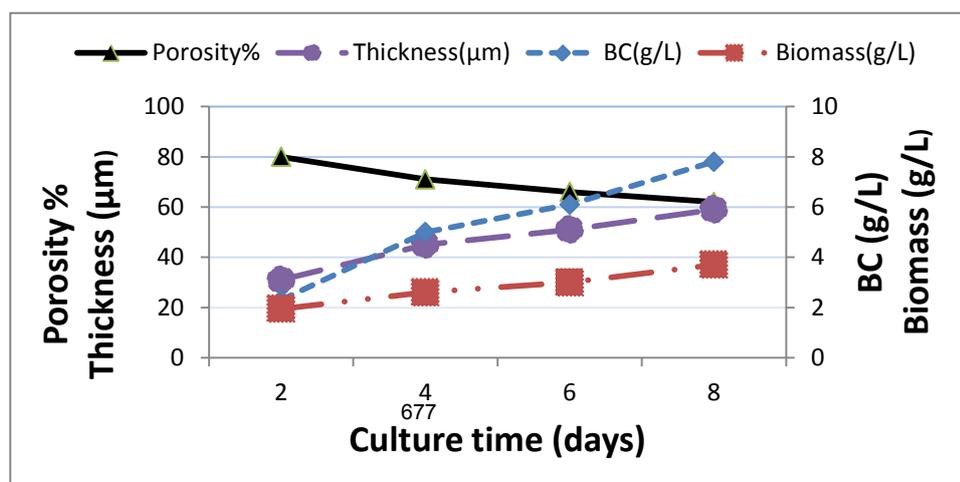


Fig. 3 Effect of culture time on porosity, thickness, yields, of bacterial cellulose

Membranes and cell growth (Biomass) of *A. xylinum* AJ3 with inoculation volume of 6% .

#### Effect of alkali treatment on porosities of bacterial cellulose membranes

Treating bacterial cellulose membranes with various alkaline solutions resulted in increases in the porosity of the membranes (Figure 4). These results indicated that the diameter of membrane's fibrils were affected by alkaline solution in a degree depending on of alkaline solution. Porosities of bacterial cellulose membranes were found to be depending also on the type of alkaline solution and it showed different porosity arranged in descending as  $K_2CO_3 > Na_2CO_3 > KOH > NaOH$ . The diameter of NaOH – treated ribbons of BC which had the lowest porosity was in a range of 45 – 130 nm, while for  $K_2CO_3$  treated ribbons of BC had the highest porosity and was in a range of 25 – 110 nm. Differences in porosities of BC treated with different alkali probably gave higher swelling fibrils of BC. These results were due to increases in diameter of fibrils especially the membrane that was treated with NaOH, thus effective pore size available in the membranes. (George et al. 2005, Brigid et al. 2009, Weihua et al.2010).

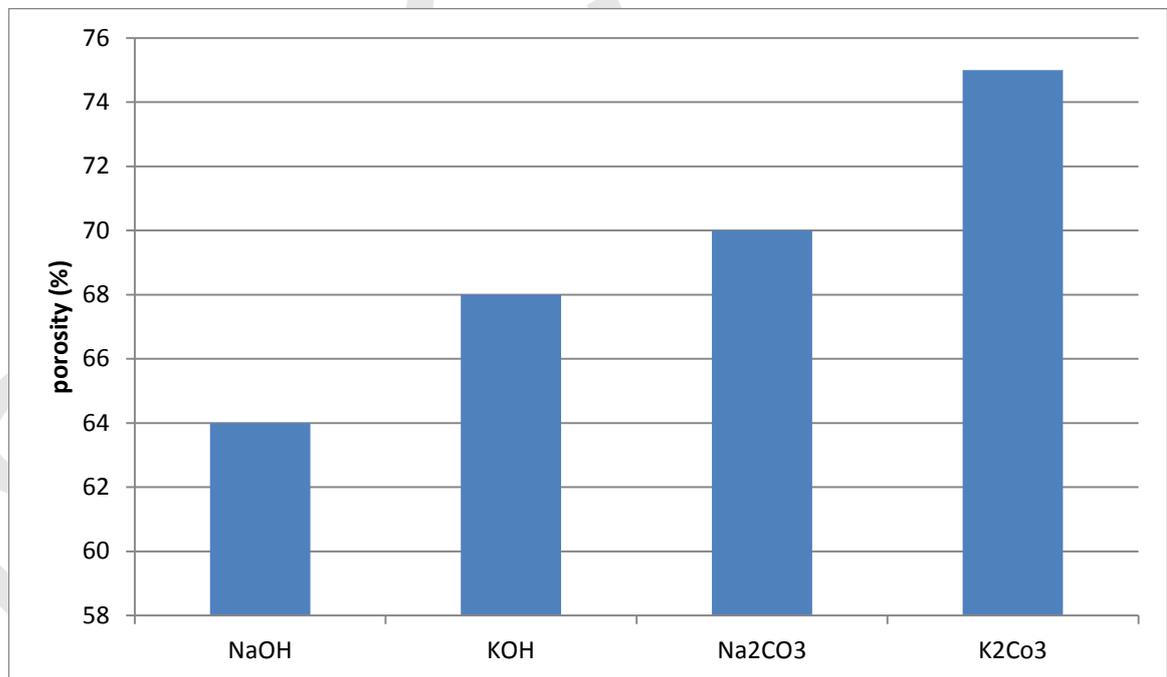
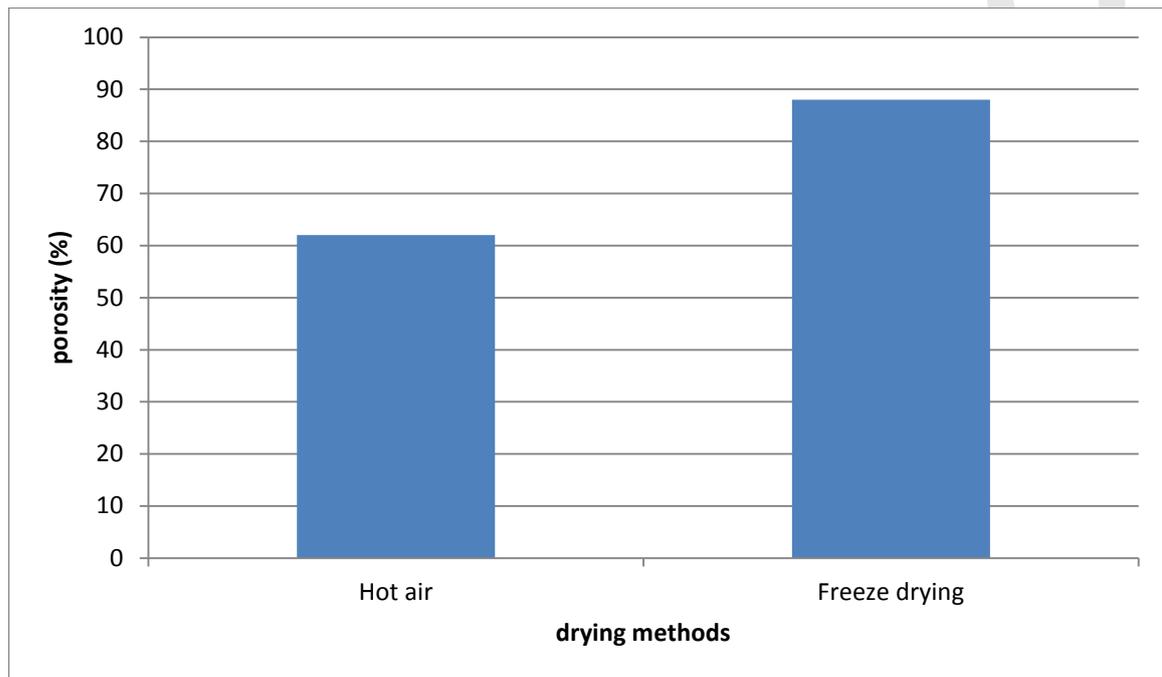


Fig-4- Porosity of bacterial cellulose membrane treated with different alkali solution.

**Effect of drying method on porosities of bacterial cellulose membranes:**

Method of drying of BC membranes affected porosity of the membrane. Membranes which were dried by hot air had the lowest porosity (62%) as compared to freeze – drying method (88%) (Fig. 5). Freeze – drying was effective in preventing the shrinkage of pores during drying (Marabi and Saguy 2004, Svensson *et al.* 2008). The collapse was very severe when hot air drying was used for drying of the high water content materials of the membrane, while the collapse was usually negligible when freeze drying method was used for drying similar membranes (Karathanos *et al.* 1996).



**Fig. 5 Effect of drying method on porosity of bacterial cellulose membranes.**

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# INFLUENCE OF HEAT TREATMENT ON WEAR OF MATERIALS COUPLE OF STEEL (ROLLER-RAIL)

A. Elhadi\*, A. Bouchoucha\*\*

\* Department of Mechanical Engineering, University Msila (Algeria).

\*\* Department of Mechanical Engineering, University Mentouri Constantine (Algeria).

Mobile : 0663445776

E-mail : elha\_di@yahoo.fr

**Abstract** The work is to study the behavior of two couples metal used in industry, at the enterprise level algal (The Algerian company of Aluminium). Especially in lifts where we meet the couple roller (steel XC35 or XC48), in the delivery state (gross) and the rail steel XC55. During operation, the roller wear and replacement is expensive. Our study is to investigate the wear of the roller, using a tribometer (pin- disc) available in the Mechanical Engineering Laboratory at the University of Constantine (Algeria). Wear is studied as a function of heat treatment of the roller. The results of various tests carried out show that heat treatment plays a vital role in changing the hardness of the roller and therefore the operating time of the roller. The discussion is based mainly on observations and microstructural analyzes of interfacial phenomenon a resulting from friction.

Finally we have reached a technical solution that can dramatically reduce a roller wear.

**Keywords** Microhardness, heat treatment, microstructure, wear, surface finish.

## 1. Introduction

Tribology is interested in studying and interpreting scientific experimental facts, it deals with many aspects of friction, lubrication and wear. Note that 11% of total energy consumption of the United States for example, is lost to friction. Stefan Korcek (Ford) and Masami Nakada (Toyota) believe that choosing appropriate technologies necessarily involves the tribology [1]. The friction and wear of friction surfaces resulting result, most often during operation, by geometrical modifications, physicochemical transformations, by material removal or by an increase in temperature. Its aspects, the friction and wear are complex phenomena whose study requires multiple approaches [1,2]. The presence of wear in the body can cause a reduction in the effectiveness of the mechanical system or be responsible for the invalidity of such system [3]. Although the specifies a roller which moves on a rail, a remarkable amount of wear is usually observed in the field of industrial application.

The objective of this work is to study the wear behavior of couples turning XC48/XC55 and XC35/XC55 and taking into account the microstructure and hardness of the roller, using a tribometer type pin- disc.

## 2. Materials used

### 2.1. Material pin

The pin is a steel rod XC35 (140HV) or XC48 (224HV), untreated.

### 2.2 Material disc

The disc is a circular plate steel XC55 treated hardness 45HRC.

## 2.3. Chemical composition of materials

| Acier | Element | C    | Si   | Mn   | P     | S     | Cr   | Mo   | Ni   | Al    |
|-------|---------|------|------|------|-------|-------|------|------|------|-------|
| XC48  | %       | 0,51 | 0,40 | 0,8  | 0,007 | 0,015 | 0,13 | 0,02 | 0,14 | 0,02  |
| XC35  | %       | 0,33 | 0,25 | 0,74 | 0,007 | 0,008 | 0,10 | 0,01 | 0,03 | 0,02  |
| XC55  | %       | 0,54 | 0,43 | 0,70 | 0,03  | 0,03  | 0,15 | 0,02 | 0,06 | 0,008 |

Table 1 : Chemical composition of materials

## 2.4. Experimental equipment

The experimental device is a type TE91 tribometer (Figure 1). The pin is fixed in a hole with a locking screw on a load arm aluminum. It is loaded against a disc by masses of variable weight. The disc is mounted on a base which rotates at variable speeds.



1: Recorder; 2: Display unit; 3 Loading Arm, 4 Load applied; 5 Disc.

Figure 1: TE91 tribometer type.

The figure 2 shows the contact pin-disc and track generated

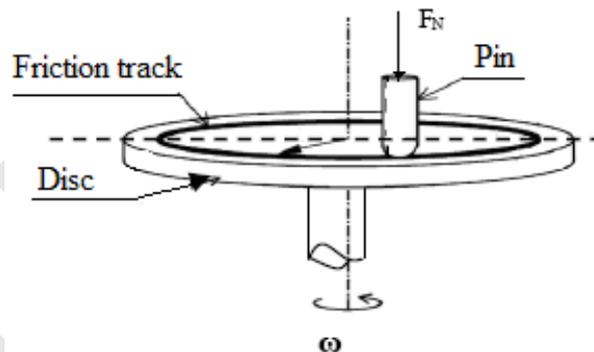


Figure 2: Contact pin-disc.

## 3. Results

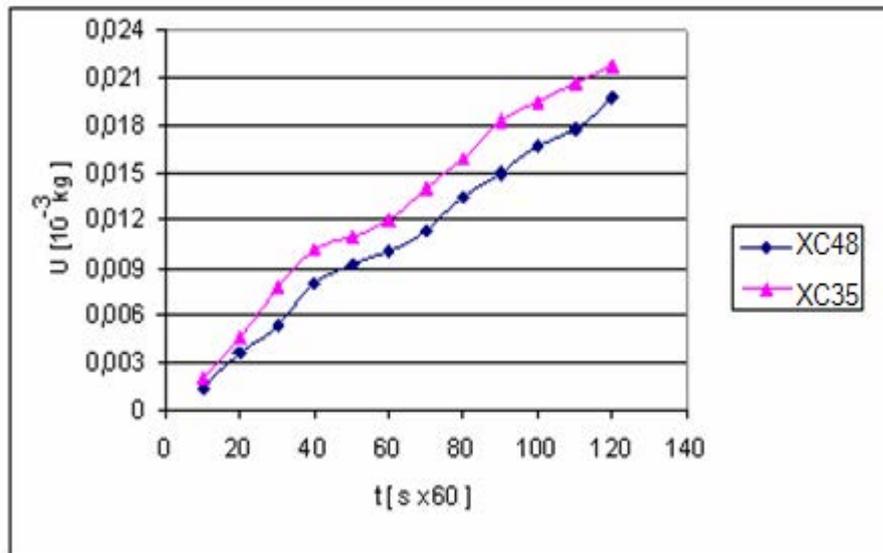
### 3.1. Test procedure

Each test lasts two hours, in an ambient atmosphere. The steels used are couples XC35et XC48 (untreated and treated) with XC55 (treated). The heat treatments performed in our study are the tempering (850 °C for XC35 and 830°C for XC48) and hardening (450 °C).

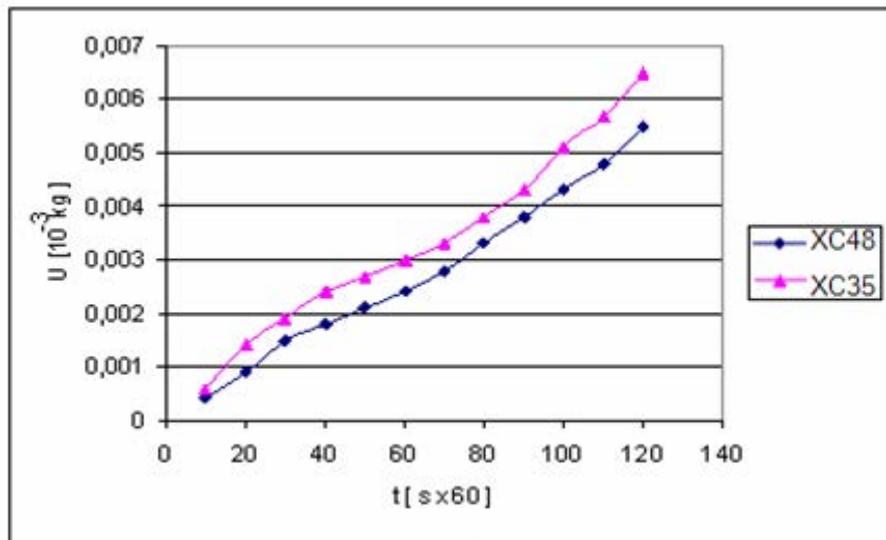
### 3.2. Variation of the wear as a function of time

Note first that for these tests, we maintained the force applied to a value at 13 N, and sliding velocity to a value 0.24 m / s.

The figure 3 gives the variation of the U wear (in mass loss of the pin in  $10^{-3}$  kg). It is seen that all curves have the look identical, they are substantially straight slope characterized during the first 40 minutes, then bend slightly and then return to their initial inclinations after 80 minutes of operation of the tribological system.



(a)



(b)

Figure 3: Evolution of wear: (a) XC35 and XC48 untreated; (b) XC48 and XC35 treated (32HRC).

### 3.3. Effect of hardness on the wear

Were conducted operations in order to have multiple hardness values of the pin (Figure 4).

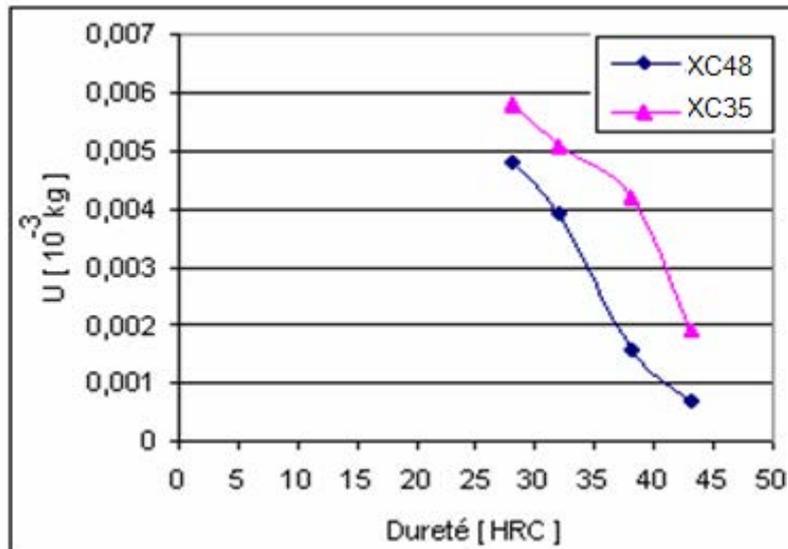


Figure 4: Effect of hardness on the wear of pins ( $N = 13\text{N}$  and  $V = 0.24\text{ m/s}$ ).

Figure 4 shows the variation of wear is inversely proportional to the hardness of the steel used. Note that the steel XC48 has a wear resistance higher than the strength of steel XC35.

#### 4. Discussion of Results

For a load and speed data, the wear  $U$  of the pins is generally a linear function over time (Figure 3). While running at the beginning of sliding, Surface roughness of the couple are rapidly changing. The highest asperities of a rough surface by plastic deformation are crushed and partly torn off. After lapping, the surfaces become almost polished and have small undulations which justifies the slow growth and stationary wear. On the other hand, sees a very smooth surface roughness increase because of plowing by asperities of the because of plowing by asperities of the opposite surface, which will consequently increase again wear.

The increase in mass loss of untreated pins is attributed to their structure feritoperlitique which is characterized by low hardness (Figure 4). Note that the couple has a XC48/XC55 wear resistance higher than the resistance of the couple XC35/XC55.

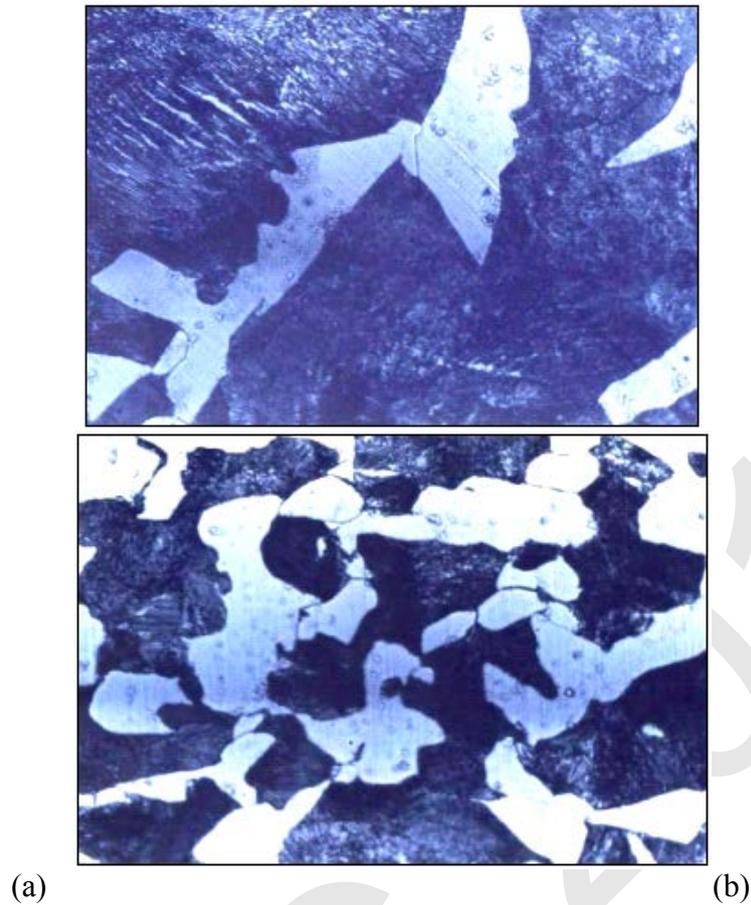


Figure 5: Micrograph of untreated steels: (a) XC48 (b) XC35.

The application of heat treatment (hardening and tempering) increases the hardness of the material and hence the wear resistance. Hardness is based on the microstructure of steels and the percentage of cementite (Figure 6). Martensitic structures obtained after heat treatment shows that as the grains of steel are more for the hardness increases. The wear resistance also increases proportionally with the content of cementite [4].

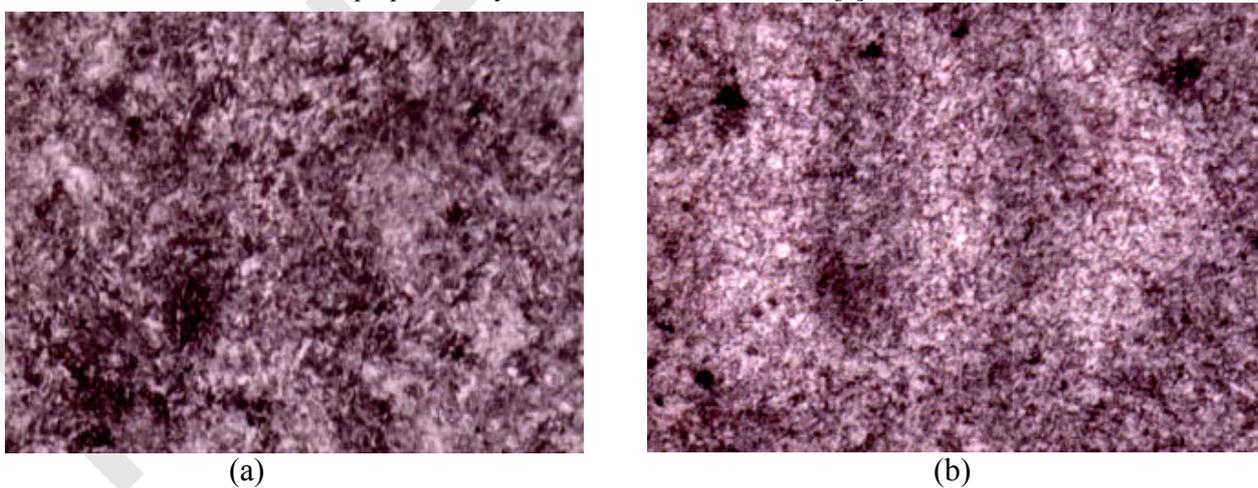
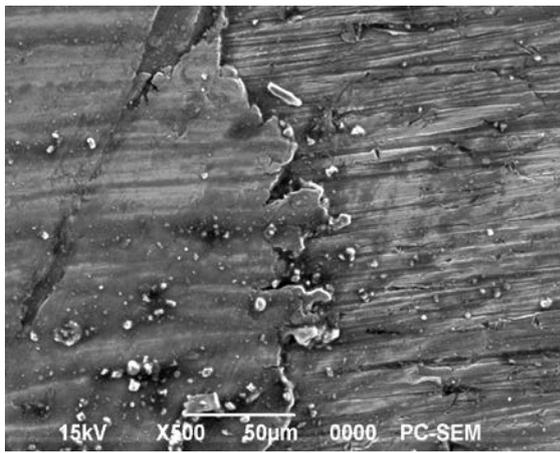
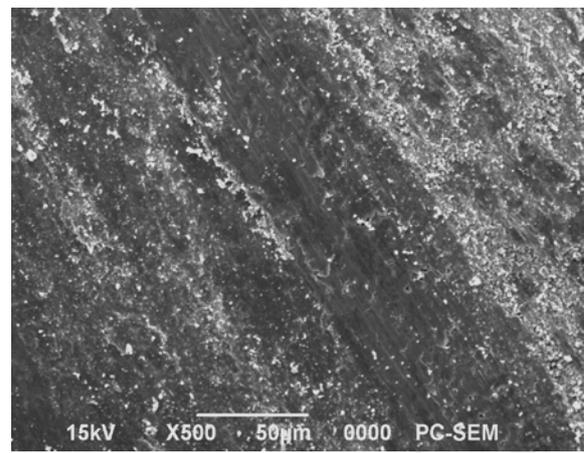


Figure 6: Microstructure of steel (x500), with hardness 32 HRC: (a) XC48 (b) XC35.

SEM observations of the worn face of the slug show a certain roughness, with furrows plowed. we see tire debris, and accumulated well before chipping agglomerates of fine particles of oxides (Figure 7). The oxides thus formed film, reduces the shearing force at the contact, and promotes the sliding wear tends to decrease due to the plasticity of the film.

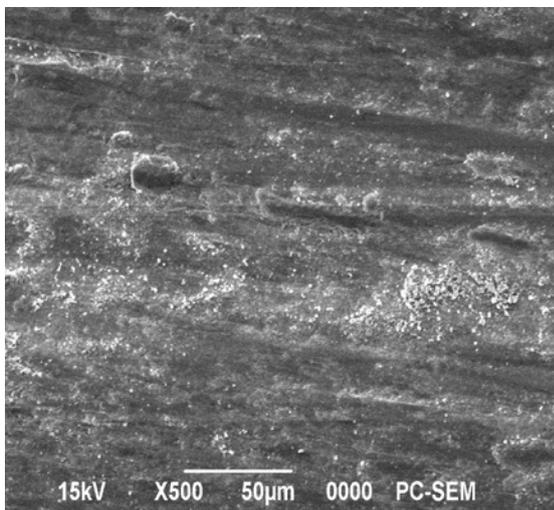


(a)

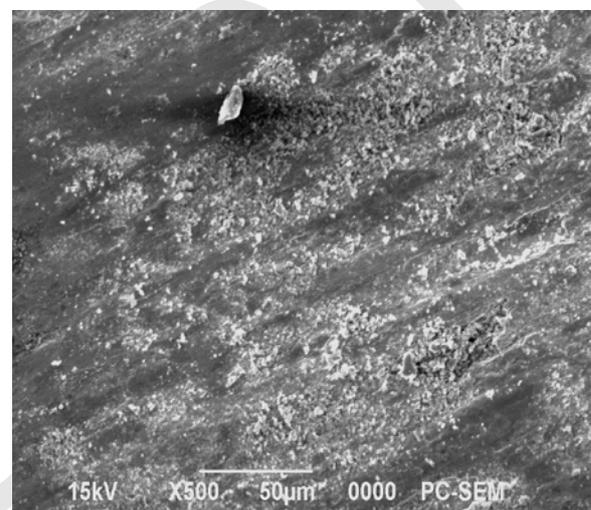


(b)

Pins XC48 worn surfaces: (a) XC48 Treaty; (b) untreated XC48



(a)



(b)

Pins XC35 worn surfaces: (a) XC48 Treaty; (b) untreated XC48

Figure 7: Worn surfaces of the pins

## 5. Conclusion

We studied by means of a machine-disk evolution pawn wear two pins of steel XC48 and XC35 or rubbing on a hard steel XC55.

It was shown that the wear is caused by the adhesion surfaces and plowing of surface roughness tangled by the opposite surface. The application of heat treatment (hardening followed by tempering) increases the hardness of the treated materials. The wear is inversely proportional to hardness.

Finally, we note that the steel most suitable and best used for the manufacture of rollers is the steel XC48 treaty because of its high resistance to wear.

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# İNSANLARIN ÇALIŞMA AMAÇLARI ÜZERİNE BİR ARAŞTIRMA: TÜİK ÖRNEĞİ

Yunus Adıgüzel  
[yunusadiguzel@tuik.gov.tr](mailto:yunusadiguzel@tuik.gov.tr)

Adnan Bedlek  
[adnanbedlek@tuik.gov.tr](mailto:adnanbedlek@tuik.gov.tr)

Mehmet Fatih Dinçer  
[mfatihdincer@gmail.com](mailto:mfatihdincer@gmail.com)

**Özet:**İnsanoğlunun gündelik yaşamında en çok vaktini alan dolayısıyla hayatının önemli bir kısmını işgal eden “çalışma” kavramı belirli amaçları içermektedir. Bizimde bu kavramla ilgili çalışmamızda Prof.Dr. Suna Tevrüz’ün uzun yıllarını harcayarak meydana getirdiği ve batıdaki çalışmalarla da örtüşen “çalışma amaçları” ile ilgili 12 soruluk ölçek kullanılmıştır. Her bir soru çalışmanın amaçlarından her birini oluşturmaktadır ve daha önceki çalışmalarda bu 12 ifade bireysel, normatif ve dünyevi boyut altında toplanmıştır. Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü çalışanları ile yaptığımız çalışmada faktör analizi sonucu 5 soru analiz dışı kalmıştır. Geri kalan 7 sorudan 5 tanesi önceki çalışmalardaki bireysel boyuta çok benzediği için “çalışmanın bireysel boyutu” adını almıştır(hayatına anlam vermek, hayatına hareket katmak, kendini meşgul etmek, hayatına keyif katmak, sevdiği işi yapmak) ancak diğer boyut 2 ifadeden oluşmaktadır ve “çalışmanın statükocu boyutu” adını almıştır(Düzenini kurmak, statü kazanmak). En çok hangi amacın tercih edildiği ile ilgili soruda “geçimini temin etmek” ile ilgili cevabın tercih edildiğini görüyoruz yani çalışanların büyük bir çoğunluğu kendi geçimlerini sağlamak için çalışıyorlar diyebiliriz(%61,4).

**Anahtar kelimeler:** Çalışmanın amaçları, TÜİK, çalışma

**Abstract:** Abstract: the term “work” which takes the most of time in human daily life and accordingly occupy the major part of his life has some specific objects. Related to this term in our study a scale of “work objects” consisting of 12 questions is used, this scale is developed by Prof. Dr. Suna Tevrüz after long years of study and it is compliant with western studies. Each single of question is for one of the object of the study and in previous studies this 12 statement is grouped under individual, normative and social aspects. In the study that we conduct with Turkish Statistical Institute Istanbul Regional Office employess 5 questions remained out of analysis after doing factor analysis. Remaining out of 7 questions 5 questions is called “Individual aspect of study” for being similar with individual aspect of previous studies (to give a meaning to his/her life, to put some movement to his/her life, keeping busy himself/herself, to put enjoyment to his/her life, doing the business that he/she like) but the other aspect consists of 2 statement and called “social aspect of study” (to accommodate himself/herself, to gain social status). Looking the question related to which object someone prefer most we see that majority of choice of answer is “provide income for a living” which means that majority of employees is working to get income to continue their life (%61,4).

**Key words:** work object, TÜİK, work.

## Giriş

Değerleri sosyal açıdan “kişilerin, kendileri ve başkaları için anlamlı buldukları eylemlerle, davranışlara ve bu eylemleri üreten şemalar” olarak tanımlayabiliriz (Dökmen, 2002: 279). Değerler amaca yönelik davranışları (French, Kahn, 1962), insanın yaşamına yön vermesi bakımından varılması farklı önem derecelerinde arzu edilen amaçları da ifade etmektedir (Tevrüz, Turgut, 2004). Zedeck (1997) çalışma değerlerini, kişilerin çalışarak varmak istedikleri amaçlar olarak tanımlamıştır. Bu değer tanımlarında amaç kavramının öne çıktığını ve değer ile eşleştirildiğini, dolayısıyla değerlerin ve amaçların birbirinin yerine kullanılan kavramlar olduklarını görüyoruz. Çalışma ile ilgili araştırmalarda en çok üzerinde durulan kavram olan amaç nedeniyle bizde “çalışma amaçları” nı bu çalışmamızda konu edineceğiz (Tevrüz, Turgut, Çinko, 2010). Çalışanların farklı amaçlar için çalıştıkları çalışma ve güdülenme teorilerinin öne çıkan en önemli unsurlarından biridir ve çalışma ile farklı ihtiyaçların karşılanmasını hedefledikleri söylenir (Beukman, 2005). Nord ve arkadaşları (1990) da benzer bir ifade ile, çalışma değerlerini, kişilerin belirli çalışma alanlarına yönelmelerinde tercihlerini belirleyen ve ancak çalışarak elde edilebileceğine inanılan

sonuçlar olarak tanımlamayı uygun görmüşlerdir. Tevrüz, yaptığı araştırmalarda çalışma amaçları ile ilgili 12 ifadeyi “çalışmanın bireyselci boyutu” – “çalışmanın normatif boyutu” – “çalışmanın dünyevi boyutu” olmak üzere 3 boyuta indirgemıştır ve bizde Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü’nde yaptığımız bu çalışma ile bu 12 ifadeyi 3 boyuta indirgeyip indirgeyemeyeceğimize bakacağız. (Tevrüz, Turgut, Çinko, 2010)

## Yöntem

Araştırmamızın hedef kitlesini Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü çalışanları oluşturmaktadır. Faktör analizi yaparak daha az sayıya indirmek ve boyutlarla ifade etmek için kullandığımız 12 soru olduğundan 60 ila 240 arası sayıda kişiye anket yapmak yeterli olacaktır.

Hedef kitlemiz olan Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü çalışanlarının tamamına yakınına anket [yunusadiguzel@tuik.gov.tr](mailto:yunusadiguzel@tuik.gov.tr) e-posta adresi aracılığıyla gönderilmiştir. Yaklaşık 260 kişiden 70 kadarı anketi doldurmuştur yani örneklemimizi TÜİK İstanbul Bölge Müdürlüğü’nün 70 kadar çalışanı oluşturmaktadır. Olasılık dahilinde olmayan örnekleme yöntemlerinden uygun örnekleme kullanılmıştır.

**Tablo 1:** Farklı gruplara göre çalışma amaçlarının üç boyutu, bunların altında toplanan maddeler ve en fazla tercih edilen 5 çalışma amacı (Tevrüz, Turgut, Çinko, 2010:25)

|                                     | <b>GRUP1:KARMA</b>  | <b>GRUP2:ÖĞRENCİ</b>   | <b>GRUP3:ÇALIŞAN</b>   |
|-------------------------------------|---|--|--|
| <b>Çalışmanın Bireyselci İşlevi</b> | <i>Bilgi edinmek/kullanmak 1</i><br><i>Sevdiği işi yapmak 2</i><br><i>Hayatına anlam vermek 4</i><br><i>Hayatına hareket katmak 5</i><br>Kendini meşgul etmek | <i>Bilgi edinmek/kullanmak 2</i><br><i>Sevdiği işi yapmak 1</i><br>Hayatına anlam vermek<br>Hayatına hareket katmak<br>Kendini meşgul etmek<br>Hayatına keyif katmak | Hayatına anlam vermek<br>Hayatına hareket katmak<br>Kendini meşgul etmek<br>Hayatına keyif katmak  |
| <b>Çalışmanın Normatif İşlevi</b>   | Topluma katkıda bulunmak<br>Sakınmak<br>Dini görevini yapmak<br>Düzenini kurmak   | <i>Topluma katkıda bulunmak 3</i><br><i>Sakınmak 4</i><br>Dini görevini yapmak<br>Düzenini kurmak  | Dini görevini yapmak<br>Sakınmak   |
| <b>Çalışmanın Dünyevi İşlevi</b>    | <i>Geçimini temin etmek 3</i><br>Statü kazanmak<br>Hayatına keyif katmak  | <i>Geçimini temin etmek 5</i><br>Statü kazanmak  | <i>Geçimini temin etmek 1</i><br><i>Statü kazanmak 5</i><br><i>Bilgi edinmek/kullanmak 4</i><br><i>Sevdiği işi yapmak 2</i><br><i>Topluma katkıda bulunmak 3</i> |

Araştırmamızı Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü çalışanlarına yaptığımız için teorik çerçeveyi oluştururken çalışanlara yapılmış faktör analizi sonuçlarını(grup3) dikkate aldık.

**Tablo2:** Grup 3 için faktör analizi sonuçları

| <b>Ç.BİREYSELÇİ İ.</b> | <b>Ç.NORMATİF İ.</b> | <b>Ç.DÜNYEVİ İ.</b> |
|------------------------|----------------------|---------------------|
| S10                    | S5                   | S3                  |
| S9                     | S6                   | S2                  |
| S7                     |                      | S4                  |
| S8                     |                      | S12                 |
|                        |                      | S1                  |

Faktör analizi yapıldıktan sonra ve faktör boyutları oluşturulup isimlendirildikten sonra bakılacak hipotezler:

- Ho: Kadın ve erkeklerin her bir boyuta verdikleri cevapların ortalamaları eşittir.
-

- c) Ho: Boyutlar arasında doğrusal ilişki yoktur.
- d) Ho: Cinsiyet ve öğrenim durumu değişkenleri birbirinden bağımsızdır.
- e) Ho: Her bir boyuta verilen cevaplar iki faktöre verilen cevaplar öğrenim durumuna göre değişiklik göstermez.

Tevrüz, Turgut, Çinko, (2010)'dan alınan 12 soru ile anketimizin ilk 12 sorusu oluşturulmuştur bunlar aynı zamanda faktör analizi yapacağımız sorulardır. 13. Soru ise ilk 12 sorudaki çalışma amaçlarından hangisinin en önemli olduğuyla ilgilidir ve son 4 soru ise demografik özellikleri oluşturan yaş, cinsiyet, gelir ve eğitim durumu ile ilgilidir. Anket gmail e-posta adresindeki dökümanlar kısmında hazırlanarak kurumsal e-posta aracılığıyla link olarak deneklere yollanmıştır.

## Analizler ve Bulgular

Çalışma amaçlarının alt boyutlarını tespit etmek amacıyla faktör analizi yapılmıştır. Veri setinin faktör analizine uygunluğunun test edilmesi için, Kaiser-Meyer-Olkin (KMO) örneklem yeterliliği testi ve Bartlett küresellik testi uygulanmış, KMO değeri 0,50'nin üzerinde olduğu ve Bartlett testi de 0,05 önem derecesinde anlamlı olduğundan veri seti faktör analizine uygun bulunmuştur (KMO=0,787, Chi-square Bartlett test (21)=189,692, p=0,000).

Temel bileşenler yöntemi ve Varimax döndürme yöntemi kullanılarak sorular analiz edilmiştir. Örneklem yeterliliği ölçüsü 0,50 değerinin altında kalan, faktör altında tek kalan, birbirine yakın faktör ağırlıkları olan sorular analizden çıkarılarak, güvenilirlik analizinde güvenilirlik düzeyini düşüren sorular analizden çıkarılarak yapılan faktör analizinde özdeğerleri 1 ve üzerinde olan 2 faktör elde edilmiştir. Toplam açıklanan varyans %68,035 olarak bulunmuştur. Faktörler sırasıyla; "Çalışmanın Bireyselci İşlevi" ve "Çalışmanın Statükocu İşlevi" olarak adlandırılmıştır. Faktörlerin içsel tutarlılıklarının hesaplanmasında Cronbach alfa değerleri kullanılmıştır (bu değerler sırasıyla 0,840; 0,742 dir).

**Tablo3:** TÜİK çalışanlarının Faktör analizi sonuçları

| FAKTÖRÜN ADI                 | SORU İFADESİ  | FAKTÖR AĞIRLIKLARI | FAKTÖRÜN AÇIKLAYICILIĞI(%) |
|------------------------------|---|--------------------|----------------------------|
| Çalışmanın Bireyselci İşlevi | Hayallerini gerçekleştirmek, kişisel zevk ve hobilerini tatmin etmek, gezip eğlenmek" amacıyla çalışmak                     | 0,844              |                            |
|                              | Hayatına yön vermek, hayatta birşeyler yapabilmiş olmak ve manevi doyum elde etmek" amacıyla çalışmak                       | 0,831              |                            |
|                              | Hayatına hareket katmak, sosyal ilişkiler geliştirmek, yeteneklerini kullanmak ve insanlara yardım etmek" amacıyla çalışmak | 0,827              | 42,474                     |
|                              | İşinden zevk alarak sevdiği mesleği yapmak" amacıyla çalışmak   |                    |                            |
|                              | Vakit geçirmek, bedenini ve zihnini meşgul etmek, zamanını değerlendirmek" amacıyla çalışmak                                | 0,657              |                            |

|                            |   |       |                        |
|----------------------------|---|-------|------------------------|
| Çalışmanın Normatif İşlevi | Kendine bir yuva kurmak, kendi işini kurmak, düzenli bir hayat sürmek ve yeni nesilleri sürdürürebilmek" amacıyla çalışmak            | 0,624 |                        |
|                            | Statü ve prestij sahibi olmak, toplumda kabul görüp saygı kazanmak, kariyer sahibi olmak, otorite ve güç kazanmak" amacıyla çalışmak. | 0,896 |                        |
|                            |   | 0,828 | 25,560                 |
|                            | <b>Toplam</b>   |       | 68,034                 |
|                            | <b>Kaiser Meyer Olkin Ölçek Geçerliliği</b>   |       | 0,787                  |
|                            | <b>Bartlett Küresellik Testi</b>  |       |                        |
|                            |   |       | <b>Ki kare</b> 189,692 |
|                            |   |       | <b>Sd</b> 21           |
|                            |   |       | <b>P değeri</b> 0,000  |

a1) Ho: Kadın ve erkeklerin bireyselci boyuta verdikleri cevapların ortalamaları eşittir.  
Sig. 0,334 > 0,05 olduğu için Ho hipotezi kabul edilir yani kadın ve erkeklerin bireyselci boyuta verdikleri cevapların ortalamaları eşittir.

a2) Ho: Kadın ve erkeklerin statükocu boyuta verdikleri cevapların ortalamaları eşittir.  
Sig. 0,302 > 0,05 olduğu için Ho hipotezi kabul edilir yani kadın ve erkeklerin statükocu boyuta verdikleri cevapların ortalamaları eşittir.

**Tablo4:** Faktör analizi sonucu ortaya çıkan boyutlarla ilgili cinsiyete göre t-testi tablosu

|              |       | N  | Ort. | Std. Sap. | t değeri | p değeri |
|--------------|-------|----|------|-----------|----------|----------|
| Bireysel B.  | Kadın | 31 | 4,27 | 1,09      | 0,972    | 0,334    |
|              | Erkek | 39 | 4,01 | 1,14      |          |          |
| Statükocu B. | Kadın | 31 | 4,89 | 1,11      | 1,040    | 0,302    |
|              | Erkek | 39 | 4,60 | 1,16      |          |          |

Kadın ve erkek çalışanların Çalışmanın Bireysel Boyutu'na ve Çalışmanın Statükocu Boyutu'na verdikleri cevapların karşılaştırılması için yapılan t-testi sonucunda cinsiyet açısından bir farklılık bulunmamıştır ( sırasıyla  $t(68)=0,972$ ;  $p=0,334$  ve  $t(68)=1,040$ ;  $p=0,302$  ). Buna göre ortalamalara bakıldığında kadın ve erkeklerin faktörlere verdikleri cevaplarda cinsiyet açısından bir farklılık yoktur.

b) Ho: Bireyselci boyut değişkeni ile statükocu boyut değişkeni arasında doğrusal ilişki yoktur.

Sig. Değeri  $0,000 < 0,05$  den küçük olduğu için Ho hipotezi reddedilir. Korelasyon katsayısının hipotez testinin  $0,01$  seviyesinde anlamlı olduğunu ve  $0,423$  zayıf ve pozitif bir ilişki olduğunu söyleyebiliriz.

c) Ho: Cinsiyet ve öğrenim durumu değişkenleri birbirinden bağımsızdır.

Sig.  $0,356 > 0,05$  olduğu için Ho hipotezi kabul edilir yani cinsiyet ve eğitim durumu değişkenleri birbirine bağımsızdır. Kadın ve erkeklerin eğitim seviyesi arasında anlamlı bir fark yoktur

d1) Ho: Bireyselci boyuta verilen cevaplar öğrenim durumuna göre değişiklik göstermez.

d2) Ho: Statükocu boyuta verilen cevaplar öğrenim durumuna göre değişiklik göstermez.

Kruskal Wallis Testi sonuçlarına göre Sig. Değerleri her iki faktör içinde  $0,05$  ten büyüktür (sig.  $0,227$  ve sig.  $0,271$ ) yani Ho hipotezi kabul edilir, iki faktöre verilen cevapların öğrenim durumuna göre değişiklik göstermediği kararına varılır.

**Tablo5:**En Çok Tercih Edilen Çalışma Amaçları

| Soru 13 |         |       |               |                 |
|---------|---------|-------|---------------|-----------------|
|         | Frekans | Yüzde | Geçerli Yüzde | Kümülatif Yüzde |
| 1,00    | 8       | 11,4  | 11,4          | 11,4            |
| 2,00    | 1       | 1,4   | 1,4           | 12,9            |
| 3,00    | 43      | 61,4  | 61,4          | 74,3            |
| 4,00    | 4       | 5,7   | 5,7           | 80,0            |
| 5,00    | 1       | 1,4   | 1,4           | 81,4            |
| 6,00    | 3       | 4,3   | 4,3           | 85,7            |
| 7,00    | 1       | 1,4   | 1,4           | 87,1            |
| 8,00    | 3       | 4,3   | 4,3           | 91,4            |
| 9,00    | 1       | 1,4   | 1,4           | 92,9            |
| 10,00   | 2       | 2,9   | 2,9           | 95,7            |
| 11,00   | 2       | 2,9   | 2,9           | 98,6            |
| 12,00   | 1       | 1,4   | 1,4           | 100,0           |
| Toplam  | 70      | 100,0 | 100,0         |                 |

Anketimizin 13. Sorusunda 12 adet çalışma amacından en çok hangisini tercih ettikleri sorulmuştur ve 43 kişi(%61,4) 3. Soruyu oluşturan “geçimini temin etmek” değişkeni ile ilgili cevabı tercih etmiştir. En çok tercih edilen 2. Amaç ise 8 kişi(%11,4) ile “topluma katkı” ile ilgili amaçtır.

## Araştırmanın sonuçları

Çalışma amaçlarını ölçmek için ile ilgili literatürde kullanılan 12 soruluk ölçek kullanılmıştır ve bu amaçla Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü'nün 70 kadar çalışanına anket yapılmıştır.

Araştırmaya katılan kişilerden sorulara 1'den 6'ya kadar (1:Hiç önemli değil, 2:Çok az önemli, 3:Biraz önemli, 4:Oldukça önemli, 5:Çok önemli, 6:Fazlasıyla önemli) aralıkta cevaplar vermeleri istenmiştir.

Çalışma amaçlarının alt boyutlarını tespit etmek amacıyla faktör analizi yapılmıştır. Veri setinin faktör analizine uygunluğunun test edilmesi için, Kaiser-Meyer-Olkin (KMO) örneklem yeterliliği testi ve Bartlett küresellik testi uygulanmış, KMO değeri  $0,50$ 'nin üzerinde olduğu ve Bartlett testi de  $0,05$  önem derecesinde anlamlı olduğundan veri seti faktör analizine uygun bulunmuştur (KMO= $0,787$ , Chi-square Bartlett test (21)= $189,692$ ,  $p=0,000$ ).

Temel bileşenler yöntemi ve Varimax döndürme yöntemi kullanılarak sorular analiz edilmiştir. Örnekleme yeterliliği ölçüsü  $0,50$  değerinin altında kalan, faktör altında tek kalan, birbirine yakın faktör ağırlıkları olan sorular

analizden çıkarılarak, güvenilirlik analizinde güvenilirlik düzeyini düşüren sorular analizden çıkarılarak yapılan faktör analizinde özdeğerleri 1 ve üzerinde olan 2 faktör elde edilmiştir. Toplam açıklanan varyans %68,035 olarak bulunmuştur. Faktörler sırasıyla; “Çalışmanın Bireyselci İşlevi” ve “Çalışmanın Statükocu İşlevi” olarak adlandırılmıştır. Faktörlerin içsel tutarlılıklarının hesaplanmasında Cronbach alfa değerleri kullanılmıştır (bu değerler sırasıyla 0,840; 0,742 dir).

Çalışmamızda ilk 12 soru çalışmanın amaçlarından her birini temsil etmektedir ve literatürdeki daha önceki çalışmalarda bu 12 sorunun bireysel, normatif ve dünyevi boyut altında toplandığını görmüştük. Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü çalışanları ile yaptığımız çalışmada faktör analizi sonucu 5 soru analiz dışı kalmıştır. Geri kalan 7 sorudan 5 tanesi önceki çalışmalardaki bireysel boyuta çok benzediği için “çalışmanın bireysel boyutu” adını almıştır(hayatına anlam vermek, hayatına hareket katmak, kendini meşgul etmek, hayatına keyif katmak, sevdiği işi yapmak: Soru 10, Soru 9, Soru 7, Soru 8, Soru12) ancak diğer boyut 2 değişkenden oluşmaktadır ve “çalışmanın statükocu boyutu” adını almıştır(Düzenini kurmak, statü kazanmak: Soru 11, Soru2). En çok hangi amacın tercih edildiği ile ilgili soruda “geçimini temin etmek” ile ilgili cevabın tercih edildiğini görüyoruz yani çalışanların büyük bir çoğunluğu kendi geçimlerini sağlamak için çalışıyorlar diyebiliriz(%61,4: Soru 13).

Tevrüz’ün çalışanlarla yaptığı çalışmasını TÜİK İstanbul Bölge Müdürlüğü çalışanları ile yaptığımız çalışma ile kıyaslırsak bizim çalışmanın bireysel boyutu olarak adlandırdığımız boyutu diğer çalışmada oluşturan ifadelerle aynıdır tek fark bizde bu grupta olan “sevdiği işi yapmak” ile ilgili ifade Tevrüz’ün çalışmasında çalışmanın dünyevi işlevi adını verdiği boyutta yer almıştır. Ayrıca o boyutta “geçimini temin etmek”, “statü kazanmak” (bizde çalışmanın statükocu işlevi adını verdiğimiz boyutta yer almaktadır), “bilgi edinmek/kullanmak”, “topluma katkıda bulunmak” yer almaktadır. Bizim çalışmamızda statükocu boyut adını verdiğimiz boyutu “statü kazanmak” ifadesi ile oluşturan diğer ifade “sakınmak” ile ilgili ifadedir ve Tevrüz’ün çalışmasında “dini görevini yapmak” ile beraber “sakınmak” ile ilgili ifade çalışmanın normatif boyutunu oluşturmaktadır. (Tevrüz, Turgut, Çinko,2010:25)

## Sonuç

Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü’nde yaptığımız çalışmada ortaya çıkan ilk boyut olan bireyselci boyutu çalışanların bireysel anlamda kendileri ile ilgili gelişimler için çalıştıklarını söyleyebiliriz. İkinci boyut olan statükocu boyutu ise geçmiş toplumlardan beri süre gelen ve devam eden statü elde etme, aile kurma, nesilleri devam ettirme gibi neredeyse toplum tarafından zorunlu kabul edilen gelişmeler için çalıştıklarını söyleyebiliriz. En çok tercih edilen çalışma amacının geçimini temin etmek ile ilgili olmasının nedeni ise çalışma şartlarının çok iyi olmasada insanların bu işe ve buradan kazanacakları paraya gerçekten ihtiyaçları olduğunu ve önceliklerinin bu olduğunu söylemek doğru olur.

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# INTELLIGENT DATA MINING FOR AUTOMATIC FACE RECOGNITION

Ahmed Ragab, Soumaya Yacout, Mohamed-Salah Ouali

*Department of Applied Mathematics and Industrial Engineering  
École Polytechnique de Montréal, Canada*

Ahmed.ragab@polymtl.ca; Soumaya.yacout@polymtl.ca; msouali@polymtl.ca

**Abstract:** The advancement in computer science and information technology is one of the most important characteristics of the century. One of the important consequences of this advancement is the availability of huge number of automated databases which are waiting to be exploited. This exploitation will lead to knowledge discovery which will help the decision making processes in many fields. In this paper a knowledge discovery, data mining, artificial intelligent technique called Logical Analysis of Data (LAD) is introduced and applied to the well know problem of face recognition. Knowledge discovered in the form of patterns is saved and then used in a machine learning system in order to identify the already learned faces, and to distinguish them from unknown faces. The results show that LAD is promising approach to pattern recognition.

**Key words:** Data mining, knowledge discovery, artificial intelligence, face recognition, Logical Analysis of Data.

## 1. Introduction

The increase in the number of databases in many field create new challenges to researchers in different field. It is reported in (Witten, Frank, & Hall, 2011) that the amount of stored databases doubles every 20 months. It is difficult or even impossible to justify the storage of this amount of data in any quantitative sense. Instead, the important information should be extracted from the data. This operation is called knowledge discovery since there is usually certain amount of useful information that is potentially important in each database and need to be discovered.

Data mining is defined as the process of automatic exploration and extraction of the knowledge from the data (Gorunescu, 2011). The idea is to build computer programs that refine the databases automatically. Among the extracted patterns, some will be trivial and non-interesting, others, on the other hand, will general and can contribute to accurate prediction of future data (Ryoo & Jang, 2009). The patterns discovered must be meaningful and have some advantage in an economic sense. From economical point of view, one of the most important requirements for the patterns is the comprehensiveness (interpretability). Some patterns are comprehensible (also called transparent or interpretable or structural) while some of them are incomprehensible (called black box patterns). From the performance point of view, both of them can make good predictions (Bishop, 2006). The advantage of using comprehensible patterns is their structural representation that can be examined to inform on future events. In other words, they can help the analyst as well the decision maker to explain something about the data in an explicit way (Bores et al., 2000).

Data mining is a topic of increasing interests that involves learning in a practical sense. Researches supported by international agencies, industry and academia are focusing on designing more effective and intelligent data mining techniques (Bozdogan, 2003).

Machine learning provides the technical basis of data mining (machine learning is the technology for mining knowledge from data) (Bishop, 2006). It relies on the availability of data and draw on learning strategies from the area of computational intelligence, statistical pattern classification, and others (Bishop, 2006). The word learning means that these techniques learn from the changes appearing in the data in a way that improves their performance in the future. Thus learning is tied to performance enhancement. Based on this learning process, the learning techniques can be employed to map data into decision model in order to produce predicting output from new data. The decision model is called classifier (Bishop, 2006).

There are two approaches for machine learning, supervised learning and unsupervised learning (Bishop, 2006). In supervised learning, the purpose is to infer the decision model from labeled data. In unsupervised learning, the learning technique is fed with only unlabeled objects (there is no a priori label).

Logical analysis of data (LAD) is a supervised data mining methodology. It was introduced by the group of researchers of RUTCOR at Rutgers University in USA (Bores, et al., 2000). Logical Analysis of Data (LAD) is a combinatorial and optimization based method used in many applications such as oil exploration, detection and prediction of some diseases (Bores, et al., 2000). LAD was introduced to the field of condition based maintenance (CBM) as a new approach for automatic diagnosis of faults in rolling bearings (Mortada, Yacout, & Lakis, 2011). LAD was also able to reproduce human expertise in detecting and analyzing the phenomenon of rogue components in airplanes (Mortada, Carroll, Yacout, & Lakis, 2009). In the airlines industry, LAD was applied to estimate the overbooking level by predicting the show rates of passengers (Dupuis, Gamache, & Pagé, 2012). LAD is applied to develop credit risk rating models for evaluating the credit quality of banks (Hammer, Kogan, & Lejeune, 2012).

One of the advantages of LAD over many data mining techniques is the interpretability (transparency) of its patterns. In other words, LAD can generate patterns that can be easily interpreted and translated into rules which are

beneficial to the decision makers (Bores, et al., 2000). LAD is not depending on any statistical analysis; this is another important advantage that makes it capable of dealing with the data that are highly correlated, without the need to satisfy any statistical assumptions.

The main objective of this paper is to apply LAD to the field of face recognition. The aim here is to build a single multi-class decision model that recognizes the images of different objects. This model can effectively deal with multiple changes in facial expression. The paper is organized as follows: The multi-class LAD decision making approach proposed here is presented in the next section. In section 3, the experimental results obtained by using LAD with a known dataset that is employed to train and test different face recognition techniques. Section 4 discusses these results while section 5 concludes the paper.

## 2. Logical Analysis of Data

LAD is a combinatorial and optimization method that evolved as an effective classification technique that relies on extracting patterns from binarized data in order to formulate decision rules that classify data into more than one class (Bores, et al., 2000). LAD was used as a Boolean technique to identify the causes of a certain event through investigating a set of factors representing all the possible causes of that event (Crama, Hammer, & Ibaraki, 1988). It is used to extract knowledge from a dataset consisting of observations that can be represented as binary or numerical vectors. Each vector is composed of the values of certain characteristic features). Originally, LAD was used as two-class classification technique (dichotomizer) (Bores, et al., 2000). The observations are classified as either positive  $\square^+$  or negative  $\square^-$  where  $\square^+$  and  $\square^-$  are the sets of positive and negative observations, respectively in the training data set  $\square$ . A specific characteristic of LAD is the extraction of a set of patterns which are the interactions between features for either positive or negative observations in the dataset. Accordingly, LAD can be used as pattern-based classifier of new observations that are not included in the original dataset (Bores, et al., 2000).

Like the conventional two-class LAD, the multi-class LAD decision making approach composed of three steps: data binarization, pattern generation, and theory formation. In what follows, we present the steps of the methodology of LAD which generates an entire set of patterns for a single dichotomy for the two classes. Then we explain how to generate a set of multi-class patterns that can be used to create the decision model in the theory formation step of the multi-class LAD approach.

### 2.1. Data binarization

The binarization procedure in (Mortada, et al., 2011) is presented in this paper, as the first step in LAD methodology. The data binarization step involves the transformation of numerical data to binary data using a binarization technique that transforms each numerical feature into a set of binary attributes. The binarization of a continuous numerical feature  $\square$ , and the number of binary attributes needed to replace it are dependent on the number of distinct values of  $\square$  in the training data set. The binarization procedure starts by ranking, in ascending order, all the distinct values of the numerical feature  $\square$  as follows:

$$\square_{\square}^{(1)} < \square_{\square}^{(2)} < \dots < \square_{\square}^{(\square)} \quad (\square \leq \square)$$

Where  $\square$  is the total number of distinct values of numerical feature  $\square$  and  $\square$  is the total number of observations.

Then a cut-point  $\alpha_{A,j}$  is introduced between each pair of values that belong to different classes. The cut-point is calculated by averaging the two values as:

$$\alpha_{\square,\square} = (\square_{\square}^{(\square)} + \square_{\square}^{(\square+1)})/2 \quad (1)$$

Where the superscript (i) refers to the order of the distinct value of  $A$  and  $j$  refers to a specific feature,  $\square_{\square}^{(\square)} \in \square^+$  and  $\square_{\square}^{(\square+1)} \in \square^-$  and vice versa. A binary attribute  $\square$  is then formed from each cut-point. Each cut-point  $\alpha_{\square,\square}$  has a corresponding binary attribute  $\square_{\square,\square}$  with is defined as:

$$\square_{\square,\square} = \begin{cases} 1 & \square \geq \alpha_{\square,\square} \\ 0 & \square < \alpha_{\square,\square} \end{cases} \quad (2)$$

As a result of this binarization process, the number of binary attributes that make up the binarized training set is equal to the number of cut-points generated for each numerical feature in the training data set.

### 2.2. Pattern generation

Patterns generation is the key building block in LAD decision model. This step is essential in identifying the positive and negative patterns from the binarized dataset of positive and negative observations. The accuracy of LAD decision model depends on the type of generated patterns (Ryoo & Jang, 2009).

#### i. Definitions and characteristics of Patterns

A positive (negative) *pattern* is defined as an elementary conjunction of some of literals that is true for at least one positive (negative) observation and false for all negative (positive) observations in the training data set (Bores, et al., 2000). A literal is a Boolean variable  $\square$  or its negation  $\bar{\square}$ . Each binary attribute  $\square_{\square}$  in the training set can be represented in a pattern by a literal  $\square_{\square}$  or its negation  $\bar{\square}_{\square}$ , where  $\square_{\square}$  is used for  $\square_{\square} = 1$  and  $\bar{\square}_{\square}$  for  $\square_{\square} = 0$ . The degree  $\square$  of a pattern indicates the number of literals used in its definition. A pattern is said to *cover* a certain observation if it is true for that particular observation (Bores, et al., 2000). The set of observations covered by the

pattern  $\square$  is denoted as  $\square\square\square(\square)$ . A high degree pattern is more likely to cover small proportion of observations, while pattern with a low degree is more likely to have higher coverage (Ryoo & Jang, 2009). In the testing dataset, misclassified observations are results of generating high degree patterns while unclassified observations are results of low degree patterns (Ryoo & Jang, 2009).

## ii. Pattern generation approaches

Patterns are the corner stones in LAD methodology. In the literature, there are three common approaches for pattern generation: enumeration based approaches (Bores, et al., 2000; Hammer, Kogan, Simeone, & Szedmak, 2004), heuristic approaches (Hammer & Bonates, 2006), and Mixed 0-1 Integer and Linear Programming (MILP) based methods (Mortada, et al., 2011; Ryoo & Jang, 2009).

The MILP based approaches proposed in (Ryoo & Jang, 2009) can generate useful patterns that are optimal with respect to various selection preferences (simplicity, selectivity, and evidential (Hammer, et al., 2004)). The procedure for generating one positive (negative) pattern is formulated as an MILP maximization problem. It can generate strong prime patterns which make LAD classifier generalize better on new observations. The experimentations in that paper show that the generated strong prime patterns can reduce the number of unclassified observations (Ryoo & Jang, 2009). The approach can also generate strong spanned patterns and hence the classifier is likely to be robust to noisy observations (reduce the number of misclassified observations) (Ryoo & Jang, 2009). The MILP based method proposed in (Mortada, et al., 2011) is a modified version of the approach introduced in (Mortada, et al., 2011). The modification aims at maximizing the diversity of patterns generated from the same training data set without a significant increase in training time, thus increases the classification power in the two-class problems.

The generation of positive and negative patterns in *two-class LAD* model is extended to *multi-class LAD* decision model. An extension to multi-class applications that involves the modification of the architecture of *LAD* is proposed in (Mortada, Yacout, & Lakis, 2010). The proposed method has the advantage that it generates a less complex decision model which has a better execution time (Mortada, et al., 2010). In that paper, the procedure for pattern generation in multiclass dataset starts by creating empty sets of patterns  $\square\square$  for each pair of classes  $(\square\square, \square\square)$  where  $\square \in \{1, 2, \dots, \square\}$   $\square \neq \square$ , and  $\square$  is the total number of classes. The sets  $\square\square$  are generated through multiple solutions of the MILP based on the single pattern generation algorithm presented in (Mortada, et al., 2011).

## 2.3. Theory formation

The final step in the *LAD* decision model is the theory formation. For the conventional two-class LAD decision model, the generated positive and negative patterns are selected and then used to create a model called the discriminant function that generates a score ranging between -1 and 1. The discriminant function used in (Mortada, et al., 2010) generates a score for each class and therefore the tested observation belongs to the class with the highest score.

## 3. Experimental Results

In this section, we explain how multi-class LAD decision model can be used in the field of face recognition. A description of the pre-processing mechanisms used here for extracting features from the images of one of the face dataset in the field is presented. The performance of *multi-class LAD* decision model is compared with other common face recognition techniques.

### 3.1. Japanese Female Facial Expression (JAFFE) database

#### i. Pre-processing and features extraction

The results presented in this section were all performed on *Japanese Female Facial Expression (JAFFE)* database (Lyons, Akamatsu, Kamachi, Gyoba, & Budynek, 1998). The database contains 203 images of different facial expressions. The images are taken for 10 Japanese female models. Each image is represented as 256×256 pixels. The pre-processing of the images is performed by resizing the images to 100×100 pixels. In order to evaluate the accuracy of the model, we have applied the standard 10-fold cross validation method (Witten, et al., 2011). The *Eigenfaces* and *FisherFaces* are extracted from the training images (Belhumeur, Hespanha, & Kriegman, 1997). The proposed model is compared to some common classification techniques: instant based (IB), Bayesian, support vector machines (SVM), multi-layer perceptron-neural network (MLP-NN) (Witten, et al., 2011). The algorithms for such techniques are implemented in the publicly available Weka software package (Bouckaert et al., 2010).

#### ii. Performance comparison

The performance comparison between *multi-class LAD* and these classification techniques is shown in Table 1 and Table 2. Table 1 shows that the accuracy is enhanced when the number of *Eigenfaces* increased. In Table 2, the performance is shown for the *FisherFaces*. The objective is to study the impact of changing the number of extracted feature (*Eigenfaces* and *FisherFaces*) on the *LAD* classification accuracy.

**Table 1:** Eigenfaces with IB, Bayesian, SVM, MLP, and multi-class LAD on JAFFE database

| Number of Eigenfaces             | 1       | 2       | 3       | 5       | 10     | 20         | 40         |
|----------------------------------|---------|---------|---------|---------|--------|------------|------------|
| Minimal Distance classifier (IB) | 31.7073 | 80.4878 | 85.3659 | 95.122  | 97.561 | 97.561     | 100        |
| K-Nearest Neighbor (K=5)         | 41.4634 | 85.3659 | 75.6098 | 85.3659 | 95.122 | 95.122     | 97.561     |
| Multi-Layer Perceptron (MLP)     | 46.3415 | 80.4878 | 85.3659 | 95.122  | 97.561 | <b>100</b> | <b>100</b> |

|  |         |         |         |         |         |         |            |
|--|---------|---------|---------|---------|---------|---------|------------|
| <i>SVM with Radial Basis Function</i>    | 41.4634 | 73.1707 | 56.0976 | 51.2195 | 34.1463 | 41.4634 | 51.2195    |
| <i>Bayesian (Maximum Posterior; MAP)</i> | 43.9024 | 85.3699 | 85.3659 | 92.6829 | 95.122  | 97.561  | 97.561     |
| <i>Multi-class LAD</i>                   | 48.7805 | 85.3659 | 85.3659 | 87.8049 | 95.122  | 97.561  | <b>100</b> |

**Table 2:** FisherFaces with IB, Bayesian, SVM, MLP, and multi-class LAD on JAFFE database

| <b>Number of Fisherfaces</b>             | 1              | 2          | 3          | 5          | 9          |
|--|----------------|------------|------------|------------|------------|
| <i>Minimal Distance classifier (IB)</i>  | 70.7317        | 97.561     | <b>100</b> | <b>100</b> | <b>100</b> |
| <i>K-Nearest Neighbor (K=5)</i>          | 73.1707        | 97.561     | <b>100</b> | <b>100</b> | <b>100</b> |
| <i>Multi-Layer Perceptron (MLP)</i>      | 73.1707        | 95.122     | <b>100</b> | <b>100</b> | <b>100</b> |
| <i>SVM with Radial Basis Function</i>    | 68.2927        | 97.561     | <b>100</b> | <b>100</b> | <b>100</b> |
| <i>Bayesian (Maximum Posterior; MAP)</i> | 70.7317        | 95.122     | <b>100</b> | <b>100</b> | <b>100</b> |
| <i>Multi-class LAD</i>                   | <b>80.4878</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> |

The software cbmLAD is implemented in C++ programming language at École Polytechnique de Montréal, Canada (Salamanca, 2008) is adapted to deal with the special application of LAD to face recognition. The multi-class LAD decision model is trained and tested using the training images of the dataset mentioned above.

#### 4. Conclusions

This paper aims at exploring an intelligent face recognition technique that employs a database from face recognition literature. *Eigenfaces* and *Fisherfaces* are applied to extract the relevant information from the images which are important for recognition. We described how to propose the *multi-class LAD* classifier as a decision model for the purpose of face recognition. The study shows how *multi-class LAD* and can be utilized and how it might be useful compared to other face recognition techniques. As a final conclusion, the *multi-class LAD* is a promising approach in the field of pattern classification and image processing in particular when it is used with efficient approaches such as *Fisherfaces* that guarantees high discriminative power among the classes. This motivates us to apply *multi-class LAD* as an image classification technique in the context of condition based maintenance in the future.

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# INVESTIGATION OF CHANGES OF PRE-SERVICE TEACHERS' OPINIONS ABOUT ENVIRONMENTAL EDUCATION WITH DRAWING ANALYSIS

Özgül Keleş, Funda Varnacı Uzun, Naim Uzun  
Aksaray University, Faculty of Education  
Turkey

ozgulkeles@gmail.com, fundavarnaci@hotmail.com, naimuzun@yahoo.com

**Abstract:** The purpose of this study is to investigate the effects of the project "Nature Education in Ihlara Valley (Aksaray) and Its Surrounding Area III" supported by The Scientific and Technological Research Council of Turkey (TUBITAK) on the pre-service teachers' environmental opinions. Drawings were used to collect data in the present study. Two questions were asked pre-service teachers to determine their opinions about environment and environmental education before the project and at the end of the project: The present study is an attempt to seek answers to these questions asked to pre-service teachers "In what kind of environment do you want to live? Please draw it" and "What kind of environmental education do you want to give to your students? Please draw it". Then, the opinions of the students expressed in their drawings are collected under the suitable categories. The opinions of the pre-service teachers are conceptualized under the emerging categories and tables of frequencies are formed for the concepts.

**Key words:** drawings, environmental education, pre-service teachers

## Introduction

Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings (UNESCO-UNEP, 1985). Various environmental education programs (field trips, trekking, camping, and adventure activities) help children to develop effective relations with their natural environment, to improve their sensitivity towards the nature, and their social relations (Palmberg & Kuru, 2000). The importance of summer camps in raising students' awareness of environmental values and learning the natural processes in their natural environments (Dresner & Gill, 1994); and the importance of ecological programs in creating positive changes in their environmental behavior (Bogner, 1998) are emphasized. When groups received information on environmental issues and appropriate action strategies, they showed an increase in environmentally responsible behavior and an increased understanding of environmental action (Jordon, Hungerford & Tomera, 1986; Newhouse, 1990). Direct experience with a variety of environmental action strategies and lifestyles that help to ameliorate environmental problems--such as the use of solar energy to heat water--is also important if students are to learn new behaviors. Role modeling, use of case studies, active participation in an environmental action project, and participation in simulations of environmental issue resolution are all techniques that can develop action skills (Dresner & Gill, 1994).

There are 41 national parks in Turkey (Varnacı Uzun, 2011). Based on the applications in America, nature education was initiated in Termessos, Kackar, Kazdagi, and Goreme national parks within the framework of the project called "Scientific Environmental Education in National Parks" by Land Sea Atmosphere and Environment Research Group of TUBITAK in 1999 in Turkey (Ozener & Yalcin, 2000; Keleş, 2011). There is a lot of research looking at the effects of nature education programs carried out in national parks on students' environmental knowledge, attitudes, and behaviors. However, the number of studies dealing with in what kind of environment pre-service teachers want to live and what kind of environmental education they want to give to their students is quite limited. Therefore, following two questions were directed to the pre-service teachers before they participated in a nature education program.

-In what kind of environment do you want to live? Please draw it.

-What kind of environmental education do you want to give to your students? Please draw it.

The responses to these questions were sought through drawings. Drawings are a way to find out learners' previous experiences or what they have learnt about a subject (Korkmaz, 2004). Thus, drawings may be effective in providing students with opportunities to improve their observational skills and allowing them to understand the natural world (Dempsey & Betz, 2001).

## Materials and Method

### *Study group*

The study group consists of 30 pre-service teachers studying in 4 different departments (preschool education, primary education, social studies, science and physics) of the education faculties of 17 universities who participated in nature education program carried out on 27 August-02 September 2012 with the support of TUBITAK. 18 (54%) of the participants are girls and 12 (46%) are boys.

### *Activities carried out within the framework of the nature education*

With this project, where active learning methods were used, the pre-service teachers were introduced to geological, geomorphologic, floral, faunal and cultural features of the natural environment and to the problems stemming from the mass tourism activities taking place in the region. In this respect, some field studies were carried out on the volcanic structure around Ihlara Valley and Hasan Mountain. Besides field studies, some activities in a classroom setting were also carried out. In the classroom setting, creative drama activities were performed for the pre-service teachers to get to know each other and take individual responsibilities.

### *Data collection instruments*

The present study consists of two parts. In the first part, what was expected from the pre-service teachers was to think about their dream environment where they want to live and then draw what they thought. In the second part, the aim was to elicit the opinions of the pre-service teachers about the environmental education they are planning to give in the future. For this purpose, the same questions were asked on the first and last days of the study.

### *Data analysis*

The opinions emphasized in the drawings of the pre-service teachers were separately conceptualized by the researcher. Then the tables of frequencies showing how many times a concept was repeated by the students were formed. Then, the conceptualizations of the researchers performed separately were brought together to subsume them under common categories. The data obtained in this way were then interpreted.

## **Results**

In this section, the pre-service teachers' opinions about environment and environmental education are presented before and after the nature education they were involved in:

### ***The Pre-service Teachers' Opinions about Environment and Environmental Education before Nature Education***

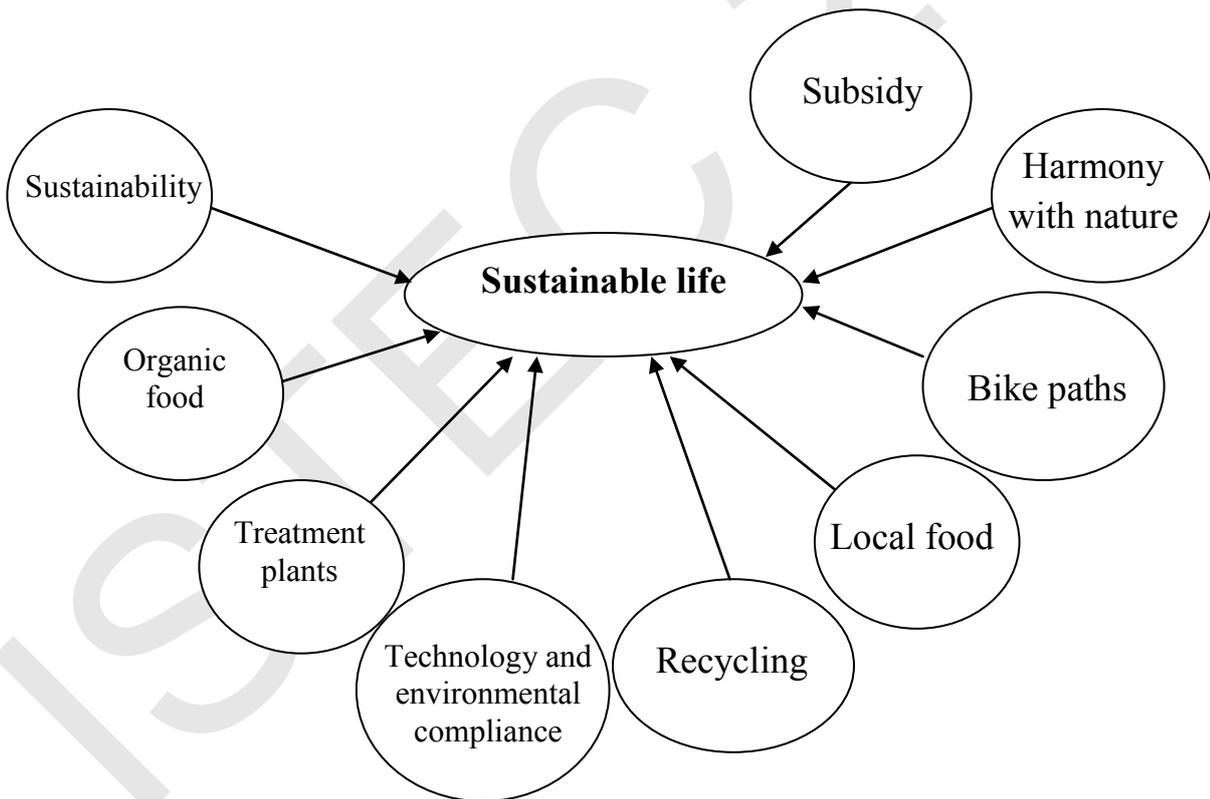
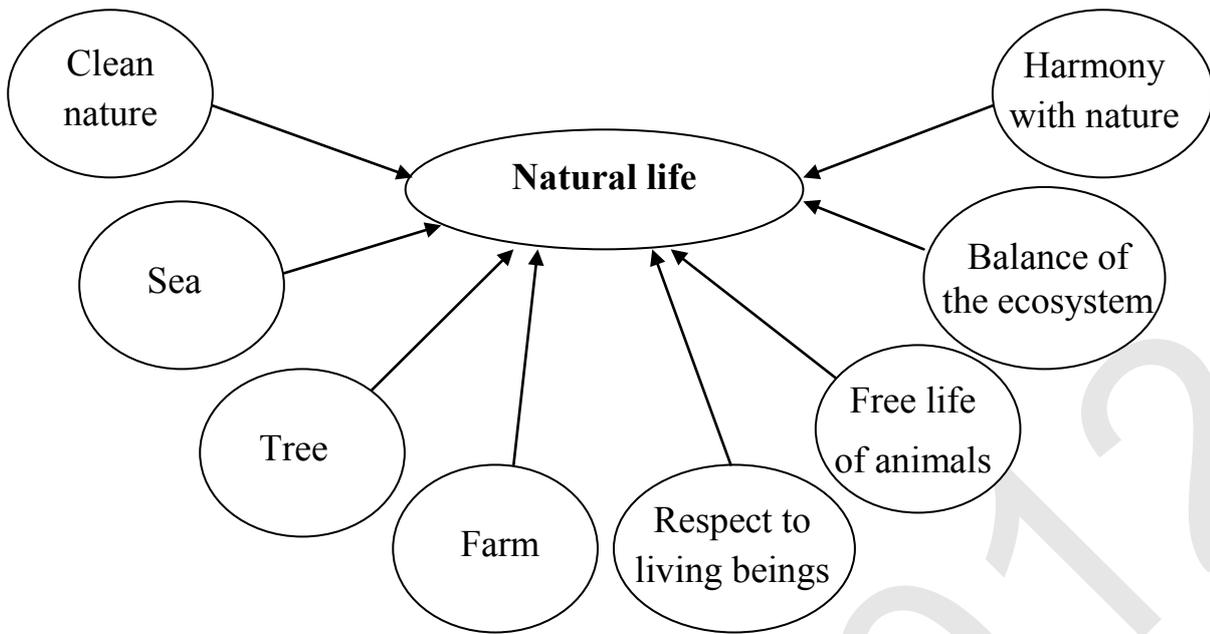
The responses of the pre-service teachers given to "In what kind of environment do you want to live? Please draw it" were classified under the categories presented in Table 1. As can be seen in Table 1, the pre-service teachers' responses given to this question before they participated in the nature education project are collected under five categories. Out of these categories, natural life and sustainable life categories came to the fore.

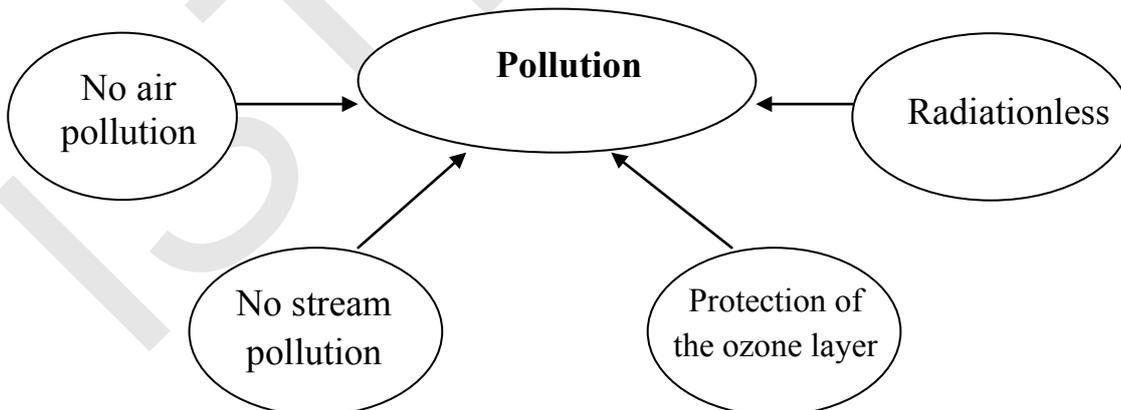
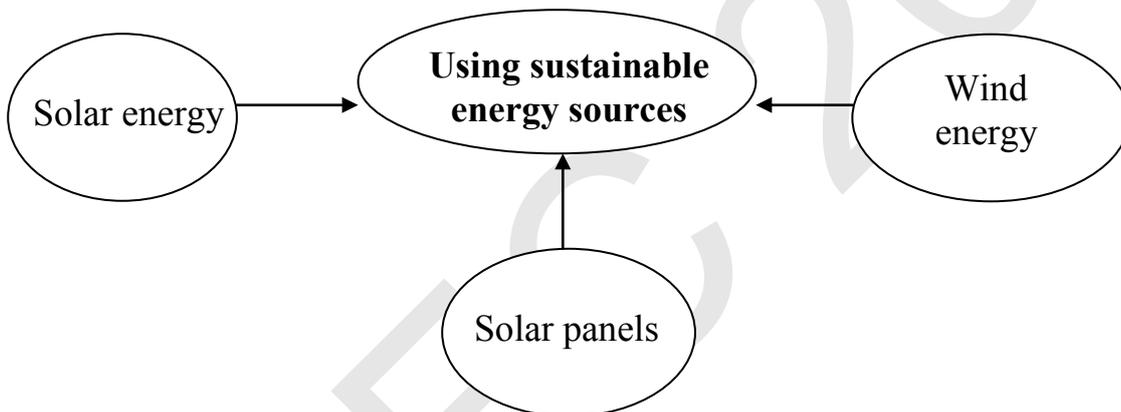
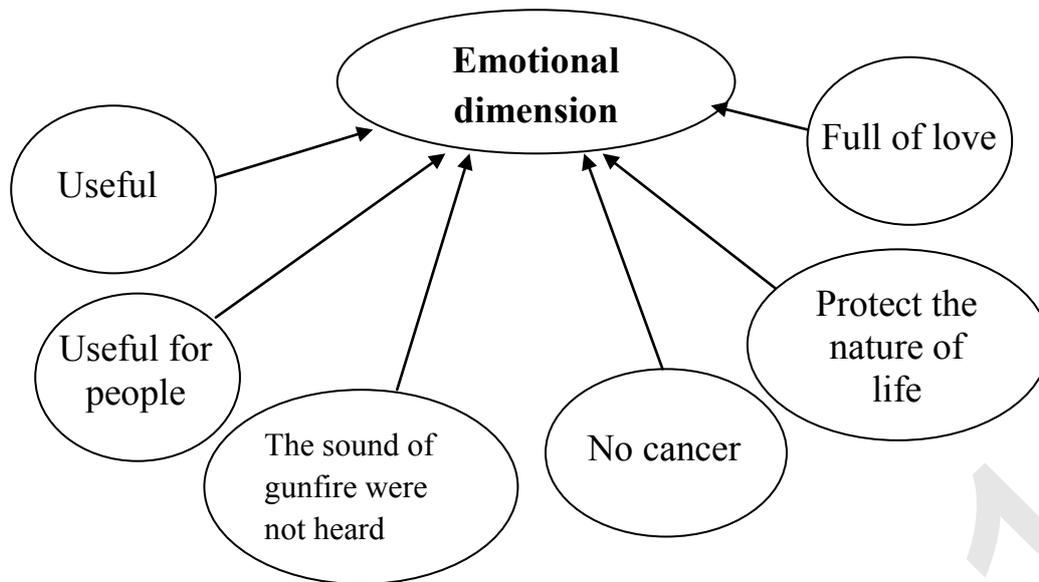
**Table 1:** The pre-service teachers' responses given to the question "In what kind of environment do you want to live? Please draw it."

| Categories                          | f  | %     |
|-------------------------------------|----|-------|
| Natural life                        | 25 | 42,37 |
| Sustainable living                  | 18 | 30,50 |
| Emotional dimension                 | 7  | 11,86 |
| The use of renewable energy sources | 5  | 8,47  |
| Pollution                           | 4  | 6,77  |

In figure 1, the concepts frequently mentioned by the pre-service teachers in each category are visualized.

**Figure 1:** Cognitive map of the responses of the pre-service teachers given to the question "In what kind of environment do you want to live? Please draw it."





The pre-service teachers' responses given to the second question were separately investigated by the researchers and then put into certain categories. Then, tables of frequency showing how many times each concept was repeated by the students were constructed. Then, the conceptualizations of the researchers performed separately were brought together to subsume them under common categories. The data obtained in this way are presented in tables below:

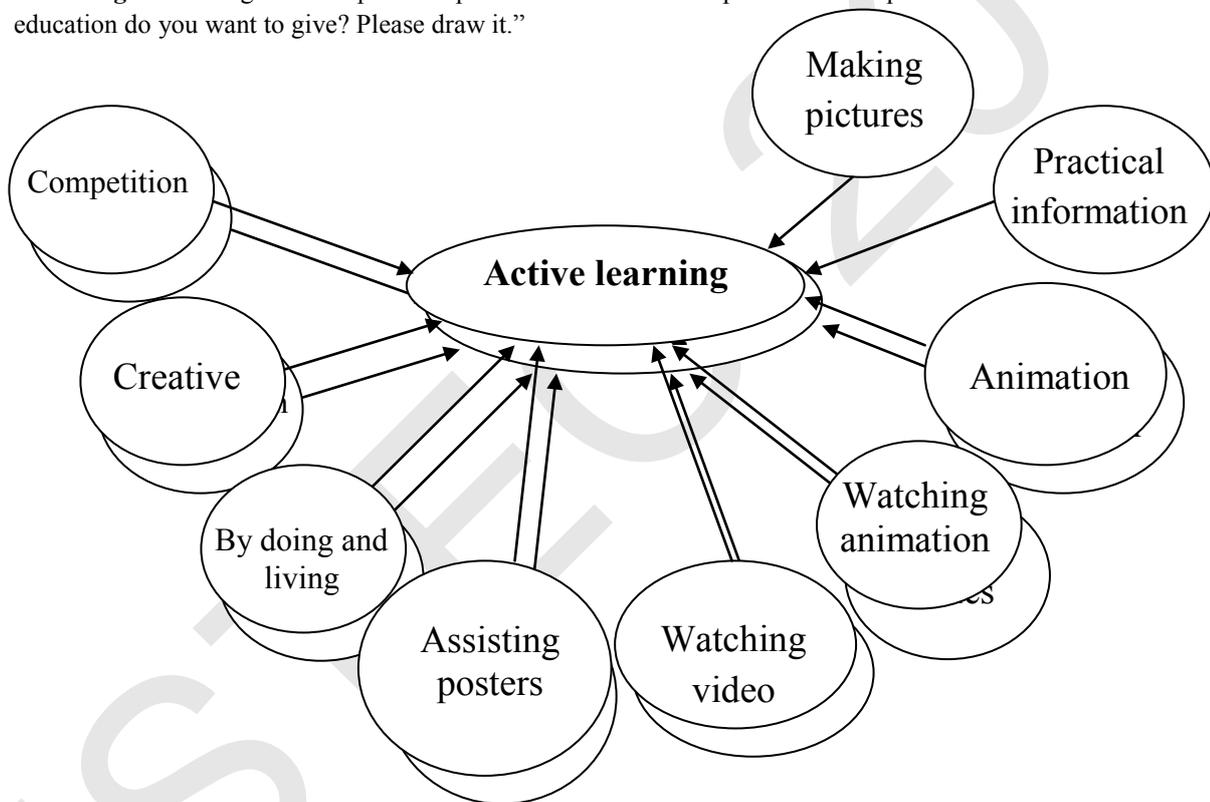
**Table 2:** The pre-service teachers' responses given to the question "What kind of environmental education do you want to give to your students? Please draw it."

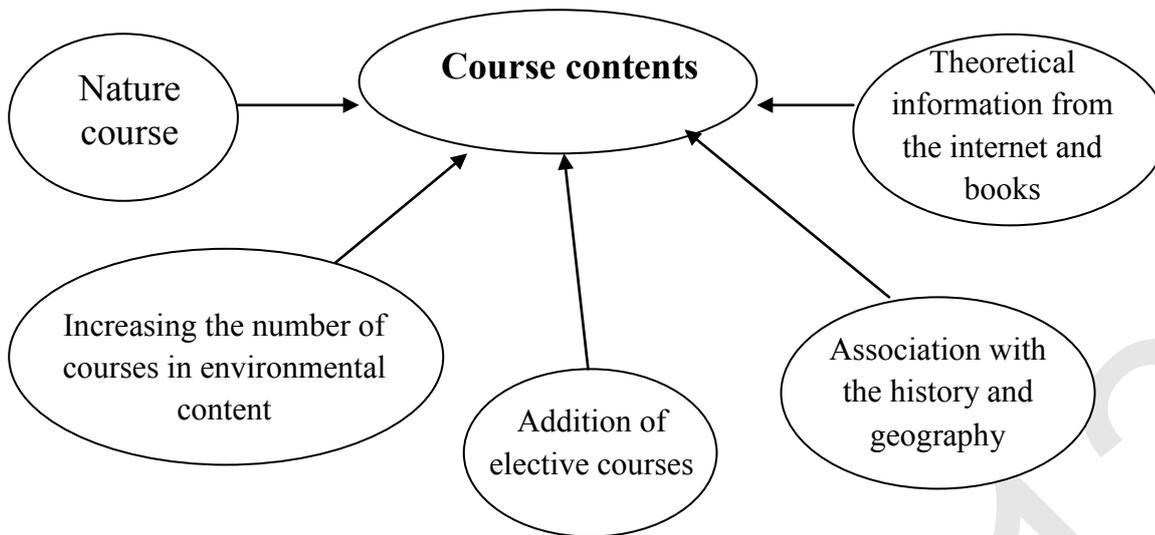
| Categories           | f  | %     |
|----------------------|----|-------|
| Active learning      | 21 | 35,59 |
| Hands-on training    | 17 | 28,81 |
| Parent training      | 7  | 11,86 |
| Content of courses   | 7  | 11,86 |
| Pre-school education | 4  | 6,77  |
| Public education     | 3  | 5,08  |

As can be seen in Table 2, the pre-service teachers' responses given to this question "What kind of environmental education do you want to give to your students? Please draw it." before they participated in the nature education project are collected under six categories. Out of these categories, active learning and hands-on training came to the fore.

The cognitive map of the pre-service teachers' responses to the question "What kind of environmental education do you want to give to your students? Please draw it." is presented in Table 2. And the categories presented in Table 2 are visualized in Figure 2. In these cognitive maps, the concepts mentioned by the pre-service teachers in relation to the categories are visualized.

**Figure 2:** Cognitive map of the pre-service teachers' responses to the question "What kind of environmental education do you want to give? Please draw it."





### *The Pre-service Teachers' Opinions about Environment and Environmental Education after Nature Education*

Following the nature education, the pre-service teachers were asked to draw to respond the first question and then the opinions emphasized in these drawings were separately categorized. Then, the tables of frequency showing how many times each concept was repeated by the students were formed. Then, the conceptualizations of the researchers performed separately were brought together to subsume them under common categories. The data obtained in this way are presented in tables below.

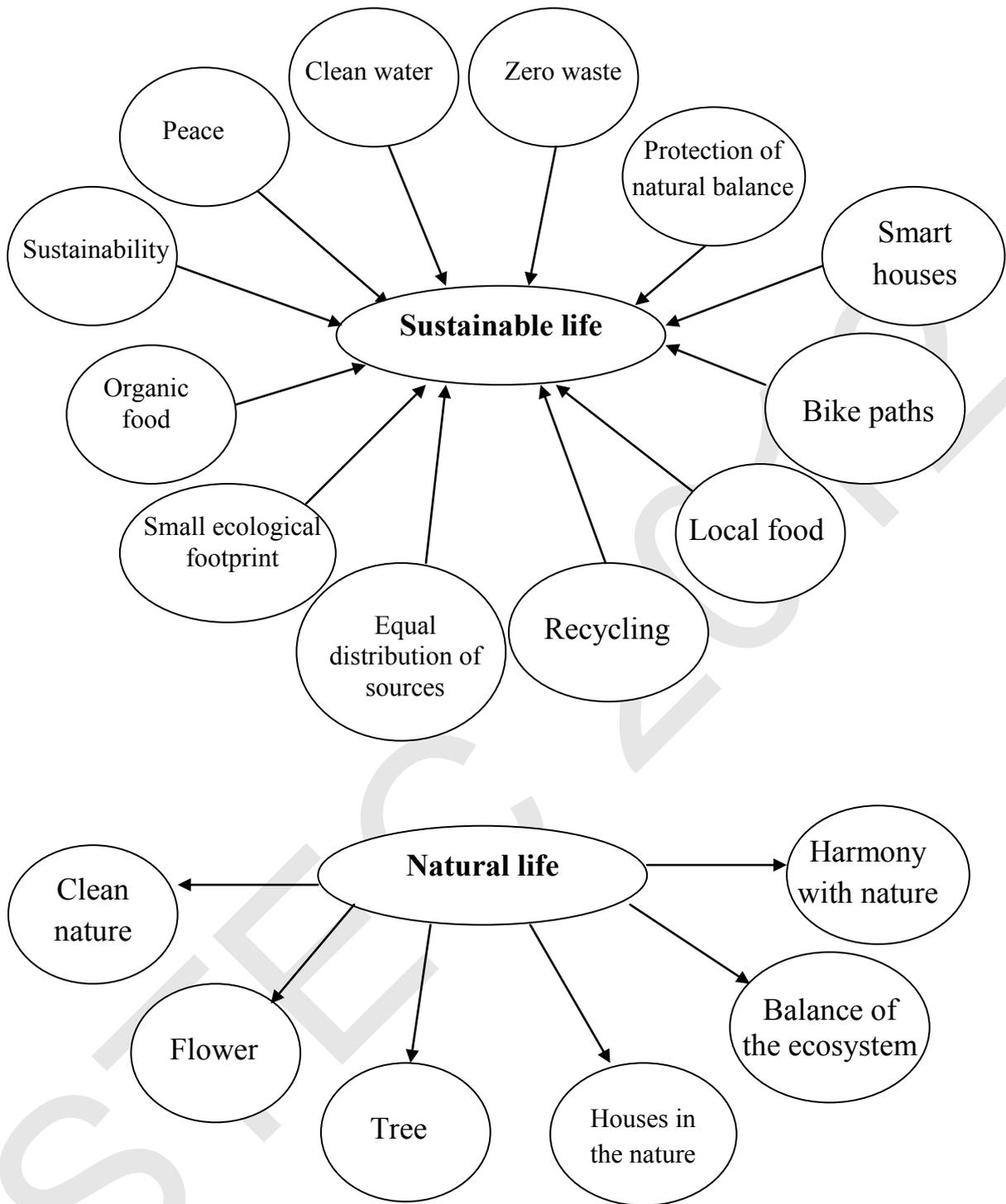
**Table 3:** The pre-service teachers' responses given to the question "In what kind of environment do you want to live? Please draw it."

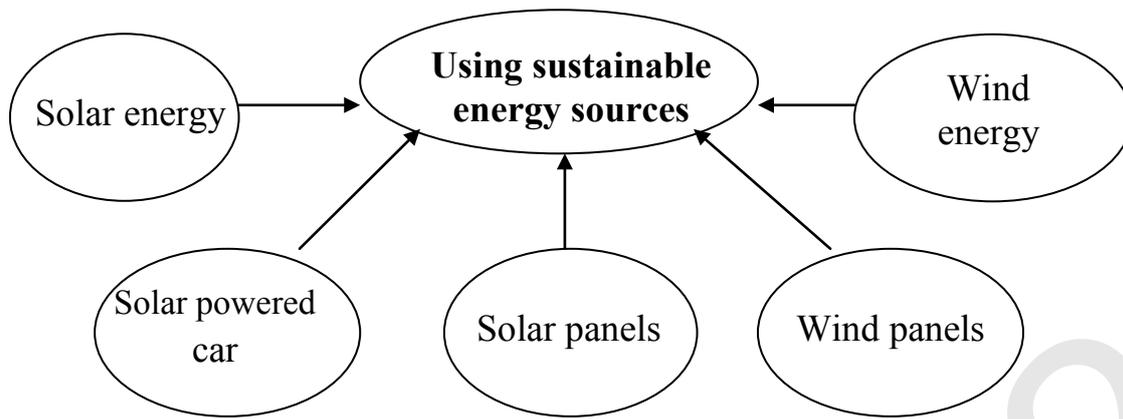
| Categories                          | f  | %     |
|-------------------------------------|----|-------|
| Sustainable living                  | 28 | 45,16 |
| Naturel life                        | 20 | 32,25 |
| The use of renewable energy sources | 14 | 22,58 |

As can be seen in Table 3, the pre-service teachers' responses to the question "In what kind of environment do you want to live? Please draw it." after they participated in the project are collected under three categories. Out of these categories, sustainable life and natural life categories came to the fore. Pollution and affective categories emphasized by the pre-service teachers before they participated in the project were not mentioned after the project.

The pre-service teachers' responses to the question "In what kind of environment do you want to live? Please draw it." were collected under categories in Table 3 and they were visualized in Figure 3. The cognitive maps concerning the concepts expressed by the pre-service teachers under the categories of sustainable life, natural life and renewable energy are presented below.

**Figure 3:** The cognitive map of the pre-service teachers' responses to the question "In what kind of environment do you want to live? Please draw it"





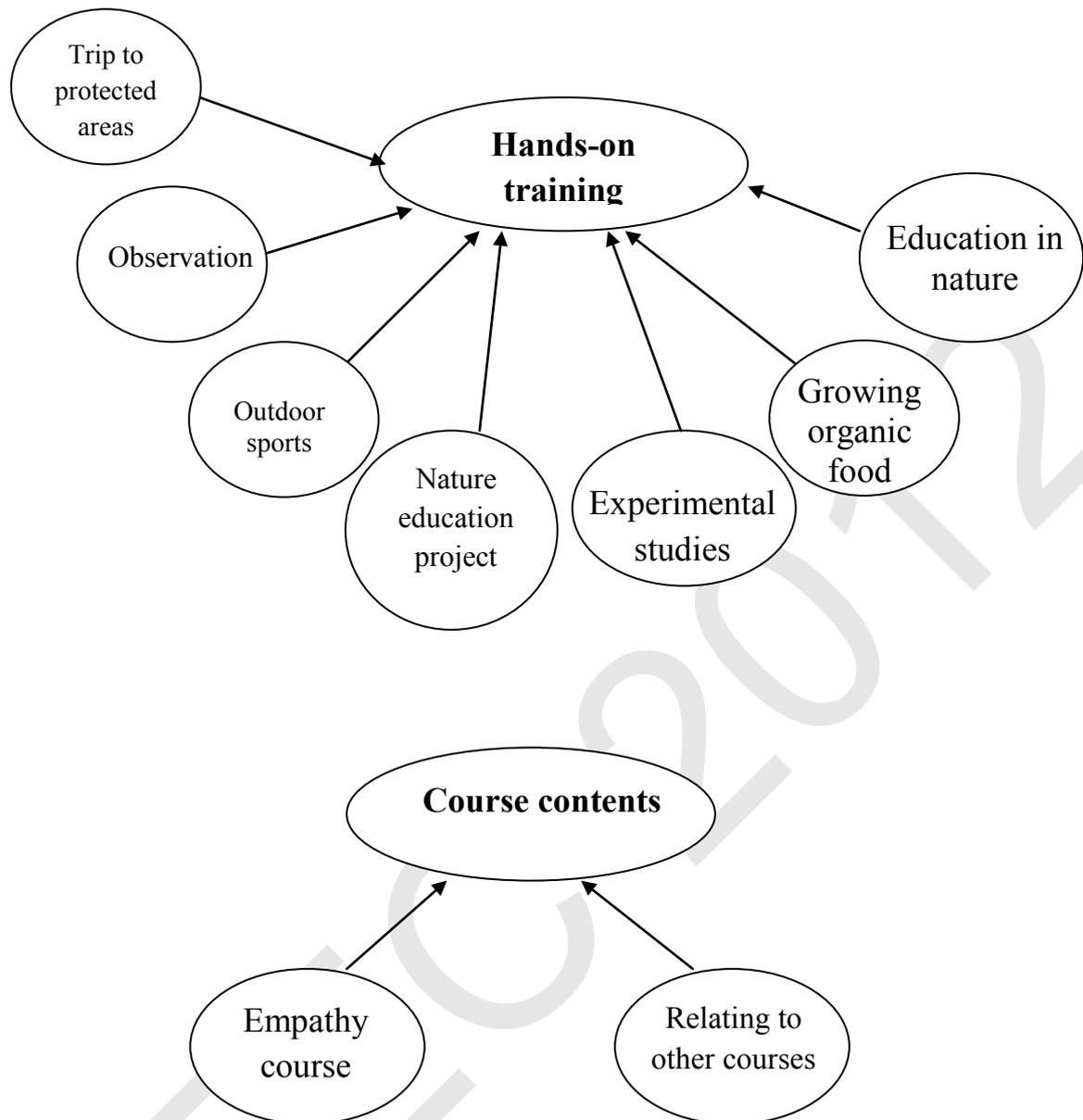
The pre-service teachers' responses to the second question were separately analyzed by the researchers and were put under certain categories. Then, the tables of frequency showing how many times each concept was repeated by the students were constructed. Then, the conceptualizations of the researchers performed separately were brought together to subsume them under common categories. The data obtained in this way are presented in tables below.

**Table 4: The pre-service teachers' responses given to the question "What kind of environmental education do you want to give to your students? Please draw it".**

| Categories          | f  | %     |
|---------------------|----|-------|
| Hands-on training   | 28 | 53,84 |
| Active learning     | 18 | 34,61 |
| Contents of courses | 4  | 7,69  |
| Parent training     | 1  | 1,92  |
| Public education    | 1  | 1,92  |

As can be seen in Table 4, the pre-service teachers' responses to the question "What kind of environmental education do you want to give to your students? Please draw it." were collected under five categories. Out of these categories, applied education, active learning and course contents categories came to the fore. The pre-service teachers' responses to the question "What kind of environmental education do you want to give your students? Please draw it" were collected under categories in Table 4 and they were visualized in Figure 4. The concepts expressed in the related categories are presented in the following cognitive figures.

**Figure 4:** Cognitive map of the pre-service teachers' responses to the question "What kind of environmental education do you want to give to your students? Please draw it."



## Discussion, Conclusions and Suggestions

It was found that the pre-service teachers' responses to the question "In what kind of environment do you want to live? Please draw it" concentrated on natural life and sustainable life concepts. Under the category of natural life; harmony with nature, balance of ecosystem, free living of animas, respect to living things, trees, seas and clean nature concepts were expressed. Under the category of sustainable life; sustainability, organic nutrients, purifying plants, harmony between technology and nature, recycling, local foods, cycling paths, harmony with nature and state subsidies concepts were expressed. Under the affective dimension, the pre-service teachers mentioned the concepts of utilization of renewable energy resources and pollution. Following the nature education; on the other hand, the pre-service teachers' responses to the same questions were collected under three categories called sustainable life, natural life and renewable energy resources. Different from what emerged prior to the application, under the category of sustainable life, peace, zero waste, small ecologic foot traces and equal distribution of resources were expressed. This shows that the participants' information about the basic principles of sustainable life enhanced after they participated in the study. Under the category of natural life; on the other hand, they mentioned the balance of ecosystem. However, while they mentioned the utilization of renewable energy resources before and after the application, they only focused on wind and solar energy.

It was observed in the pre-service teachers' responses to the question "What kind of environmental education do you want to give? Please draw it.", emphasis was put on the concepts such as active learning, hands-on training, parental education, course contents, pre-school education and public education. Under the category of active learning, the pre-service teachers mentioned organizing competitions, creative drama and learning by doing and experiencing. Under the category of applied education, they mentioned the concepts of field trips, observations, and environmental education projects. Under the category of course contents, they emphasized elective courses and increasing the number of courses with an environmental content. Following the nature education, they repeated the concepts such as applied education, active learning, course contents, parental education and public education. Different from the responses they gave before the study under the category of applied education, they mentioned the concepts of specially protected sites, nature sports, growing organic foods and experimental studies. Under the category of active learning, the concepts of student-centeredness, activity-based and alternative methods and techniques were emphasized. Under the category of course contents, they mentioned the concepts of the course of empathy and relating to other courses.

Following the nature education, the scope of the pre-service teachers' responses to these two questions was expanded. It was found that depending on the education given within the framework of the present study, the pre-service teachers' opinions improved. The concepts expressed by the pre-service teachers in their drawings show that the nature education has increased the participants' knowledge about environment. The findings of many studies carried out on environmental education support this finding. Findings of Benedict (1991) defining active learning as the key to achieving affective, ethical and behavioral objectives of environmental education and those of Ballantyne and Packer (2002) stating that interaction with nature is an effective strategy concur with the findings of the present study. Eaton (2000) stated that learning experiences occurring in open air are better than in-class learning experiences in terms of improving cognitive skills. Keleş, Uzun and Varnacı Uzun (2010) reported that nature education programs have significant influences on people's environmental consciousness, attitudes, and behaviors and enhance retention. Demirsoy emphasized the importance of field works by saying "field works have resulted in many people becoming scholars. But we have not been able to explain this fact to anybody. We have not been able to make it widespread" (Yanık, 2006).

In light of the findings of the present study, it is suggested that such projects supported by TÜBİTAK should be expanded and answers should be sought to the question "what type of environmental education should be given?"

## Acknowledgements

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# INVESTIGATION OF CONVECTION HEAT TRANSFER FROM POROUS BLOCKS

Ayla Dogan , Tugce Tezel

Department of Mechanical Engineering  
Faculty of Engineering  
Akdeniz University  
07058 Campus, Antalya, TURKEY

**Abstract :** An experimental study was conducted to investigate the convection heat transfer through a horizontal rectangular channel equipped the bottom wall with 8x2 porous blocks made of aluminum alloy. Porous blocks were placed on copper plates subjected to uniform heat flux. Open-celled aluminum blocks have different pore densities of 10, 20 and 40 PPI (Pore Per Inch). The whole channel surfaces were insulated. The experimental parametric study was made for foam aspect ratios of 0.5, 0.75 at Reynolds number 4241 and Grashof number  $5.0 \times 10^8$ . The effects of pore density and Aluminum-foam block height were reported. Obtained results show that row averaged-Nusselt number increases with decreasing pore density and increase with increasing aspect ratio of the foam blocks. As a result of comparison, aluminum foam having pore density of 10 PPI and aspect ratio of 0.75 shows higher thermal performance than those of 20 and 40 PPI.

**Key words:** Porous block, electronic cooling, convection heat transfer.

## Introduction

Along with the development of technology, need for new materials in heat transfer applications become necessary. Porous metal foams having large surface area to volume ratio and to intense mixing of the flow are using many heat transfer applications such as, compact heat exchangers, heat pipe technology, integrated circuit of electronic equipment and so.

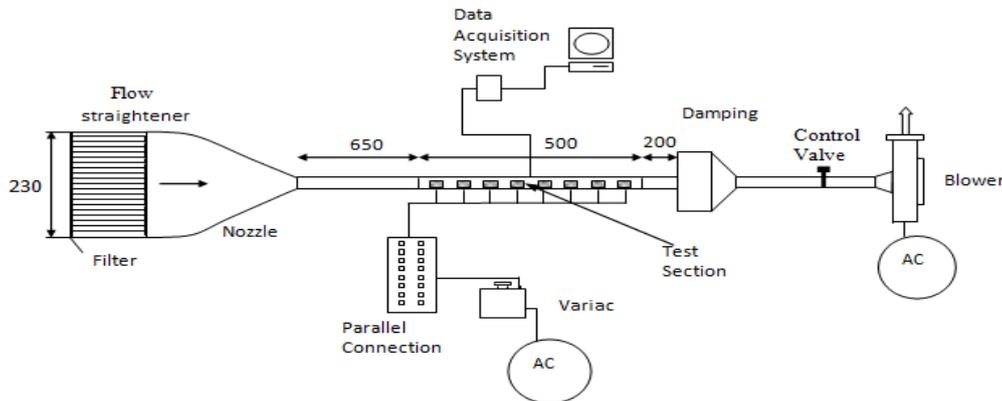
Among the thermal performance enhancement schemes, one of the promising techniques is the application of metal porous materials. Because they have the advantages of high thermal coefficient, high permeability, high heat-sinking capability and intense mixing of fluid flow. All electronic equipments have widely bad performance if their temperature exceeds certain limits. One of the ways to overcome the overheating of the chips is to augment the convective heat transfer by using extended heat transfer surfaces as well as by a cooling flow. Among the most usable materials to augment the heat transfer rate are copper or aluminum porous materials. The introduction of porous materials in channels has also been the subject of few studies. Cui (2001) et al., investigated forced convection flow through a porous channel with discrete heat sources on the upper wall. They made an experimental study and measured the temperatures along the heated channel wall with different heat fluxes and they calculated the local Nusselt numbers at different Reynolds numbers. An experimental investigation of forced and mixed convection heat transfer in a foam-filled horizontal rectangular channel was performed by Kurtbas (2009) et al. They investigated the heat transfer characteristics of open-cell metal foams with different pore densities (10, 20 and 30 PPI). Also, they compared the obtained results of all cases to that of the empty channel and literature. Another study was conducted by Kim (2001) et al., who made an experimental study to investigate impact of presence of aluminum foam on the forced flow and convective heat transfer in an asymmetrically heated channel. Paek (2000) et al., experimentally studied the effective thermal conductivity and permeability of aluminum foam materials. The permeability of aluminum foams was determined from the measured data of pressure drop. The effective thermal conductivity of the aluminum foam was little affected by the increase of pore density. Ko and Anand (2003) conducted a study on heat transfer enhancement in a rectangular channel by using porous baffle made up of aluminum foam. Baffles were mounted on top and bottom walls in a staggered fashion. The obtained results showed that the use of porous baffles resulted in heat transfer enhancement as high as 300% compared to heat transfer in straight channel with no baffles. Mixed convection heat transfer from arrays of discrete flush-mounted heat sources that subjected to uniform heat flux and put in lower and upper surfaces of a horizontal channel was investigated experimentally by Dogan (2005) et al. From these experimental studies, row-averaged surface temperature and Nusselt number distributions of the discrete heat sources were obtained. The results revealed that top and bottom heater surface temperatures increase with increasing Grashof number. Bea (2012) et al., conducted numerical computations for mixed convection in a channel with porous blocks. In their study, the heat flux from the most upstream heater was varied in a sinusoidal form, while the others had a constant heat flux. They reported the effects of pore density and of porous block height. Chikh (1998) et al., showed that the use of porous blocks may alter substantially the flow pattern and may improve heat transfer rate for optimal values of thermo-physical properties of the porous medium.

In the present work, an experimental study is carried out for an adiabatic horizontal channel where the lower surface on which equipped with intermitted aluminum porous blocks having different pore densities (10, 20 and 40 PPI).

This is the more realistic situation because of the fact that, 8x2 aluminum heat sinks configuration in a channel is chosen. Each aluminum-porous block is subjected to uniform heat flux. Experiments are conducted for different aluminum porous blocks aspect ratio of 0.50 and 0.75, respectively.

## Materials and Method

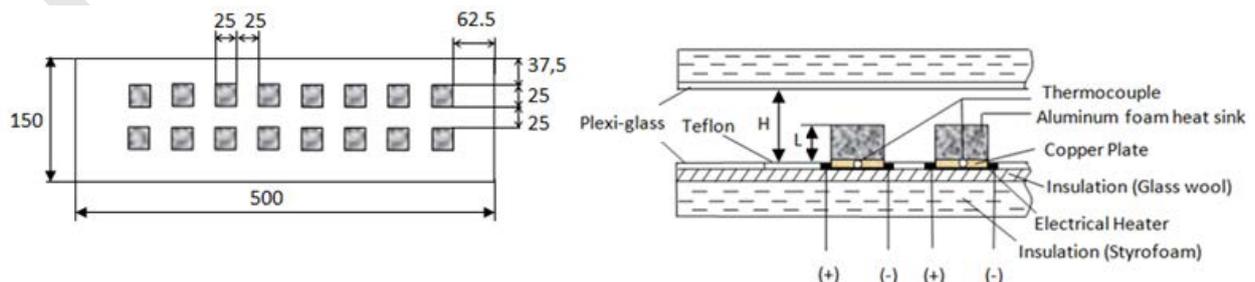
A summary of that information is presented below. Fig. 1. shows a schematic representation of the experimental set-up.



**Figure 1:** Schematic diagram of the experimental set-up (measures in mm)

The flow rate was measured with a hot wire anemometer (Testo 425) with an accuracy of 5%. A control valve was used to control the flow rate. The test section is isolated from the blower acoustically and mechanically with a damping chamber and flexible hosing. At the channel entrance, a nozzle with flow straightener was used in order to suppress turbulence and achieve steady, laminar flow conditions with a uniform velocity distribution at the channel entrance. The flow straightener was made of 5 mm diameter and 50 mm long plastic hoses, 250 in total. In addition, a filter is used for the incoming air. The nozzle is made of a 0.5 mm thick aluminum sheet and has been designed to eliminate flow separation, minimize turbulence, and provide a uniform velocity profile at the channel entrance.

The test section is a bottom heated rectangular duct with a cross section of 40 mm in height and 150 mm in width. The inlet section before the test section was used to achieve hydrodynamic boundary layer thickness which was greater than or close to the half of the channel height. Sides, the top and bottom entry, and exit regions of the duct are constructed of 5 mm thick plexi-glass. The top and sides of the channel were insulated with 50 mm Styrofoam. The bottom wall of the test section is made of 5 mm thick pure Teflon (PTFE) ( $k=0.25$  W/m K) in which the heat sources extended by aluminum porous blocks were embedded. This heated section was insulated with 20 mm Glasswool (Izopan) and 50 mm Styrofoam ( $k=0.028$  W/m K). Distribution of discrete aluminum porous blocks in the test section is shown in Fig. 2 with all the necessary dimensions. Aluminum porous blocks dimensions are  $25 \times 25 \times L$  mm. Here,  $L$  is the block height and gets the different value of 20 and 30 mm. Porous blocks having pore density of 10, 20 and 40 PPI were used in the experiments. The heating elements were electrically insulated and the resulting assembly was screwed to the copper plates using a heat sink compound providing the least possible contact resistance. Aluminum porous blocks were placed on these copper plates in the same way. The heater blocks were equipped with 30 gauge copper-constantan thermocouples one for each and at the center of the block. Electric current was provided to the heaters via a variac and a parallel connection board. TECHNIC VC-9808 multimeter with accuracy of  $\pm 0.5\%$  for voltage and  $\pm 0.2\%$  for resistance was utilized for this purpose. The whole process was controlled with a computer program developed specially for this experimental study. It was observed that experimental conditions reach a steady-state condition after approximately 3 to 4 h



**Figure 2:** Layout and dimensions of aluminum porous blocks and schematic of block assembly (measures in mm)

The particulars of the porous blocks are displayed in Table 1. The parameters to specify the porous blocks are the porosity, i.e., the volumetric fraction of void inside porous block, the pore density in pores per inch (PPI) and the permeability, i.e., the flow conductance (Kim et al., 2000) The permeability decreases as the pore density increases.

**Table 1 :** Particulars of the Aluminum porous blocks.

| Specimen   | Porosity ( $\epsilon$ ) | Pore density (PPI) | Permeability(m2) |
|------------|-------------------------|--------------------|------------------|
| 1(Al-6101) | 0.912                   | 10                 | 7.73x10-8        |
| 2(Al-6101) | 0.906                   | 20                 | 4.93x10-8        |
| 3(Al-6101) | 0.914                   | 40                 | 2.40x10-8        |

The amount of heat dissipation from each of the porous blocks in one row was very close to each other for all the experiments. Under this condition, experimental data were reduced in terms of a row-averaged Nusselt number for heater row  $j$  as given below.

$$\bar{Nu}_{D_h j} = \frac{Q_{cj} D_h}{A_{sj} (\bar{T}_{sj} - \bar{T}_b) k_{air}} \quad (1)$$

In this equation,  $Q_{cj}$  and  $A_{sj}$  are total values for each heater row  $j$ . The hydraulic diameter  $D_h$ , was used as the characteristic length as given below:

$$D_h = \frac{4A_c}{P} \quad (2)$$

Here  $A_c$  is the cross-sectional area and  $P$  is the perimeter of the channel. The bulk-mean temperature  $T_b$  was calculated from an energy balance applied to a control volume comprising one row of heat sinks together with non-heated sections. All thermophysical properties were evaluated at this bulk-mean temperature.  $T_s$  is the row-averaged surface temperature calculated from the thermocouple measurements.  $A_s$  is the total heater area in one row.  $Q_c$  is the corrected heat dissipation rate, which represents the heat transferred to the fluid directly by convection through the heater face.  $Q_c$  was calculated from an energy balance as given below:

$$Q_{cj} = Q_{tot j} - Q_{cond j} - Q_{rad j} \quad (3)$$

The results of experiments showed that the radiation losses never exceeded 5% of total power dissipated. Therefore it was neglected in the calculations.

In these calculations, first the total heat addition from the resistance heaters was calculated from:

$$Q_{tot j} = 2 \frac{V^2}{R} \quad (4)$$

where  $V$  is the voltage drop across the heater and  $R$  is the resistance of the heater. From this value  $Q_c$  was calculated by subtracting losses due to conduction and radiation.  $Q_{cond j}$  is the sum of conduction heat transfer rate from channel walls to insulation material

Here,  $T_b$  the arithmetic average of the bulk-mean fluid temperature for two adjacent rows was calculated from:

$$\bar{T}_b = \frac{T_{bj} + T_{bj+1}}{2} \quad (5)$$

Other dimensionless numbers affecting the heat transfer are:

The Reynolds number:

$$Re_{D_h} = \frac{U_{in} D_h}{\nu_{air}} \quad (6)$$

The modified Grashof number:

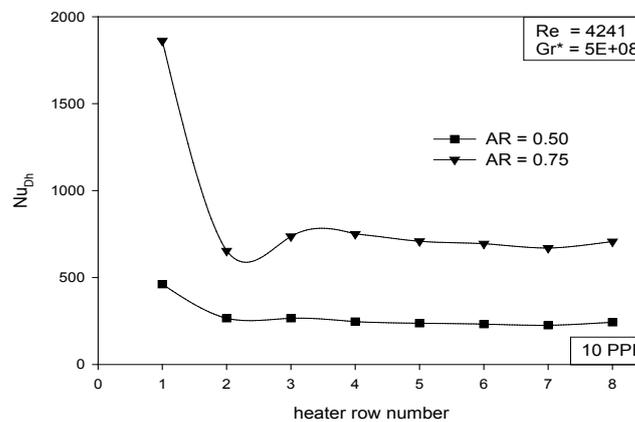
$$Gr^*_{D_h} = \frac{g \beta q_c D_h^4}{k_{air} \nu_{air}^2} \quad (7)$$

where,  $q_c$  is the average convection heat flux for all the heaters.

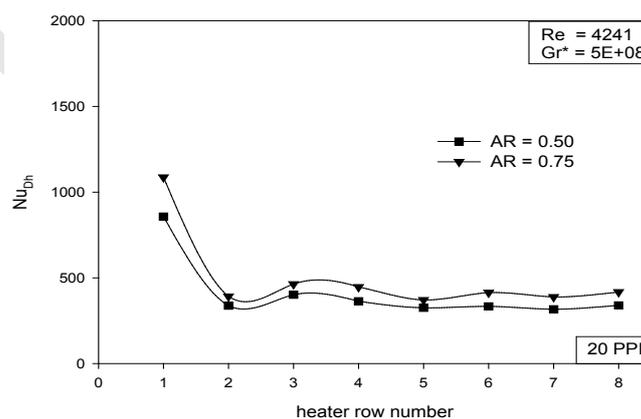
In order to determine the reliability of the experimental results an uncertainty analysis was conducted on all measured quantities as well as the quantities calculated from the measurement results. Uncertainties were estimated according to the standard procedures reported in the literature. Overall, the uncertainty in the Nusselt number is around  $\pm 5.2\%$  and for the Grashof number it is around  $\pm 4.4\%$ , which is primarily due to uncertainties in the convective heat flux values. Uncertainty in the Reynolds number is around  $\pm 3.1\%$ .

## Results and Discussions

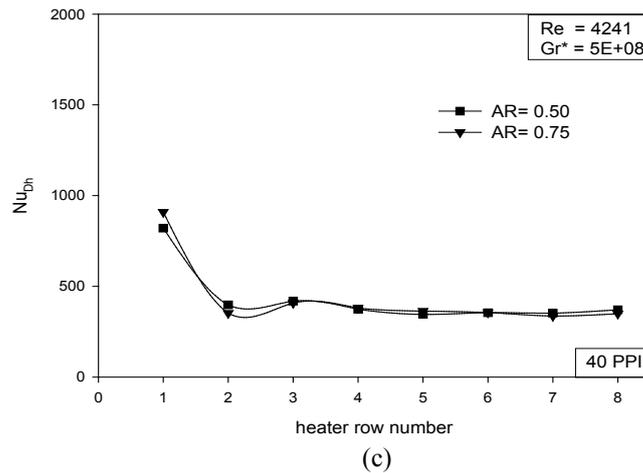
The effect of porous block aspect ratio on heat transfer is illustrated in Figure 4 for  $Re=4241$  and  $Gr^*=5 \times 10^8$ . The heat transfer rate is enhanced substantially as the aspect ratio increases. In Fig. 4(a) it can be observed clearly that Nusselt number values increase with increase of aspect ratio especially for 10 PPI porous blocks. At the beginning of the heated section, the row averaged Nusselt number variations show a forced convection thermal entry region characteristic. After the second row, Nusselt number slightly increases because of buoyancy effect which accelerates development of the secondary flow. In Fig. 4(b), for 20 PPI porous blocks, the difference between two aspect ratio decreases and Nusselt number values close up to each other along the row in the channel. As shown Fig 4(c) row-averaged Nusselt number values take almost the same values and very little fluctuation is observed in Nusselt number through downstream for 40 PPI. For blocks with low permeability or high porosity, recirculation flow appear between the blocks and prevent fluid from going through the next row as mentioned numerical study of Chick (1998) et al. Therefore the row averaged-Nusselt number repeats itself downstream of the channel. Consequently, aluminum porous blocks having pore density of 10 PPI show higher heat transfer rate compared with 20 and 40 PPI due to its large surface area to volume ratio and intense mixing of fluid flow.



(a)

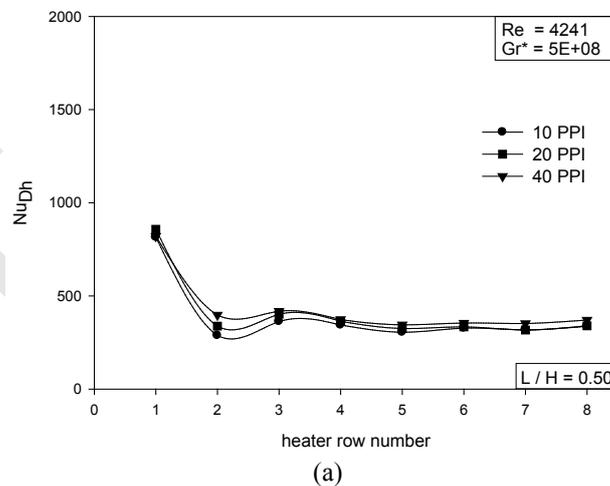


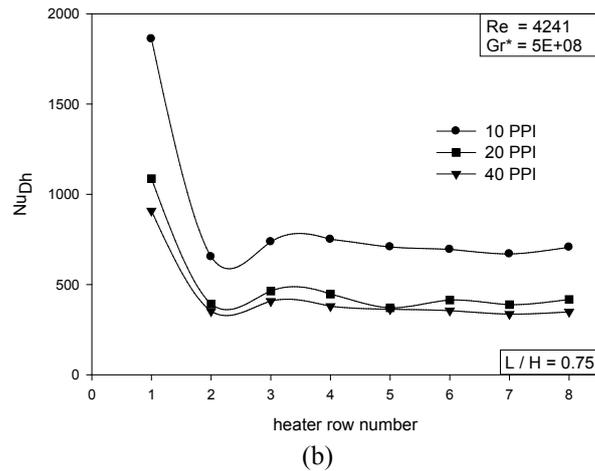
(b)



**Figure 4 :** Effect of various aspect ratios on Nusselt number for (a) Al 10PPI, (b) Al 20 PPI and (c) Al 40 PPI

Fig. 5 represents the row averaged-Nusselt number for different aspect ratio of blocks having pore densities of 10, 20 and 40 PPI. It can be seen from the Fig 5(a), Nusselt number values are very close to each other for all pore densities for AR=0.50. However, in Fig 5(b) all blocks having different pore densities represent larger Nusselt number for aspect ratio of 0.75 along the rows. At the beginning of the heated section, the row averaged Nusselt number variations show a forced convection thermal entry region characteristic. Nusselt number at first row of the porous block increases appreciably as the pore density decreases. This can be explained by noting that the flow resistance decreases as the pore size increases, which gives rise to an increased penetration of fluid into the porous block. After the second row Nusselt number slightly increases because of buoyancy effect which accelerates development of the secondary flow. But for the block 4-8, enhancement of heat transfer is not significant. For these blocks, there exist inter block recirculation flows, which weaken the penetration of fluid into the blocks. At the downstream of the rows in the channel, the penetration of fluid into the block is minimal, and convective heat transfer is decreased within the block as mentioned the numerical study of Bae (2012) and Chick (1998). In Fig. 5(b), the difference between row averaged-Nusselt number values increases with decreasing pore densities for aspect ratio of 0.75. Accordingly, the pore density of 10 PPI and aspect ratio of 0.75 porous blocks higher thermal performance than 20 and 40 PPI for the same aspect ratio and the same condition.





**Figure 5 :** Effect of various pore densities on Nusselt number for AR=0.50 and AR=0.75, respectively.

## Conclusions

Experiments were conducted to study heat transfer enhancement in a rectangular channel by using aluminum porous blocks having different pore densities of 10, 20 and 40 PPI. Aluminum foams were mounted on bottom wall of the channel in the order of 2x8. Experiments were conducted in Reynolds number 4241 and Grashof number  $5 \times 10^8$ . Aspect ratio was varied from 0.50 to 0.75. For the aspect ratio of 0.75, all foams higher heat transfer performance at the inlet of the heated section which is affected forced convection flow. According to data obtained from this work, heat transfer increases especially for the foam of lower pore density (10 PPI). Heat transfer enhancement at the middle section of the row was affected buoyancy flow for 10 PPI and aspect ratio of 0.75. Heat transfer enhancement at the downstream heaters is minor because of the recirculating flow between the foam blocks.

## Acknowledgements

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# INVESTIGATION OF OPTIMUM MIXTURE BY USING TAGUCHI DESIGN APPROACH FOR PRECAST CONCRETE

Yasemin Tabak\*, Kasım Baynal\*\*, Mert Onan\*\*\*, Ekrem Altuncu\*\*\*\*

\* TUBITAK MRC, Materials Institute, Gebze/Kocaeli

\*\* Faculty of Engineering, Department of Industrial Engineering, Kocaeli University, Kocaeli

\*\*\* Faculty of Engineering, Department of Metallurgical and Materials Engineering, Kocaeli University, Kocaeli

\*\*\*\* Faculty of Technology, Department of Metallurgical and Materials Engineering, Sakarya University, Sakarya

**Abstract:** Taguchi Method is an experimental design technique to minimize the effects of the uncontrollable factors by using orthogonal arrays. In this technique, various methods are used to determine the levels of the factors.

This paper presents the results of an experimental investigation carried out to optimize the mix proportions of the precast concrete by Taguchi method of parameter design. The experiments have been designed using an  $L_9$  orthogonal array with four factors and three levels each of them. Small quantity of cement has been mixed as binding materials. Cement, ceramic wall tile waste, coarse aggregate, stone dust used are indicated as mixing material and water binder ratio has been considered as one of the control factors. So the effects of water/binder ratio, ceramic wall tile, coarse sand, and stone dust on the performance characteristic are analyzed using signal-to-noise ratios and mean response data. According to the results, water/binder ratio and stone dust play the significant role on the compressive strength of the concrete. Confirmatory experimental result obtained for the optimum conditions.

**Key words:** Concrete, Taguchi design, Compressive strength

## Introduction

In this paper, the results of an investigation carried out to better understand the mechanisms of deterioration of low water-binder ratio of concrete and the effect of low volume mineral admixtures on the concretes in different curing regimes and curing times are presented. The experimental work was designed to give, using the Taguchi method, the optimum working conditions of the parameters that affects some physical properties of concrete mixtures. One of the advantages of the Taguchi method over the conventional experimental design methods, in addition to keeping the experimental cost at the minimum level, is that it minimizes the variability around the investigated parameters when bringing the performance value to the target value. Its other advantage is that the optimum working conditions determined from the laboratory work can also be reproduced in the real production environment.

Precast concrete consists of concrete (a mixture of cement, water, aggregates and admixtures) that is cast into a specific shape at a location other than its in-service position. The concrete is placed into a form, typically wood or steel, and cured before being stripped of the form, usually the following day. These components are then transported to the construction site for erection into place. Precast concrete can be plant-cast or site-cast, but this book deals specifically with planted-cast concrete. Precast concrete offers a wide range of benefits and advantages to the designer to help meet all of the owner's goals. Precast concrete's most dramatic benefit may be the speed with which it can be designed, cast, delivered, and erected. This can ensure that projects stay on schedule and meet tight deadlines. Precast concrete can speed the construction process in a variety of ways [1].

Ceramic waste from ceramic and construction industries is one of the most important parts in the global volume of construction and demolition waste (CDW). The Ceramic waste from ceramic and construction industries is a major contribute to CDW, representing a serious environmental, technical, and economical problem of nowadays society [2]. As a result, recent years have witnessed rising social concern about the problem of waste management in general, and industrial waste and waste from the construction industry in particular. This problem is becoming increasingly acute due to the growing quantity of industrial, construction and demolition waste generated despite the measures which have been taken in recent years at European Community, national and regional levels aimed at controlling and regulating waste management, in accordance with sustainable development policies and the Kyoto Protocol [3].

Thus the objective of the present study is to find out the optimum mix design for making brick so as to achieve the maximum compressive strength. The experiments were designed using an  $L_9$  standard orthogonal array considering the process parameters such as water/binder ratio, ceramic wall tile, coarse sand, and stone dust and each with three levels. Results derived from statistical analysis of the experimental data were presented, based on Taguchi's parameter design technique. After experimental studies over materials like concrete, mechanical properties such as strength etc. was explained by using different orthogonal array Taguchi Design [4,5]. Only Water-Cement ratio (W/C) is the most effective variable according to other variables and is determined in the experiment results [5]. The optimization of concrete freezing resistance was investigated by controlling response variables; bending and pressure strengths. These

mechanical properties on failure life of concrete was shown both of them are effective on the concrete freezing resistance and also there are linear relationship between bending and pressure strengths [6].

## Experimental Design-Taguchi Methodology

The objective of the ‘‘Taguchi method’’ is to obtain products (or processes) more robust under varying environmental conditions and to consider the variability in the products’ components (sub-products). The Taguchi method after bringing the mean performance of products to some targeted values has shown that experimental designs could be used to make the variability around the targeted value minimum. According to Taguchi, the performance of a product (i.e. optimum working conditions) may be affected by

1. Environmental conditions in which it is going to be used and
2. Components used in its production.

Thus, when determining the optimum working conditions, environmental conditions in which the product will be used and details of its components should be taken into account. The parameters affecting the product may be divided into two groups as follows:

1. Controllable and
2. Uncontrollable.

Because of the very high cost, instead of determining uncontrollable parameters and removing them, values of controllable parameters, which will reduce the negative effects of uncontrollable parameters, should be investigated. Controllable parameters can further be divided into three groups with respect to their effects on the performance of the product [7]:

1. Control parameters,
2. Adjustment parameters, and
3. Ineffective parameters.

## Materials and Method

In this study, availability of ceramic wall tile wastes in concrete production has been investigated. For this purpose, experiments were made two samples produced for determining physical and mechanical features of concretes produced through using wall tile wastes as aggregate. Pressure and bend strength and wearing tests were made to produce concretes.

Achieve to optimization of mix proportions of precast concrete, variable material, contains different factors and level were used, are given in the Table 1. In experimental studies, 4 different control factors were used and these are water/binder ratio, wall tile waste, coarse aggregate and stone powder. Each control factor is in 3 levels and given in Table 2. Orthogonal sequence was used in experimental studies. The use orthogonal sequence is  $L_9 (3^4)$  and given in Table 3.

**Table 1.** Materials used in the experiments are given to production properties and standards [8,9]

| Materials        | Description   |
|------------------|---|
| <b>Cement</b>    | In experimental studies, CEM I 42.5 R Portland Cement having TS EN 197-1 standard and packaged in 50 kg bags produced by Cement Factory (NUH ÇİMENTO) in Hereke was used.   |
| <b>Aggregate</b> | No II stone chips of which unit weight is 2744 kg/m <sup>3</sup> , stone powder of which unit weight is 2736 kg/m <sup>3</sup> and wall tile breakings having 2460 kg/m <sup>3</sup> unit size of no I stone chips is maximum 8 mm (wall tile size), size of no II stone chip is 16 mm. |
| <b>Water</b>     | In chemical analysis of mains water, it has been seen that the water is appropriate for mixing water qualifications in ‘‘TS 1247 Concrete Production, Pouring and Maintenance Rules’’.  |

**Table 2.** The factors and levels are used in the experiments according to Taguchi Method

| Factors                        | Level 1 | Level 2 | Level 3 |
|--------------------------------|---------|---------|---------|
| <b>A: Cement/Water ratio</b>   | 0.4     | 0.5     | 0.6     |
| <b>B: Wall tile (%)</b>        | 25      | 35      | 40      |
| <b>C: Coarse aggregate (%)</b> | 20      | 24      | 28      |
| <b>D: Stone powder (%)</b>     | 30      | 40      | 50      |

**Table 3.**  $L_9 (3^4)$  Standard orthogonal sequence

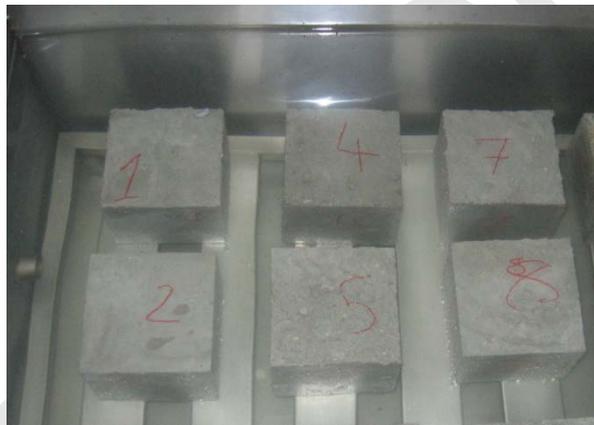
| Experiment no. | Factor A | Factor B | Factor C | Factor D |
|----------------|----------|----------|----------|----------|
|----------------|----------|----------|----------|----------|

|   |   |   |   |   |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 2 | 2 | 2 |
| 3 | 1 | 3 | 3 | 3 |
| 4 | 2 | 1 | 2 | 3 |
| 5 | 2 | 2 | 3 | 1 |
| 6 | 2 | 3 | 1 | 2 |
| 7 | 3 | 1 | 3 | 2 |
| 8 | 3 | 2 | 1 | 3 |
| 9 | 3 | 3 | 2 | 1 |

## Production of Concrete

For the purpose of determining physical and mechanical features of concretes to be used in the study, cube samples of dimensions as 15x15x15 cm and beam samples of dimensions as 15x15x30 cm were produced. Only one cure was applied for producing samples, period of this cure is 28 days and kept waiting at Standard cure conditions (in saturated water of  $21 \pm 1^\circ\text{C}$  suitable for lime). During experiments, views odd samples in cure bath are shown in Figure 1. Tests made to hardened concrete are as follows.

1. Compressive strength
2. Bending strength
3. Presence of wearing resistances



**Figure 1.** Keeping samples waiting in cure bath

## Compression Strength Measurements

Compressive strength of concrete is called as resistance capability of concrete under axial pressure load for not is broken (maximum stress formed in concrete with the influence of axial pressure load) and an example compression has been given in Figure 2.



**Figure 2.** Compression strength test of concrete material

It will enable to have an opinion on determining the load amount that concrete samples at certain ages will be able to carry and the load that the concrete produced with the same mixture in an actual application will be able to carry [10]. These experiments of 2-7 and 28 days carried out based on TS 3323 have been performed in deformation controlled concrete and cement test press (MATE brand) having 3000 tons capacity. The smoothest surface of samples was placed onto the press table as contacting to press table and as concrete pouring direction is horizontal and breaking loads were calculated. Compressive strengths of samples were obtained by dividing breaking loads obtained with the help of Compressive strength equality 1 into the surface area measured at the beginning of the experiment [11].

$$\sigma_b = \frac{P}{A} \quad (\text{Eq. 1})$$

In equation 1, terms are  $\sigma_b$ ; Compressive resistance, P; breaking load, A; area of the surface on which pressure was applied.

### Bending Strength Measurements

Bending strength of concrete is determined through a simple beam method loaded from one-third points over beam samples, simple beam method loaded from middle point and a sample bend is given in Figure 3. Bending strength of a concrete sample is calculated by using the following formulas [12].

In simple beam method loaded from one-third points, if breaking occurred in one-third middle part,

$$\sigma = \frac{P \times L}{b \times h^2} \quad (\text{Eq. 2})$$

If breaking occurred on out of one-third middle point,

$$\sigma \times a = \frac{3P \times L}{b \times h^2} \quad (\text{Eq. 3})$$

formula is used. Here;

$\sigma$  = Tensile strength in bend, (kgf/cm<sup>2</sup>)

E= Elastic modulus of material (MPa)

P = The biggest load at the breaking moment on experimental press, (kgf)

L = Clearance between loading table basis, (cm)

h = Average weight of breaking edge, (cm)

a = Average distance between breaking line and nearby basis, (cm).



**Figure 3.** Applied concrete specimen of a bending strength measurement

### Wear Loss Measurements

Abrasion resistance is a most important characteristic of concrete floors and paved surfaces. The Abrasion resistance of concrete pavements is a surface property that is mainly dependent on the quality of the surface layer characteristics. The top 1-3 mm is the most important part for the abrasion resistance of the concrete product. Cement content, water-cement ratio, cement type, aggregate type, the use of pigments and curing regime are the factors that influence abrasion resistance [13].

Concrete specimens prepared as rectangle samples of 9x5cm were calculated on daily post-cure abrasion resistance concrete abrasiveness test equipment (Figure 4). The abrasion resistances of the produced concrete samples were made at 500 loop and 30 rpm rotational speed.



**Figure 4.** Wear specimens of concrete

In structural engineering, especially stone structured elements are influenced by abrasion event. Therefore, materials used in places such as concrete road, airport, stairs, floorings, etc. should be resistant to abrasion [14].

### Results and Discussion

The aim of this paper is the assessment of the properties of concrete which use waste ceramic as an aggregate partial substitute. To achieve this, compression resistance, bending strength and weight loss measurement to ensure that fundamental parameters needed in the design are evaluated. The data in the Table 4 indicate that the Compression resistance, bending strength and weight loss measurement results depending on the experimental design matrix.

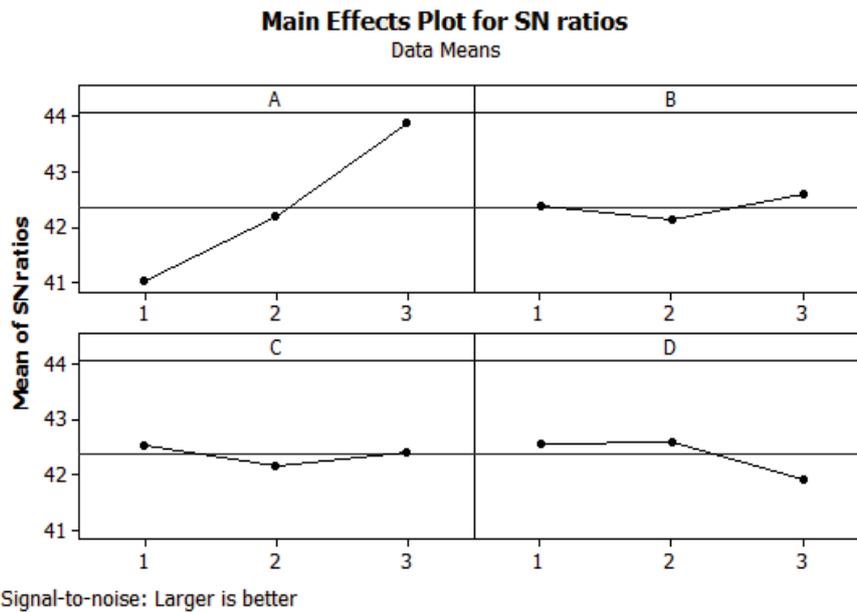
**Table 4.** Compression resistance, bending strength and weight loss measurement results depending on the experimental design matrix

| Test | Pressure strength-1 | Pressure strength-2 | Pressure strength-3 | Bending Strength-1 | Bending Strength-2 | Bending Strength-3 | Weight Loss-1 (%) | Weight Loss-2 (%) |
|------|---------------------|---------------------|---------------------|--------------------|--------------------|--------------------|-------------------|-------------------|
|      |                     |                     |                     |                    |                    |                    |                   |                   |

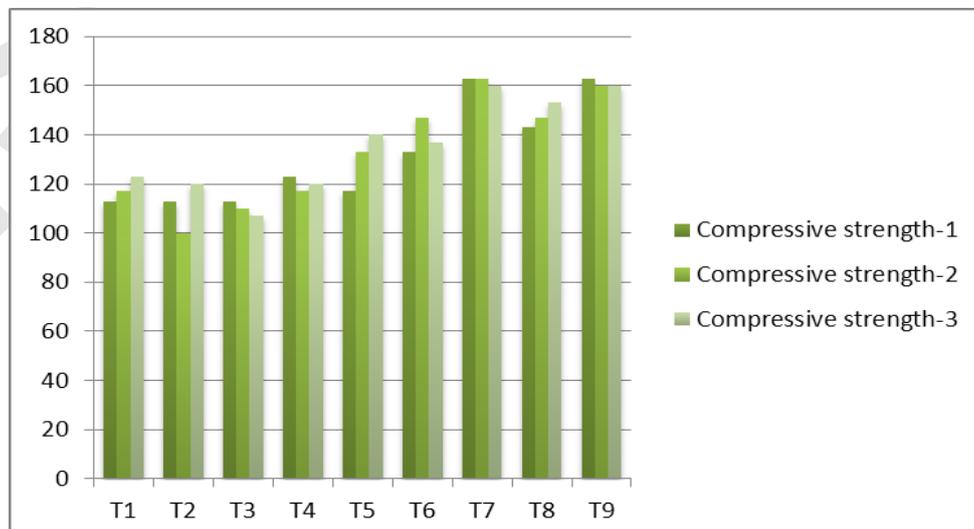
|           |     |     |     |      |      |      |      |      |
|-----------|-----|-----|-----|------|------|------|------|------|
| <b>T1</b> | 113 | 117 | 123 | 1,56 | 1,58 | 1,54 | 0,70 | 0,72 |
| <b>T2</b> | 113 | 100 | 120 | 1,32 | 1,34 | 1,36 | 0,86 | 0,90 |
| <b>T3</b> | 113 | 110 | 107 | 1,24 | 1,26 | 1,25 | 1,20 | 1,46 |
| <b>T4</b> | 123 | 117 | 120 | 1,36 | 1,35 | 1,38 | 0,94 | 1,10 |
| <b>T5</b> | 117 | 133 | 140 | 2,26 | 2,25 | 2,27 | 0,62 | 0,64 |
| <b>T6</b> | 133 | 147 | 137 | 3,10 | 3,20 | 3,18 | 0,36 | 0,38 |
| <b>T7</b> | 163 | 163 | 160 | 4,40 | 4,16 | 4,26 | 0,24 | 0,32 |
| <b>T8</b> | 143 | 147 | 153 | 3,64 | 3,62 | 3,46 | 0,42 | 0,44 |
| <b>T9</b> | 163 | 160 | 160 | 4,20 | 4,12 | 4,18 | 0,18 | 0,24 |

In experimental studies, cement/water ratio (Factor A) appears as the most effective factor. With the increase in cement/water ratio, the compression resistance increases, too. The most important factor following cement/water ratio is stone powder (Factor D). Increase in stone powder amount leads to decrease in pressure resistance at high levels. Due to changing setting time arising from hydration heat change, addition of stone powder over medium level plays an effective role in decrease of pressure resistance causing segregation. Based on the measurement results, regression analysis has been determined and given in the Equation 4. There is a 93.4% harmony between obtaining variables and correlation. This case is the indication of reliability of measurement results, and also adjusted R value is found approximately 86.7% by using Minitab Software.

$$\text{Average Compression resistance} = 96.8 - 5.17 D - 0.39 C + 1.72 B + 22.0 A \quad (\text{Eq. 4})$$



**Figure 5.** Main effects of Compressive strength according to S/N ratio results



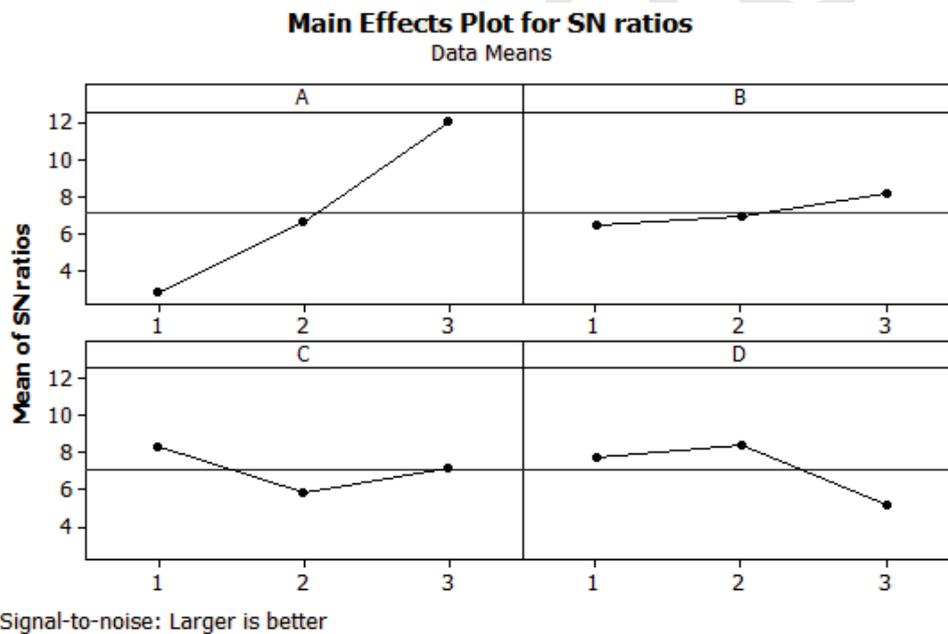
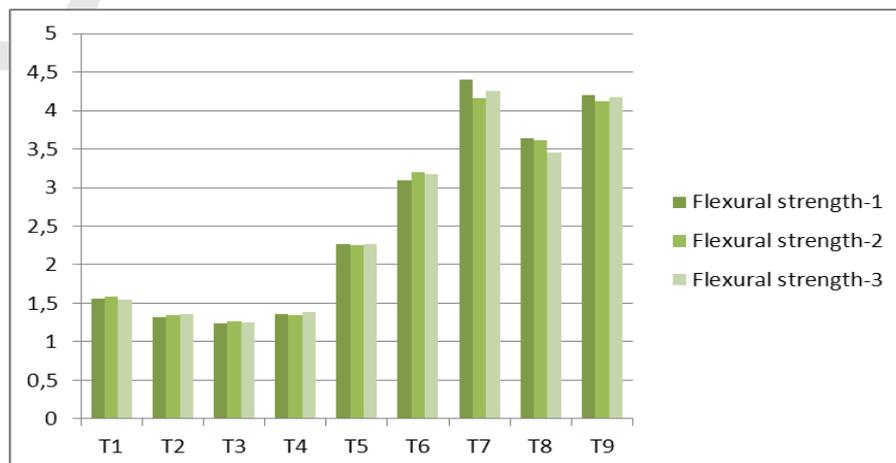
**Figure 4.** Comparison of compressive strength results

The results of variance analysis are given in the Table 5. Between 95% confidence interval, accuracy of test results is expressed. Besides, primarily A and D factors have been determined as an effective factor on compression strength.

**Table 5.** The results of variance analysis

|    | Source         | Degree of freedom (DF) | Sum square (SS) | Mean square (MS) | F-test value | P factor |
|----|----------------|------------------------|-----------------|------------------|--------------|----------|
| PS | Regression     | 4                      | 3082,87         | 770,72           | 14,07        | 0,013    |
|    | Residual Error | 4                      | 219,15          | 54,79            |              |          |
|    | Total          | 8                      | 3302,02         |                  |              |          |
| BS | Regression     | 4                      | 11,2061         | 2,8015           | 7,87         | 0,035    |
|    | Residual Error | 4                      | 1,4232          | 0,3358           |              |          |
|    | Total          | 8                      | 12,6293         |                  |              |          |
| WL | Regression     | 4                      | 1,00930         | 0,25233          | 9,69         | 0,025    |
|    | Residual Error | 4                      | 0,10419         | 0,02605          |              |          |
|    | Total          | 8                      | 1,11349         |                  |              |          |

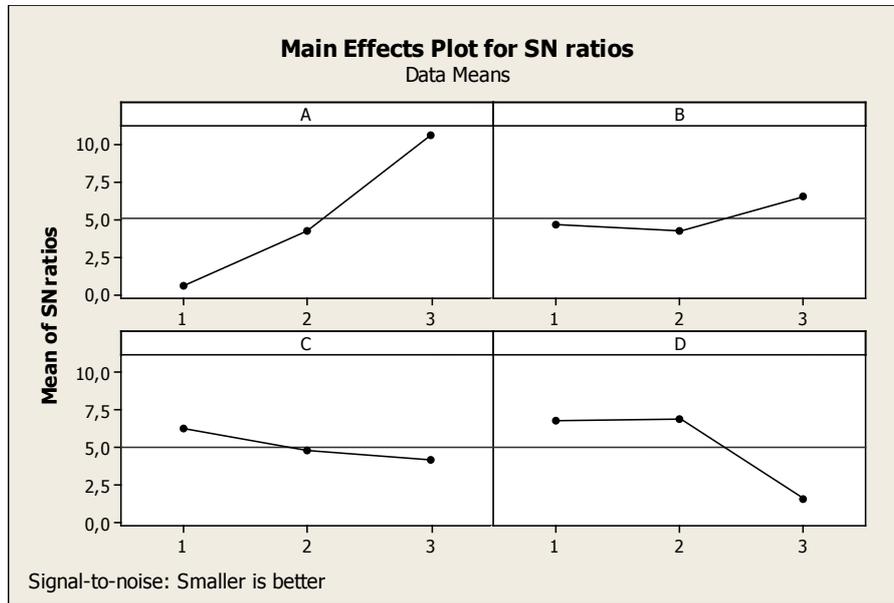
In experimental studies, cement/water ratio (Factor A) appears as the most effective factor on bend resistance. With the increase in cement/water ratio, the bend resistance increases, too. The most important factor following cement/water ratio is stone powder (Factor D). Increase in stone powder amount leads to decrease in bend resistance at high levels. Close correlations are observed between compression strength and bend resistance results.


**Figure 6.** Main effects of bending strength according to S/N ratio results


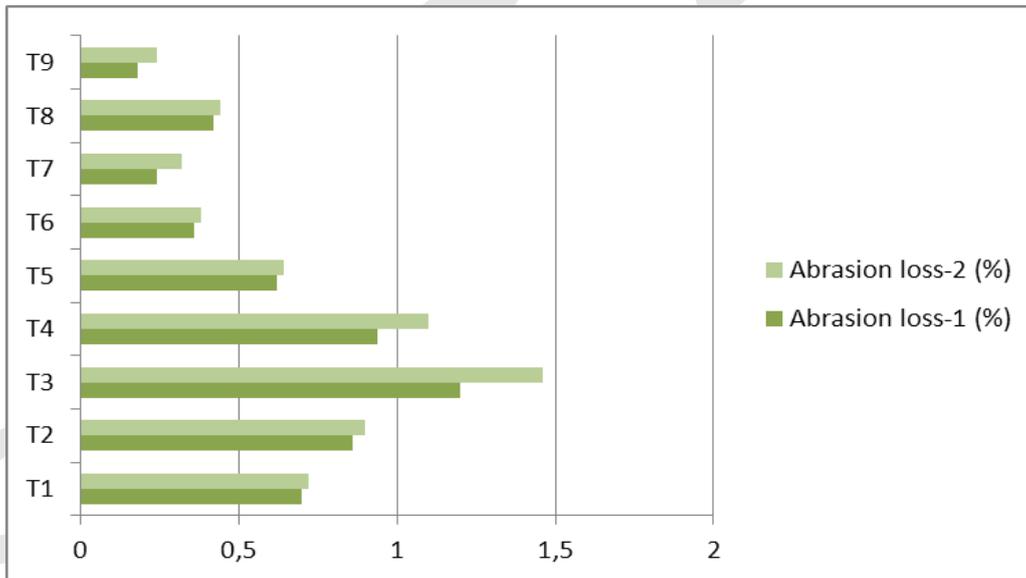
**Figure 7.** Comparison of bending strength results

Based on the measurement results, regression analysis has been determined. There is an 88.7% harmony between obtaining variables and correlation. Formulation obtained through regression analysis is shown below:

$$\text{Average Bend resistance} = 0.239 + 1.31A + 0.230B - 0.085C - 0.300D \quad (\text{Eq. 5})$$



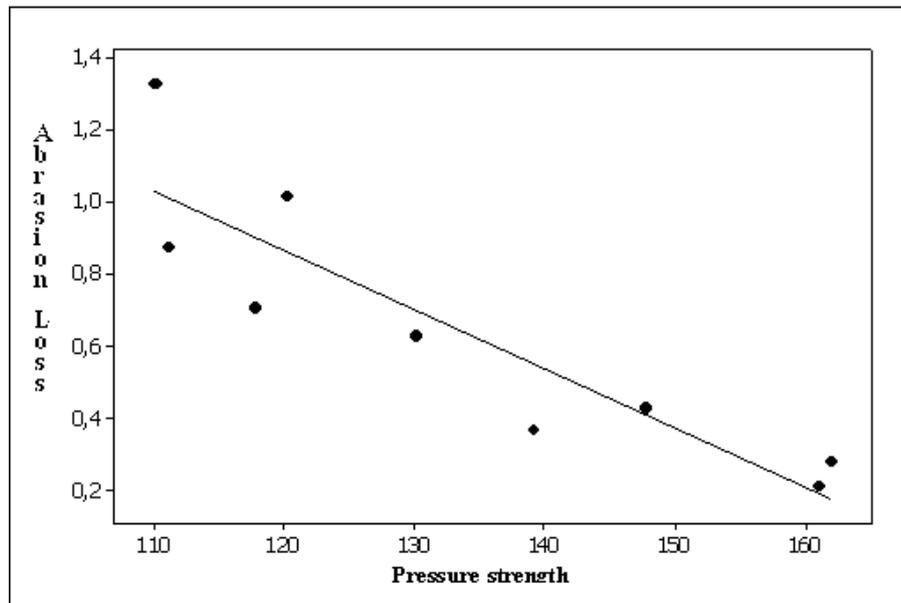
**Figure 8.** Main effects of wear loss according to S/N ratio results



**Figure 9.** Comparison of wear results associated with Weight Loss data and specimens

Formulation obtained as a result of regression analysis is as follows:

$$\text{Wear Loss} = 0.698 + 0.205 D + 0.122 C - 0.0167 B - 0.333 A \quad (\text{Eq. 6})$$



**Figure 10.** Linear decrease of relationship between Abrasion loss-Pressure strength

The optimal combinations of the three response variables (Compressive strength, bending strength and abrasion loss) is the same as  $A_3B_3C_1D_2$ . When the experiment has done at this production conditions, the results will be seen that much better. To do this, a confirmation test should be performed. However, the results of analysis for the present experiment data are given in the conclusion.

## Conclusions

- When compared to full factorial designs, number of tests has been significantly reduced by using Taguchi Method and orthogonal sequences. While  $3^4:81$  test should have been made in a full factorial design at 4 factors with 3 levels, the number of tests has been reduced to 9 via Taguchi Method. When receiving 3 measurements is planned for each test, the number of samples causes high costs provided that there is  $342 \times 3$  (compression, bend, wear) samples. However, the number of samples as a result of experimental design via Taguchi has been reduced as  $27 \times 3 = 81$ .
- In compression, bend strength, the most important factors between process variables are cement/water ratio and stone powder amount added into the mixture, respectively. Cement/water ratio increase strength is increased.
- The highest compression and bend strength and the lowest abrasion loss has been obtained during T7 and T9 test series. In this context, cement/water ratio is 0.6, stone powder ration of the mixture should be 40%.
- The lowest abrasion loss has been obtained during T9 test series. In this context, cement/water ratio is 0.6, stone powder ration of the mixture should be 30%.
- With the increase of compression resistance, abrasion loss is decreased.
- When it is assessed in terms of mechanical strength features of blended concrete mixture, it has been decided to carry out production depending on T7 parameters as a result of optimization.
- The obtained results from this research, would hopefully be initial contributions to the use of precast concrete

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# İSLAMİ İLİMLERİN EĞİTİMİNDE TEKNOLOJİNİN KULLANIMI\*

Muhammed Aydın

## Eğitim

Eğitim, bir toplumun standartlarını, ilmini, inançlarını ve kültürünü bu bağlamda tüm birikimini, bireye açık bir şekilde veya dolaylı olarak, doğumundan ölümüne kadar olan süreç içerisinde aktarma eylemine verilen addır. Dolayısıyla her birey isteyerek veya istemeyerek bu sürecin bir parçası olmaktadır.

Bu sürecin ilk aşamasını bireye ebeveyni tarafından verilen ve hayatının ilerleyen dönemlerini de direkt olarak etkileyen temel eğitim süreci oluşturmaktadır. Eğitim sürecinin bir sonraki aşamasını ise okul vb kurumlarda verilen eğitim teşkil etmektedir. Bireyin okul vb kurumlarda almış olduğu eğitim, aile içi eğitimden tamamen farklı olup öğretmenler eşliğinde belli bir müfredat dahilinde verilir.

Bireye, öğretmenler tarafından verilen eğitimi klasik ve modern eğitim olmak üzere ikiye ayırmak mümkündür. Bu ayrımında belirleyici unsur ise modern anlamıyla teknolojidir. Klasik eğitim metodunda birey bir öğretmenin eğitim halkasına dahil olur, öğretmenin nezaretinde bir mesele ele alınır ve var olan sorulara cevaplar verilmeye çalışılır. Bu eğitim sistemini, Antik Yunan ve İslam Medeniyetinde görmek mümkündür. Modern eğitim metodunda ise öğretmen bilgi aktarıcı olmaya devam etmekle birlikte işin içine teknoloji de girmiştir. Modern eğitim metodunda, hem ebeveyn hem de öğretmenler tarafından verilen eğitim esnasında duruma göre farklı birçok materyal kullanılabilir. Bu durum öğretmene veya ebeveyne eğitim verme, bireye de aktarılan konuyu anlama konusunda yardımcı olmaktadır.

Bu bağlamda modern anlamıyla teknolojinin eğitimdeki yerini göz ardı etmemek ve mümkün oldukça da faydalanmak gerekir.

## Teknoloji

Teknoloji, bireyin hayatını kolaylaştırma noktasında ihtiyaca uygun alet ve edevatın inşa edilmesi için gereken bilgi ve kabiliyettir. Bu bağlamda teknoloji, insanoğlunun yeryüzünde var olduğu ilk andan itibaren insan hayatının her safhasında varlığını sürdürmüştür.

Teknolojinin bizi ilgilendiren tarafı daha çok sanayi devrimiyle birlikte son iki yüzyılda elde edilen bilimsel birikimdir. Bu bilimsel birikimin doğal bir sonucu olarak insan hayatı birçok alanda inanılmaz bir şekilde değişime uğramıştır. Bu değişim hiç şüphesiz kendisini eğitim alanında da göstermiştir.

Bu bildiride biz teknolojinin bireyin islami eğitimi üzerindeki etkilerini ele alıp açıklamaya çalışacağız.

## İslami İlimlerin Eğitiminde Teknolojinin Kullanımının Faydaları

Eğitim yukarıda da belirttiğimiz gibi insan hayatının ayrılmaz bir parçasıdır. Buna bağlı olarak da eğitim insanoğlunun var olduğu ilk andan itibaren insan hayatında varlığını sürdürmektedir. Genel anlamıyla her dönemin şartlarına göre teknoloji de, eğitim faaliyetinden ayırt edilemeyeceği için, ilk eğitim faaliyetiyle birlikte insan hayatındaki yerini almıştır diyebiliriz.

Teknolojinin eğitimin ayrılmaz bir parçası olduğunu izah ettikten sonra bu ayrılmazlığın İslami ilimlerin eğitiminde de olması bir gerekliliktir. Nitekim her dönemde teknoloji o dönemin şartlarına göre mevcuttur ve doğal olarak bireylerin eğitiminde kullanılmıştır. Bu durum İslam Medeniyeti içinde geçerlidir. Bu bağlamda teknolojiden faydalanmadan verilen İslami bir eğitim eksik ve yetersizdir. Dolayısıyla günümüz şartlarında modern teknolojinin İslami ilimlerin eğitiminde kullanılması kaçınılmaz bir zorunluluktur.

## Çocuğa Verilen İslami Eğitim

\* Prof. Dr. Muhammed Aydın, Sakarya Üniversitesi, İlahiyat Fakültesi Öğretim Üyesi.

Bireyin eğitiminin aile içinde daha doğduğu andan itibaren başladığını yukarıda vurgulamıştık. Her ebeveyn, çocuğunu kendi dünya görüşüne göre yetiştirme hakkına sahip olduğuna göre Müslüman bir ebeveyn de doğal olarak kendi çocuklarına İslami bir eğitim verme hakkına sahiptir ve buna mecburdur. Konumuzla alakalı olarak ebeveynin çocuklarına verdikleri İslami eğitimde teknoloji nasıl kullanılmalıdır? Çocuğa verilmek istenen dini bir bilgi, kısa ve tekrarı bol olan anlaşılır şarkılar, eğitici çizgi filmler, resimli kitaplar, basit bilgisayar oyunları vasıtasıyla öğretilir. Fakat bunların hepsi ebeveyn kontrolünde olmalıdır.

Bu bağlamda çocuğa İslami bir eğitim verecek anne babanın da dini bilgisinin ne derece iyi olduğu da önemli bir konudur. Bu konuda kendilerini yetersiz gören ebeveynler internet, televizyon, radyo gibi görsel medyanın yanı sıra dergi, kitap gibi yazılı medyayla da dini meseleler hakkında bilgi edinebilirler. Buna ek olarak İlmî yeterliliği olan kimselerin internet vasıtasıyla sorulan sorulara cevap verdikleri internet sitelerinin olması da ayrı bir nimettir. Bu sitelere örnek olarak [www.fetvameclisi.com](http://www.fetvameclisi.com) gösterilebilir.

## **Okullarda Teknolojinin Kullanımı Ve İslami İlimler**

Ailesinden aldığı eğitimle resmi anlamda okul çağına gelmiş bir bireyin İslami eğitiminde okulun çok önemli bir yeri vardır. Ailesinden aldığı İslami eğitimin üzerine okulda hiçbir şey eklenmediği takdirde bireyin dini hissiyatı, bilgisi eksik kalabilmekte ve bu da dine karşı laubali bir bireyin ortaya çıkmasına sebep olabilmektedir. Okullardaki dini eğitimin eksik olmasından ötürü ebeveyn, çocuklarını dini anlamda aç bırakmama hususunda büyük görevler düşmektedir. Bu bağlamda İslami eğitimde teknolojinin kullanılmasının ehemmiyetinin yanında bu mesele de büyük sorunlar teşkil etmektedir. Biz bu mühim yaraya işaret ettikten sonra okullarda ya da benzeri kurumlarda İslami ilimlerin eğitiminde teknolojinin nasıl kullanılması gerektiğine değinmeye devam ediyoruz.

Günümüz Türkiye’inde eğitim alanında son on yılda ciddi atılımlar olmuş ve son projelerle birlikte teknolojinin eğitim alanındaki etkinliği arttırılmaya çalışılmıştır. Bu çalışmalardan bir tanesi var ki İslami ilimlerin eğitiminde kullanılması zorunlu olan bir proje olan FATİH projesidir. Bu projeye birlikte öğrenci tablet bilgisayarından derslerini hem görsel hem işitsel olarak takip edebilmektedir. Bu da öğrenciye meseleleri daha iyi kavrama konusunda yardımcı olmaktadır. Aynı şekilde öğretmenin kullanmış olduğu akıllı tahta, projeksiyon cihazı, bilgisayar ve internet gibi teknolojik aletler, dersin anlatımı, derse hakim olma gibi konularda öğretmene yardımcı olmaktadır. Öğretmen, dersi anlattığı esnada, anlattığı konuyla alakalı hiçbir ayrıntıyı, az önce saymış olduğumuz teknolojik aletler yardımıyla kaçırmamaktadır. Örnek verecek olursak; Ders esnasında anlatılan bir meseleyle alakalı kafaya takılan bir husus olduğunda internet vasıtasıyla konu açıklığa kavuşabilmekte ve öğrencinin kafasında konular daha somut bir şekilde oturabilmektedir. Fatih projesinin yanı sıra dersi anlatan öğretmenin sesinin kaydedilmesi ve bu ses kayıtlarının öğrencilere verilmesi ya da anlatılan dersin yazılı doküman haline getirilmesi de dersin daha sonra tekrarı açısından ehemmiyet teşkil etmektedir.

İslami ilimlerin eğitiminde de yukarıda bahsettiğimiz şekliyle teknolojiden faydalandığı takdirde İslami ilimlere vakıf olmuş bireylerin yetişmesi mümkün olur. Bu noktada okullarda, kuran kurslarında, medreselerde, ilahiyat fakültelerinde öğretmenlere çok iş düşmekte ve teknolojiyi yakından takip etmeleri gerekmektedir.

## **İslami İlimlerin Eğitiminde Teknoloji Nasıl Kullanılmalıdır?**

İslami ilimlerin eğitimine örnek olarak zikredilmesi gereken ilk konu Kuran ezberi eğitimidir. Kuran’ı ezberlemede yardımcı birçok bilgisayar programı, internet sitesi mevcuttur. Bu tip programlar herhangi bir okuyucunun sesini tekrar, tekrar dinleme üzerine çalışmaktadır. Bu bağlamda hafızlık eğitiminin kaçınılmazı olan tekrar hafızlık hocasının eşliğinde bu tip programlarla yapılabilir. İslami ilimleri öğrenen bir kimse için gerekli olan Arapçayı pratik ve modern anlamda öğrenmek de teknolojik imkanların geniş olması sebebiyle nispeten kolaydır. Arapçasını geliştirmek isteyen bir kimse internet vasıtasıyla istediği materyale ulaşabilmekte istediği videoyu izleyebilmektedir. Bunun yanında aklına bilmediği bir kelime takıldığında online sözlük sitelerini kullanıp bu ihtiyacını giderebilmektedir. Diğer İslami ilimlere gelince, ilim talebesi bir kimseye büyük kolaylıklar sağlamasından dolayı Şamile gibi programlar oldukça önemlidir. Şamile benzeri programlar binlerce ilmi kitabı ihtiva etmelerinden dolayı herhangi bir mesele hakkında yazılmış söylenmiş ne varsa ilim talebesinin önüne sermektedir. Böyle bir imkan bireye İslami ilimleri öğrenme faaliyeti esnasında bilgiye erişebilme kolaylığı tanımaktadır.

Teknolojinin İslami ilimlerin eğitime faydalarından biri de şudur; Klasik metotla işlenen bir ders esnasında karşılaşılan bir meselenin modern karşılığının ne olduğunu öğrenmede teknoloji büyük kolaylıklar sağlamaktadır. Buna

örnek olarak şunu verebiliriz; Fıkıh kitaplarında geçen dirhem kavramının karşılığının ne olduğunu bilmeden geçmek, konunun öğrencinin kafasında tam olarak oturmamasına neden olur. Ders esnasında internet vasıtasıyla dirhem ne olduğunu ve kaç grama karşılık geldiğini öğrenmek ve dersi, dirhem ne olduğunu bilerek işlemek öğrencinin konuyu daha iyi anlamasına yardımcı olur.

Bir diğer mesele de, herhangi bir ilmi konu hakkında muasır Alimlerin görüşlerinin ne olduğunu bilmek o meseleye daha geniş bir perspektiften bakma olanağı verir. Çünkü birinin yakaladığı inceliği öbürü yakalayamamış olabilir. Bu noktada öğretmene ilmi anlamda gündemi takip etmek ve neler konuşulduğunu neler çizildiğini bilmek düşmektedir. Bunun yanında alimlerin konuştukları meseleler de insanların güncel sorunlarının neler olduğu hakkında öğretmene fikir verebilir. Bu bağlamda İslami ilimleri öğrenen bireye de gündemi takip etme açısından yardımcı olabilme imkanına sahip olur.

## **Kaynak Eserlerin Dijital Kütüphanelerde Bir Araya Getirilmesi**

Yukarıda bahsettiğimiz gibi Şamile benzeri programlarda bir araya getirilen kaynaklar ya da internet ortamında oluşturulmuş ansiklopediler öğrenciye büyük kolaylıklar sağlamaktadır. Fakat bu bilgiler değiştirilebilir olduğundan teyidi gerekmektedir. Bu sorun İslami eserlerin taranmasını ve dijital ortama pdf ya da resim olarak aktarılmasını zorunlu kılmaktadır. Böyle bir çalışma dijital ortamda ulaşılan bilginin güvenilirliğini teyit ettiği için ihtiyaç anında bu dijital kütüphanelere rahatlıkla başvurulabilir. Kaldı ki bu sistemin dünyanın birçok yerde kullanıldığı bir vakiydir. Bizim de bu sistemi kullanmamız İslami ilimleri öğretme ve öğrenme açısından önemlidir. Ayrıca dijital ortama aktarılan kütüphanelerde bulunan kitaplar bilgisayar gibi ortamlara indirildiği takdirde internetin ve kütüphanenin olmadığı yerlerde de bilgiye ulaşmak ve kafaya takılan bir meseleye çözüme kavuşturmak da önemli bir konudur.

## **İslami İlimlerin Eğitiminde Sosyal Medya**

İslami ilimlerin eğitiminde facebook, twitter gibi popüler yayın ağlarını kullanmak teknolojinin sunmuş olduğu bu imkanlardan faydalanmak insanlara ulaşma açısından önem arz etmektedir. Son 4-5 yıllık süreç içerisinde sosyal medya giderek etkinliğini artırmış hatta büyük insan kitlelerini harekete geçirebilen bir kuvvete ulaşmıştır. Sosyal medyayı bugün aktif olarak birçok dini lider kullanmaktadır. Öyle ki kısa bir süre önce Papa 16. Benedict bile 7 dilde yayın yapan resmi twitter hesabı açmıştır. Bu dillerin arasında Arapça olması da dikkate değer başka bir husustur. Bu sosyal medyanın ne kadar ehemmiyet sahibi olduğunu gösterme açısından takdire şayan bir örnektir. Hal böyle iken ilim ehli kimselerin de ders verdikleri esnada teknolojik imkanları kullanmalarının yanında geniş insan kitlelerine ulaşabilmeleri için sosyal medyayı kullanmaları önem arz etmektedir.

## **Tümüyle Teknolojiye Teslim Edilmiş Bir İslami Eğitimin Zararları**

Bireyi, İslami ilimlerin eğitimi hususunda teknolojiyi işin içine çok fazla dahil etmek hem öğretmende hem öğrencide tembellik hasıl olmasına neden olur. O yüzden teknolojiden faydalanmalı fakat klasik metodun unsurlarını da göz ardı etmemeliyiz. Öğretmenin sadece dijital ortamdaki bilgilerden faydalanması ve öğrencisini de bu noktada iyi idare edememesi her iki tarafın da kaynaklara aşına olmaması problemini beraberinde getirir. Kaynaklara inmeden yapılan eğitim ne kadar ilmi olabilir? Teknolojiden faydalanmak, kaynakların bir kenara atılıp taraflarına bakılmaması anlamına gelmemelidir.

Aynı zamanda klasik eğitim metodunu göz ardı edip teknolojik imkanların önümüze koymuş olduğu kolaylıklar sonucunda öğretmen ve öğrenci hazır konar ve araştırma ruhu körelir. Oysaki araştırma, İslami ilimlerde vazgeçilmez bir unsurdur.

İlmi usullerden habersiz ve sadece dijital ortamdan faydalanılarak yapılan eğitim beraberinde birçok hatayı da getirir. Hem bilginin dijital ortama aktarılması esnasında birçok hata olabileceği gibi hem de öğrencinin kendi başına bu kaynaklara başvurması hatalı birçok bilginin sanki ilmi bir bilgi kabul edilmesi kaçınılmaz bir sonuçtur.

## **Sonuç**

İslami ilimlerin eğitiminde teknolojinin etkisi göz ardı edilmemeli fakat merkeze de oturtulmamalıdır. Teknolojinin birçok faydası olduğu yan etkilerinin de olduğunu bilmek ihtiyatlı olma açısından ehemmiyet arz

etmektedir. İslami ilimlerin eğitiminde işinde tecrübeli kimseler öğretmen olarak seçilmeli ve bu kimselerin nezaretinde eğitim verilmelidir. Çünkü İslami ilimler hassasiyet gerektiren konuları ihtiva etmektedirler. Bunun yanı sıra eğitim verecek olan ilim ehli kimselerin ders vermelerinden evvel dijital verileri kaynaklarından kesinlikle kıyas etmeli ve öğrencinin kullanımına öyle vermelidir.

İslami ilimlerin eğitimindeki temel hedef ilim ehli bir neslin yetiştirilmesi olmalıdır. Özellikle günümüzde günahın yaygınlaşması ve günaha ulaşmanın kolaylaşması, bizi kullanmak zorunda olduğumuz teknolojiyi bir kez daha aktif şekilde kullanmaya mecbur bırakmaktadır. Meydanı ilim ehli insanlar doldurmaz ise bireylerin gayri İslami bir şekilde yetiştirilmesi işten bile değildir. Bu noktada dini konulara vakıf ilim erbabına büyük görev düşmektedir. Bu bağlamda teknoloji boş geçilemez bir yere ve öneme sahiptir. Televizyon, internet, sosyal medya, akıllı tahta, tablet vb aklımıza gelen her türlü teknolojik unsur kötüye de alet olabilir, eğer biz kullanırsak iyiyi öğrenme ve öğretme konusunda iyiyi de alet olabilir. Bu yolda çalışmak ve çabalamak bizden, muvaffakiyet Allah'tandır.

## **İstanbul kent içi yol ağlarındaki trafik kazaları, risk bölgelerinin belirlenmesi ve alınması gereken tedbirler**

**\*A.Sertaç KARAKAŞ, \*\*Cemil AKÇAY \*\*\*Baris SAYIN**

\*İnş. Yük. Müh. İstanbul Üniversitesi Yapı İşleri ve Teknik Daire Başkanlığı – İstanbul

\*\* Dr. İnş. Yük. Müh. İstanbul Üniversitesi Yapı İşleri ve Teknik Daire Başkanlığı – İstanbul

\*\*\*PhD, Visiting Research Associate, Department of Civil Engineering and Engineering Mechanics, The University of Arizona, USA

\*skarakas@istanbul.edu.tr

**Özet:** Dünya’da olduğu gibi Türkiye’de de yük ve yolcu taşımacılığının büyük kısmı karayolları tarafından karşılanmakta ve bu açıdan karayolları pahalı bir yatırım olmaktadır. Kentlerin artan nüfus potansiyeli ve yerleşim bölgelerinin büyümesi, kent içi ulaşım ihtiyacını artırmaktadır. Ulaşımın sağlanmasında kullanılan motorlu taşıt sayılarının artması, trafik kazalarının da artmasına yol açmıştır. Trafik kazaları, beraberinde ekonomik, sosyal ve çevresel etkiler bakımından telafisi çok zor olan sorunlar doğurmaktadır. Bu çalışmada, Türkiye’deki kazalar ele alınarak, İstanbul özelinde, kent içi trafik kazaları, nedenleri, alınması gereken tedbirler ve risk bölgeleri belirlenmiştir. Çalışma kapsamında, meydana gelen kazalar tespit ve analiz edilerek sırasıyla kazaya sebep olan unsurlar istatistiksel olarak ele alınmıştır. Ayrıca, İstanbul kent içi karayollarında kaza nedenleri ve sonuçları araştırılmış, risk bölgeleri tespit edilerek trafik kazalarının azaltılması için öneri ve yöntemler sunulmuştur.

**Anahtar kelimeler:** Trafik kazaları, İstanbul, Karayolu taşımacılığı

**Abstract:** The majority of cargo and passenger transportation is covered by highways in Turkey as well as in the world. In this respect, the highways are accepted as an expensive investment. The need for urban transportation is increased by the increasing population in the cities and the growth of the residential areas. Increase in the number of motor vehicles used in the transportation has led to increase the number of accidents. Traffic accidents lead to economic, social and environmental problems which are not easily compensated. In this study, the accidents occurred in Turkey are discussed. Moreover, the reasons, the measures and the risk areas for the traffic accidents occurred in Istanbul also are determined. The accidents also are identified and analyzed with this study and then the factors that caused the accidents are evaluated statistically. Also, the reasons and the results of the accidents are investigated. By identifying the risk areas, various suggestions and methods are developed in order to decrease the number of accidents.

**Keywords:** Traffic accidents, İstanbul, Road transportation

### **Giriş**

Dünya devletlerinin birçoğunda olduğu gibi trafik kazaları hem Türkiye hem de İstanbul için önemli problemlerin başında gelmektedir. Türkiye ve İstanbul’da yük ve yolcu taşımacılığının büyük bir kısmı karayolları tarafından karşılanmaktadır. Bu bakımdan karayolları pahalı bir yatırım olmakta ve kaynakların en optimum şekilde kullanılması gerekmektedir. Dünyadaki metropol kentler arasında gösterilen İstanbul, Asya ve Avrupa kıtalarını birbirine bağlayan stratejik öneme sahip bir konumda yer almakta ve nüfus yoğunluğu itibarıyla birçok Avrupa ülkesinden daha büyük bir konumda olduğu görülmektedir. İstanbul’daki karayolu ağı, şehrin büyümesi ile gelişme eğilimi göstermiştir. Geçmişten günümüze tarihi süreçte hep önemini koruyarak bir çok medeniyete evsahipliği

yapmış bir kent olan İstanbul, her zaman önemini korumuştur. Sosyal ve kültürel yapısı ile turizm merkezi olması, ulusal ve uluslararası kapsamda sanayi ve ticari faaliyetlerini yürütüldüğü bir konumda bulunması, trafiğin yoğun olmasına ve dolayısıyla ulaştırma problemlerinin de yaşanmasına yol açmıştır. Nüfus ve taşıt trafiğinin artışına paralel olarak sosyal problemlerden biri olan trafik kazaları da artma eğilimi göstermiş, bu bakımdan kazaların artması can ve mal kaybı olarak sıkıntılara yol açmaktadır (Akgüngör, A.P., 2008; Karakaş, A.S., Akçay, C., 2011)

Trafik kazalarıyla ilgili araştırmacıların birçoğu kaza istatistik verileri kullanarak modeller sunmuştur. Smeed (1949) yaptığı çalışmada, farklı ülkelerden elde ettiği trafik verileriyle ölümcül kaza sorunlarını nüfus ve taşıt sayısı oranlarına göre belirlemiş ve kendi modelini geliştirmiştir. Mekky (1985) araştırmasında, gelişmekte olan ülkelerde taşıtlardaki hızlı artışların ölüm oranlarına etkilerini incelemiştir. Zeeger'e göre (1987), şerit genişliği arttıkça yaralı ve hasarlı kaza oranları düşerken, ölümcül kaza oranlarında büyük bir değişim olmamaktadır. Bu duruma bakılırsa, yollardaki şerit genişlemeleri araçların süratlerinde artışlara yol açarak, taşıt sürücülerinin dikkatlerinin dağılması ve manevra kabiliyetlerinin yavaşlamasıyla kaza riskini çoğaltmaktadır. Partkaya (1984) ise, iş, nüfus ve iş verileri kullanılarak kaza tahmin modeli geliştirmiştir

İstanbul Metropolitan Alanı Kentsel Ulaşım Ana Planı (IUAP, 2011) tarafından hazırlanan raporda, İstanbul nüfusunun yaklaşık 13 milyon olması ve kentsel gelişme paralelinde karayolu ağı ve motorlu taşıt ihtiyacını arttırmış, taşıt sayısı 2 milyona yaklaşmıştır. Bu bakımdan yolcu taşımacılığında en büyük karayolları taşıtları oluşturmakta, diğer ulaşım araçları motorlu taşıtlarla karşılaştırıldığında yetersiz kalmaktadır. İstanbul'da yaşanan trafik kazaları can ve mal kaybına yol açmakta ve ülke olarak büyük ekonomik kayıplara yol açmaktadır. Bu durumu en asgari düzeyde tutmak için bir takım caydırıcı tedbirlerin alınması gerekmektedir.

Kentlerin nüfus potansiyeli olarak büyümesi, ulaşım ihtiyacını arttırmakta, planlı ve doğru yapılaşma ile kentleşmenin olduğu alanlarda bu ihtiyaçlar karşılanmakta, eski kent merkezlerinin ve çarpık kentleşmenin olduğu alanlarda ise mevcut durum itibarıyla ulaşım yetersiz kalıp, problemler yaşanmaktadır. Plansız yapılaşmanın yoğun olduğu alanlarda, karayolu taşıtlarının kullanması için ayrılan yolların dar ve yetersiz olması, park sorunu oluşturarak trafik sıkışıklığına ve kazaların oluşmasına neden olmaktadır.

Sunulan çalışmada Türkiye ve İstanbul'daki kazaların tespitine yönelik yıllara göre istatistiksel analizler yapılmıştır. Sırasıyla trafik kazalarına neden olan unsurlar belirlenmiş, trafik kazalarının iyileştirilmesine yönelik çeşitli öneri ve yöntemler geliştirilmiştir. Kapsam olarak yıllık periyotlardaki kazalar baz alınmış, nedenleri ve sonuçları araştırılarak kazaya neden olan risk bölgeleri belirlenmiştir.

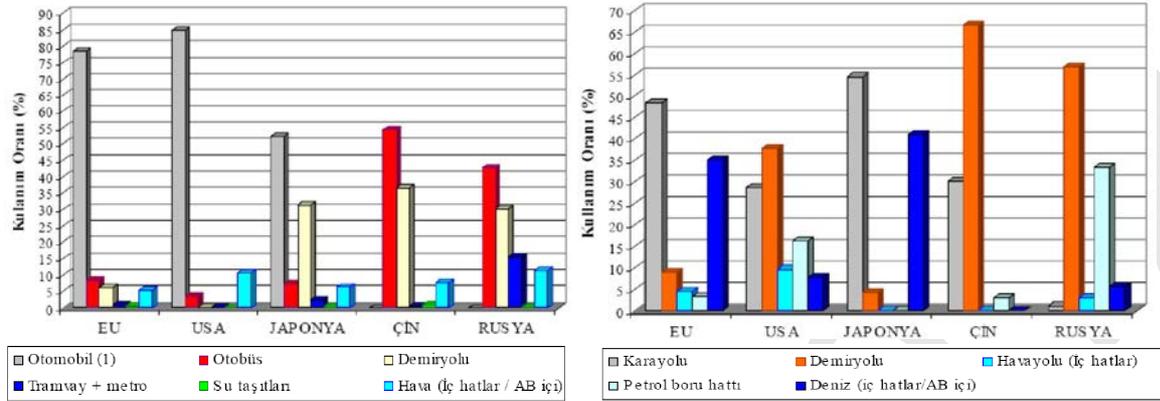
İstanbul kenti, Türkiye genelinde özellikle kırsal kesimden kentlere göçün yoğun bir şekilde yaşandığı şehirlerin başında gelmektedir. Nüfusunda ciddi derecede artışların olması paralelinde şehrin ihtiyaçlarında da artış eğilimi görülmüştür. 1970 yılından 2009 yılına kadar İstanbul'da %327,79'luk bir nüfus artışı görülmüş, yaklaşık 40 yıllık süre zarfında, Türkiye'deki payı %8,5'tan %17,7'ye çıkmıştır (Tablo 1).

**Tablo 1:** İstanbul'un yıllara göre nüfus değişimi (IUAP, 2011)

| Yıllar | Nüfus      | Türkiye Payı (%) |
|--------|------------|------------------|
| 1970   | 3.019.032  | 8,8              |
| 1980   | 4.741.890  | 10,6             |
| 1990   | 7.309.190  | 13,0             |
| 2000   | 10.018.735 | 14,8             |
| 2005   | 11.608.349 | 15,9             |
| 2009   | 12.915.158 | 17,7             |

Yolcu taşımacılığında dünya ülkelerinin birçoğunda karayollarıyla yapılan yolcu taşımacılığı ön sıralarda yer almaktadır. Otomobil kullanım oranları olarak ilk sırayı yaklaşık %85 ile Amerika Birleşik Devletleri alırken, ardından sırasıyla Avrupa Birliği Ülkeleri ve Japonya gelmektedir. Toplu taşıma aracı olarak otobüs kullanımında yaklaşık %55 ile Çin Halk Cumhuriyeti ilk sırada bulunurken, ardından Rusya Federasyonu gelmektedir. Yük taşımacılığında ulaşım tipi olarak demiryolu kullanımının ön sırada olduğu görülmekte, en büyük oran %65 ile Çin Halk Cumhuriyeti'ni Rusya ve Amerika Birleşik Devletleri takip etmektedir. Karayolu ile yapılan yük

taşımacılığında ise Japonya yaklaşık %55 ile ön sırada yer almakta ve ardından Avrupa Birliği Ülkeleri gelmektedir (Şekil 1).



Şekil 1: Yolcu ve yük taşımacılığının ulaşım türlerine göre dağılımı (Karaşahin, 2010)

## Araştırma Metodu

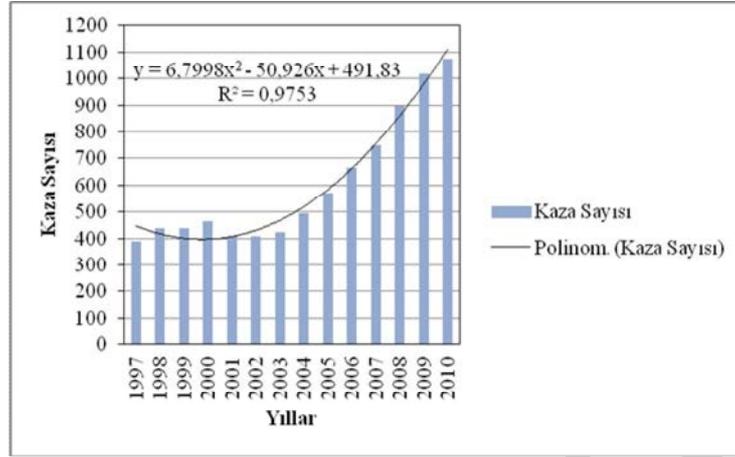
Çalışmada; maddi hasar, yaralanma ve can kayıplarına karşı kazaların önüne geçecek tedbirler alınması amacı hedef seçilmiştir. Çalışma kapsamında, İstanbul, kent içi yük ve yolcu taşımacılığında yaşanan kazalar istatistiksel olarak ele alınmış ve Türkiye’de yaşanan toplam kazalarla karşılaştırılması yapılmıştır. Sırasıyla trafik kazalarına neden olan unsurlar belirlenmiş, trafik kazalarının iyileştirilmesine yönelik çeşitli öneri ve yöntemler geliştirilmiştir. Ayrıca belli periyotlardaki kazalar baz alınarak nedenleri ve sonuçları araştırılıp kazaya neden olan risk bölgeleri belirlenmiştir.

Trafik kazalarına yönelik İstanbul Emniyet Müdürlüğü Trafik Denetleme Müdürlüğü kapsamında yıllık trafik kazaları verilerinden faydalanılmıştır. Trafik kazalarına karşı tedbir amaçlı verilen eğitimsel faaliyetlerle ilgili İstanbul Büyükşehir Belediyesi Trafik Müdürlüğü istatistiksel verilerinden yararlanılmıştır.

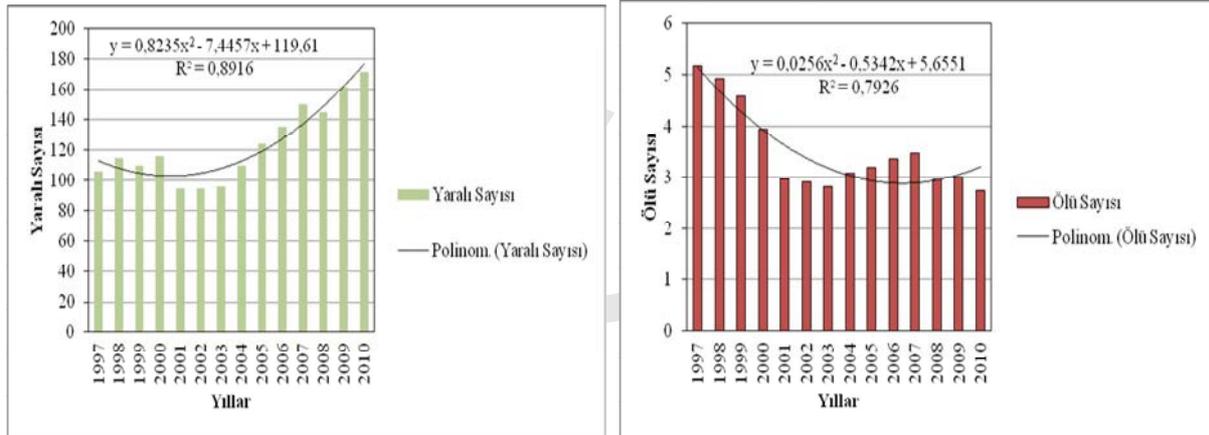
## Türkiye Yıllık Trafik Kaza Verileri ve Yol Açtığı Unsurlar

Türkiye’de her yıl meydana gelen trafik kazalarında maddi hasarlar meydana gelmekte, binlerce insan yaralanmakta, sakat kalmakta ve yaşamını yitirmektedir. Bu durum, ülke ekonomisinde büyük sıkıntılara yol açmaktadır. Şekil 2’de trafik polisi sorumluluğu bölgesinde Türkiye’de meydana gelen kaza verileri görülmekte, Şekil 3’de ise kaza sonucu yaralanma ve ölüm vakalarının yıllık değişimleri gösterilmiştir.

Türkiye’de 1997-2010 yılları dönemini kapsayan 14 yıl içinde yaklaşık 8440273 kişi yaşamını yitirmiş, 1728594 kişi yaralanmış, 49100 kişi ise hayatını kaybetmiştir. Kaza sayısında yıllara göre artışlar yaşanmış, 2001, 2002 ve 2003 yılları döneminde yaralanma ve ölüm oranlarında düşme olmasına rağmen sonraki yıllarda yaralanma ve ölüm oranlarında artış görülmüş, 2008, 2009, 2010 dönemlerinde ise ölüm oranlarında düşüş görülmüştür. Yaralanma sayısındaki artışa rağmen ölüm oranlarının düşmesinde araçlardaki güvenlik unsurlarının artırılması etkili olmuştur (Şekil 2-3).



**Şekil 2:** Türkiye’de Yıllık Periyotlarda Meydana Gelen Kaza Sayıları (Akçay, C., Karakaş, S.,2011; İUAP, 2011)



**Şekil 3:** Türkiye’deki Yıllık Periyotlardaki Trafik Kazası Sonucu Yaralanma ve Ölüm Sayısı İstatistikleri (EGM, 2006; TÜİK, 2010)

Trafik güvenliği için gereken önlemlerin alınmaması durumunda, sonraki yıllardaki kaza sayısı, yaralanma ve can kayıplarında artışların olması kaçınılmazdır. Stratejik bir yaklaşımla sorunun kaynağı olarak trafik kazalarının azaltılması ve yaşanacak travmaların giderilmesi için yalnızca yasal düzenlemeler ve günlük önlemlerle yetinilmemelidir, sorunların çözümlerinde planlı ve kararlı yaklaşımla sonuca gidilmelidir (Karakaş, A.S., Akçay, C., 2011).

## Trafik Kazası Türleri ve Kaza İstatistiklerinin Karşılaştırılması

Trafik kazalarına ilişkin veriler İstanbul Emniyet Genel Müdürlüğü kaza veritabanlarında kayıt altında tutulmaktadır. Trafik kazaları olarak yaralanma ve ölüm vakalarının yaşandığı maddi hasarlı görülen kazalarda İstanbul tüm Türkiye genelinde %30'dan fazla bir paya sahiptir. Yaralanmaların yaşandığı kazalarda aynı paya sahip olup, yıllık ölümlü kaza sayısı Türkiye'de 2.581 iken İstanbul'da 262'dir (İUAP, 2011).

Araçların ve yolların güvenliklerinin artırılmasına rağmen her yıl toplam kaza sayısı ve buna paralel olarak maddi hasarlı kaza sayısı artmaktadır. Bu durum trafiğe çıkan taşıt sayısı artışı ve taşıt teknolojilerinde yaşanan gelişmelere bağlı hız performanslarının yüksek olmasının kullanım durumunu da etkilemesinden kaynaklanabilir.

**Tablo 2:** Türkiye ve İstanbul Trafik Kazaları İstatistikleri (İUAP, 2011, EGM, 2006, İEM, 2006)

| KAZALAR          | TÜRKİYE       | İSTANBUL    | PAY (%) |
|------------------|---------------|-------------|---------|
| Ölümlü kaza      | 2,581         | 262         | 10      |
| Yaralanmalı kaza | 76,615        | 8,193       | 11      |
| Mal hasarlı kaza | 585,344       | 209,544     | 36      |
| Toplam           | 664,54        | 217,999     | 33      |
| Ölen kişi        | 3,365         | 282         | 8       |
| Yaralı kişi      | 135,224       | 12,809      | 9       |
| Mal hasarı (TL)  | 1,152,919,799 | 349,279,296 | 30      |

Yıllık periyotlardaki İstanbul'da yaşanan trafik kazaları ve kazalar sonucu meydana gelen yaralanan ve ölen kişi sayıları Tablo 3'te gösterilmiştir. Bu verilere göre her yıl kaza sayısı ve maddi hasarlı kaza sayısı artmakta, ölümlü kaza sayısı 2002 yılında azalırken, yaralanma görülen kaza sayısı 2003 yılında azalmış ve 2004 yılından itibaren tekrar artma eğilimi göstermektedir.

Trafik kazalarında ölen ve yaralanan kişilere bakıldığında ise her yıl iki değişkenin de artış gösterdiği görülmektedir (İUAP, 2011)

**Tablo 3:** İstanbul'daki Trafik Kazaları ve Ölen, Yaralan Kişilerin Yıllara Göre Değişimi (İUAP, 2011, EGM, 2006, İEM, 2006)

| Yıllar | Ölümlü kaza sayısı | Yaralanmalı kaza sayısı | Maddi hasarlı kaza sayısı | Toplam kaza sayısı | Ölen kişi sayısı | Yaralanan kişi sayısı |
|--------|--------------------|-------------------------|---------------------------|--------------------|------------------|-----------------------|
| 2002   | 248                | 6.168                   | 138.507                   | 144.923            | 282              | 9.281                 |
| 2003   | 217                | 6.377                   | 146.063                   | 152.657            | 268              | 9.691                 |
| 2004   | 236                | 6.262                   | 155.771                   | 162.269            | 270              | 9.795                 |
| 2005   | 244                | 7.178                   | 179.459                   | 186.881            | 277              | 11.528                |
| 2006   | 262                | 8.193                   | 209.544                   | 217.999            | 282              | 12.809                |

## İstanbul Özelinde Kaza Türleri ve Sebepleri

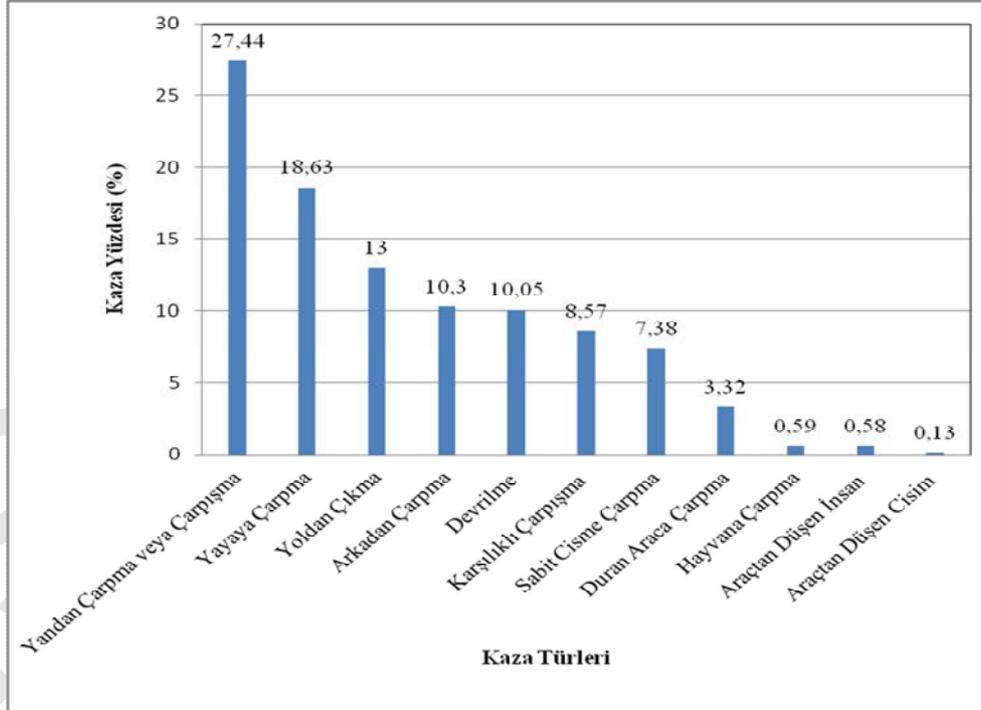
İstanbul'da kazaların oluşum türünde birçok faktör etkili olmaktadır. Kazalarda sürücü, yolcu ve yaya parametreleri en fazla etki eden unsurlardır. Kazalarda çoğunlukla yandan çarpma veya çarpışma, yayaya çarpma, yoldan çıkma ve arkadan çarpma ön plana çıkmaktadır (Tablo 4).

Kaza oluşum türlerindeki dağılım bakımından en fazla %27,44'lük bir oranda yandan çarpma ve çarpışma şeklinde kazalar görülmektedir. Yayaya çarpma şeklinde görülen kazalar %18,63 ile önemli bir oranda yer almakta

dolayısıyla bu durum yayaya öncelik verilmediğinin ve trafik kurallarına uyulmadığının bir göstergesidir. Diğer kaza oluşum türleri olarak %13,0 ile yoldan çıkma, %10,03'lük bir oranda ise arkadan çarpma ve %10,05 ile devrilme şeklinde görülen kazalar bulunmaktadır (Şekil 4).

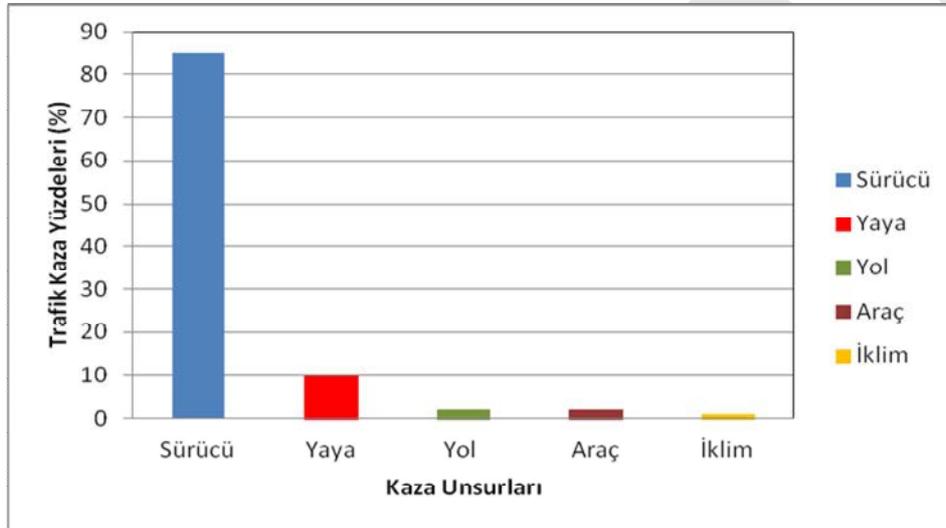
**Tablo 4:** İstanbul'daki Kaza Oluşum Türleri (İUAP, 2011, EGM, 2006, İEM, 2006)

| Kazaların Oluşumlarına Göre Türleri | Yıllık        |
|-------------------------------------|---------------|
| Yandan Çarpma veya Çarpışma         | 23.469        |
| Yayaya Çarpma                       | 15.933        |
| Yoldan Çıkma                        | 11.120        |
| Arkadan Çarpma                      | 8.809         |
| Devrilme                            | 8.598         |
| Karşılıklı Çarpışma                 | 7.332         |
| Sabit Cisme Çarpma                  | 6.308         |
| Duran Araca Çarpma                  | 2.835         |
| Hayvana Çarpma                      | 507           |
| Araçtan Düşen İnsan                 | 492           |
| Araçtan Düşen Cisim                 | 115           |
| <b>Toplam</b>                       | <b>85.518</b> |



**Şekil 4:** İstanbul'da Meydana Gelen Trafik Kazası Oluşum Şekilleri (İUAP, 2011, İEM, 2006)

Türkiye, trafik kazaları açısından Dünya’da önde gelen ülkeler arasında yer almaktadır. Trafik kazaları; sürücü, yolcu, yaya, yol ve araçların sebep olduğu unsurlardan kaynaklanan çeşitlilik göstermektedir. Trafik kazalarında insanların neden olduğu kusurlar %90-95’lik bir orana sahiptir. Alkollü araç kullanılması, trafik işaretlerine dikkat edilmemesi, trafik kurallarına uyulmaması, psikolojik olarak ruhsal bozukluğun bulunması, dikkatsiz, yorgun ve uykusuz araç kullanımıyla %85’lik bir oranla sürücüler ilk sırada yer almaktadır. Yayaların sebep olduğu kazalar %10 oran ile ikinci sırayı oluşturup, yayaların dikkatsizliği, dalgın oluşu, trafik kurallarına uymaması, alkollü olması, reflekslerin zayıf olduğu yaşlılık dönemleri ve dikkatsizliğin yoğunlaştığı çocukluk dönemlerinde yaygın olarak görülmektedir. Yol kusuru olarak karayolunda işaretlendirmelerin eksik, uygun yere konulmaması ve yapılmamış olması, karayolu bakımlarının zamanında yapılmaması, yolun yetersiz kalması ve amacı dışında kullanılması ile yollar %2-4’lük bir payı oluşturmaktadır. Araçlar %2’lik bir oranda yer alıp, araçların bakımsız, eski ve teknik bakımdan yetersiz olması kazalarda etkili olmaktadır. İklim koşulları %1-2 oranında trafik kazalarında yer almakta, hava şartlarının çok sıcak, soğuk, sis, yağmur şeklinde olması ve yolların buzlanması kazalara davetiye çıkartmaktadır (Şekil 5).

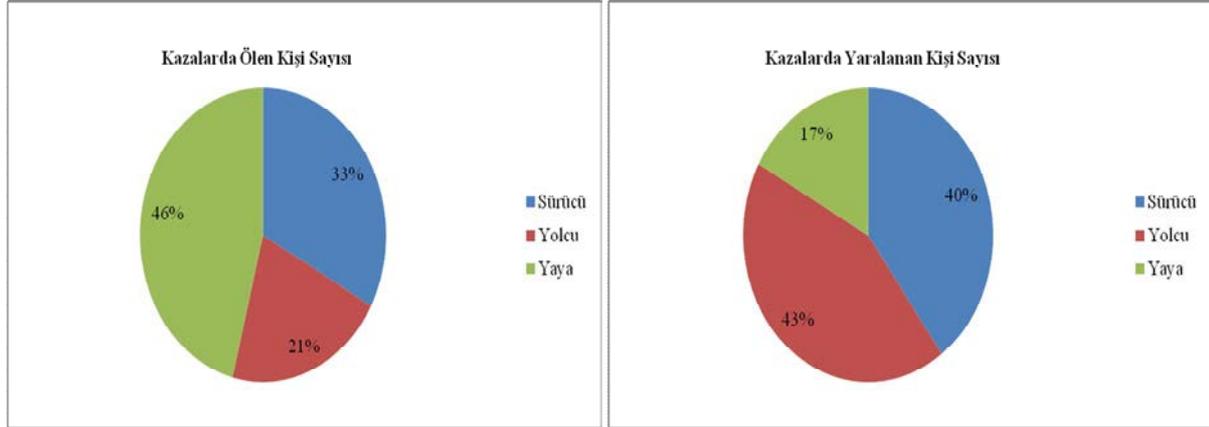


Şekil 5: Trafik kazalarına sebep olan unsurlar (Karakaş, A.S., Akçay, C., 2011, EGM, 2006, TÜİK, 2010)

Kazalarda hayatını kaybeden kişilere bakıldığında en büyük pay yayalarda görülmektedir. Bu durum kaza oluşum türleri içerisinde önemli bir yere sahip olan yayaya çarpma ile paralellik göstermektedir (Tablo 5). Ölen kişi sayılarında %46 ile yayalar birinci sırada, %33 oran ile sürücüler ikinci sırada yer almaktadır (Şekil 6). Kazalarda yaralanan kişilerde ise, %43’lük bir oranla yolcular en büyük oranda yer alıp, sürücülerde %41’lik bir oran ile kazalarda yaralanma bakımından yüksek bir değerde yer almaktadır (İEM, 2006).

Tablo 5. Kaza Mağdurları Dağılımları (İUAP, 2011, İEM, 2006)

| Mağdurlar | Kazalarda Ölen Kişi Sayıları | Kazalarda Yaralanan Kişi Sayıları |
|-----------|------------------------------|-----------------------------------|
| Sürücü    | 93                           | 5.190                             |
| Yolcu     | 60                           | 5.452                             |
| Yaya      | 129                          | 2.167                             |
| Toplam    | 282                          | 12.809                            |



Şekil 6: Kaza Mağduru Dağılımları (İUAP, 2011, İEM, 2006)

## Trafik Kazası Önlenmesine Yönelik Tedbirler

İstanbul kent içi ulaşımında meydana gelen trafik kazaları beraberinde birçok probleme yol açmaktadır. Kazalarda can ve mal kaybı ile birlikte trafik akışında ciddi boyutlarda trafik sıkışıklığı görülmektedir. Bu duruma mahal vermemek için yollarda çeşitli ıslah çalışmaları ile trafik güvenliği çalışmalarının yürütülmesi gerekmektedir. Trafik kaza sayısını düşürmek için Milli Trafik Güvenlik Programı başlamış ve eylem planı geliştirilmiştir. Program kapsamında Trafik kazalarına yönelik ıslah çalışmaları tespit edilen 317'den daha fazla kara noktalarda başlatılmış ve bu noktaların iyileştirilmesi ile olumlu sonuçlar elde edilmiştir (İUAP, 2011).

Kara noktalar, yol tasarımındaki hatalar, trafik işaretlerinin yetersizliği, sürücülerin uygun olmayan davranışlarda bulunmasına yol açan alanların kullanılması gibi nedenlerden kaynaklanmaktadır. Kara noktaların iyileştirilmesi yaralanma ve ölüm vakası sayısında önemli ölçüde düşüşlere yol açmıştır. Kara noktalarıyla ilgili İstanbul Büyükşehir Belediyesi 2003 yılında bir analiz yapmıştır. D100 karayolu çevresinde Üsküdar-Kadıköy Bölgesinde 548 metre mesafe içinde iki veya daha fazla kazanın meydana geldiği bölgeler kara nokta alanları olarak belirlenmiştir (İUAP, 2011, İBB, 2009).

Toplum bilincinin geliştirilmesi ve trafik eğitimi çalışmaları faaliyetleri kazaları önlemede etkili olan diğer bir unsur olmuştur. Trafik kazalarının gerçekleşme nedenlerine bakıldığında kazaların %95'inin insan hatasından kaynaklandığı görülmektedir. Bu durum trafik eksikliğinin ciddi boyutlarda olduğunu göstermektedir (Karakaş, A.S., Akçay, C., 2011, Akçay, C., Karakaş, A.S., 2011, İUAP, 2011). Eğitim amaçlı olarak okullarda, isteğe bağlı sivil ve kamu kurumlarında trafik eğitimleri verilmektedir.

Yürütülen eğitim çalışmalarında yüksek derece verim elde edilip, öğretilen bilginin kalıcı olması için kaliteli bir hizmet sunulması gerekmekte, bu kapsamda trafik eğitim parkları, gezici trafik eğitim araçları ve trafik eğitimiyle ilgili yazılı ve görsel eğitim dokümantasyonları hazırlanarak birçok merkeze ulaştırılması hedeflenmektedir (Karakaş, A.S., Akçay, C., 2011, Akçay, C., Karakaş, A.S., 2011, İUAP, 2011).

Trafik kazalarıyla ilgili caydırıcı unsur olarak trafik uygulamaları yapılmakta, trafikte denetlemelerin sıklaştırılması ve ceza miktarlarının yüksek olması tedbirleri uygulanmaktadır.

Kısa mesafelerde motorlu taşıt kullanma yerine yaya ve bisiklet ulaşımının desteklenmesi, uzun mesafelerde ise toplu taşıma araçlarının özendirilmesi ile otomobille yapılan seyahat yoğunluğunun azaltılması önem arz etmektedir.

Toplu ulaşım aracı kullanan taksi, otobüs ve minibüs gibi motorlu taşıtlarda bekleme, yolcu indirme ve bindirme sırasında yolların kapasitesinin düşürülerek trafiğin yavaşlatılmasının önüne geçilmesi, yol güzergahlarında uygun bekleme yerleri ve duraklarının planlanması ve kentte hizmet eden taksilerin gelişigüzel kent içinde trafik içinde yer almalarına özen gösterilmesi, kaza risklerinin azaltılması bakımından önem arz etmektedir.

## Değerlendirme

Bu çalışmada, belli periyotlarda İstanbul kent içinde meydana gelen trafik kazalarının nedenleri, sonuçları analiz edilerek risk bölgeleri tespit edilmiş ve alınması gereken tedbirler ele alınmıştır. Kazalarda maddi hasar miktarı, yaralı ve ölü sayılarında çarpıcı sonuçlar elde edilmiştir. 2001 yılının trafik güvenliği yılı olması ve tedbirlerin alınması, bu dönemdeki kazaları önlemede caydırıcı etken olmuştur. Kazaların nedenleri olarak teknik nedenler ile sosyal ve toplumsal sebepler birlikte değerlendirilmelidir.

Risk bölgeleri bakımından kazalar;

- Yolun geometrisi bakımından; eğimsiz, düz, geçit ve kavşak olmayan yollarda daha sık görülmektedir.
- Yolların yüzey durumu olarak en çok kaza; kuru yüzeylerde olup, ıslak yüzeylerde ise azımsanmayacak sayıda meydana gelmektedir.
- Kaza oluş yeri olarak en çok kent içi ve şehirlerarası yollarındaki kazalar öne çıkmaktadır.
- Yolun kaplama cinsi bakımından en fazla kaza, asfalt kaplamalı zeminlerde meydana gelmiş, 2006 yılı kazaların en fazla görüldüğü yıl olmuştur. En az kaza ise 2002 yılında görülmüş, bu durumun nedeni ise 2001 yılının trafik güvenliği yılı olmasının etkili olmasından kaynaklanmaktadır (Karakaş, A.S., Akçay, C., 2011).

Kazalarda araçların teknik bakımdan cinsleri, kullanım amaçları ve cinsleri de kazaların oluşumunda önemli etkindir. Araç cinsi olarak en fazla kaza taşıt sayısı ve sürat bakımından diğerlerine göre daha üstün olan otomobillerde görülmüş, bunu sırasıyla yük taşımacılığında yaygın kullanılan kamyonetler ve yolcu taşımacılığında kullanılan minibüsler takip etmiştir. Diğer araç cinsleri bunların oransal dağılımından çok daha küçüktür.

İstanbul'daki kaza nedenleri teknik nedenler dışında toplum ve sosyal açıdan;

- 1) Toplumsal bilinçsizlik
- 2) Eğitimsizlik
- 3) Denetim yetersizliği
- 4) Sürücü belgesinin herkese verilmesi
- 5) Dikkatsizlik
- 6) Yasalardaki boşluk
- 7) Ahlaki ve kültürel değerlerin yitirilmesi
- 8) Yanlış örnek alma
- 9) Cezaların caydırıcı olmaması
- 10) Karşılıklı saygının olmaması şeklinde sıralanabilir (Karakaş, A.S., Akçay, C., 2011, Tunç, A., 2003, TMMOB, 2003).

## Sonuçlar

Ulaşım sistemleri, trafik sıkışıklığını önlemek ve akışı kolaylaştırarak en az maliyetle en fazla alana ulaşmak amacıyla oluşturulmaktadır (İUAP, 2011). Türkiye'nin nüfus olarak en yoğun kenti İstanbul, coğrafi konumu itibarıyla stratejik bir noktada bulunması nedeniyle sanayi ve ticari faaliyetlerinin yoğun olduğu bir konumdadır. Anılan özelliklerinden dolayı ulaşım sistemi olarak karayolu, raylı sistem ve deniz yolu ulaşım sistemleri çeşitlilik göstermektedir. Artan nüfus ve yeni yerleşim bölgelerinde konut ve iş yeri alanlarının artması ile ulaşım sistemlerinin gelişme göstermesi ve çeşitlilik arz etmesi gerekmektedir. Bu bakımdan karayolu sistemi olarak otoyollar, kent merkezi dışındaki karayolu bağlantıları, ana ve ara alterlerin yol ağı olarak iyileştirilmesi gerekmektedir. Karayolu ağının geliştirilmesinde karayolu belirli kesimlerinin genişletilerek özel ve toplu taşımanın kolaylaştırılması, tek yön uygulaması ve yeni yol çalışmalarının yapılması, karayolu ağının işleyişine önemli etkileri olmaktadır. Kazaların teknik bakımdan önlenmesi için yol ağı tasarımında kesintisiz trafik akışının sağlanması ve ana-ara alter bağlantılarının kolay bir şekilde gerçekleştirilmesi gerekmektedir. Yollarda trafik uyarı levhalarının ve trafik işaretlerinin kullanılması, bölünmüş yolların ve otoyolların yapılması zorunludur. Ulaşım tipi olarak yük ve

yolcu taşımacılığı olarak yükün büyük çoğunluğunun karayolları tarafından karşılanması yerine, raylı sistem ve deniz yolu ulaşımının da yaygınlaştırılarak dengenin sağlanması gerekmektedir.

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# İSTANBUL'DA TURİZM SEKTÖRÜNÜN İSTİHDAM YAPISI ÜZERİNE BİR ARAŞTIRMA

## A SURVEY ABOUT EMPLOYMENT STRUCTURE AT TOURISM SECTOR IN ISTANBUL

Adnan BEDLEK, Özgür ERGÜN, Mehmet Fatih DİNÇER\*, Yunus ADIGÜZEL

Türkiye İstatistik Kurumu İstanbul Bölge Müdürlüğü, Beşiktaş İstanbul  
\*Doktora Öğrencisi, Sakarya Üniversitesi Sosyal Bilimler Enstitüsü, Sakarya

**Özet:** Turizm sektörü, büyük ekonomik krizler, salgın hastalıklar ya da büyük felaketler olmadığı sürece küçülme tehlikesi olmayan, pek çok ülke için çok önemli bir sektördür. Türkiye'de özellikle 1980'lerin ortalarından itibaren turizm sektörü hızlı bir gelişim süreci yaşamaktadır. Buna paralel olarak dünyanın en büyük şehirlerinden biri olan İstanbul da turizm hareketinden yoğun bir şekilde etkilenmektedir. Bugün İstanbul, Antalya'dan sonra Türkiye'de en çok ziyaret edilen ikinci şehirdir, dünyada da en çok ziyaret edilen şehirlerden birisidir. Bu durum İstanbul için sosyo-ekonomik etkilerinin yanı sıra önemli de bir istihdam kaynağı oluşturmaktadır. Turizm sektörünün en önemli bileşenlerinden olan konaklama tesisleri, bu istihdamın önemli parçalarındandır. Bu çalışma ile İstanbul'daki konaklama tesislerinde çalışan personelin cinsiyet, çalıştıkları bölüm, eğitim durumu, yaş gibi özelliklerinin belirlenmesi, personel ve turizm sektörüyle ilgili değerlendirmelerin ortaya konulması amaçlanmaktadır. Bunun için İstanbul genelinde 123 konaklama tesisi ile anket uygulaması gerçekleştirilmiştir. Ayrıca elde edilen veri ile konaklama tesislerinde belli kriterlere göre farklılıklar tespit edilmeye çalışılmıştır.

**Anahtar Sözcükler:** Turizm, İstanbul, İstihdam, Konaklama Tesisi.

**Abstract:** Tourism sector is a vital sector for most countries that there is no risk of downsizing as long as there is no economic crisis, big natural disasters or plagues takes place. In Turkey especially after mid 1980s tourism sector is experiencing a rapid growth process. Accordingly the city of Istanbul which is the one of the big city in the world is getting affected from this tourism movement intensely. Today Istanbul is the one of most visited city in Turkey after Antalya and also it is in the most visited cities in the world. Besides its socio-economic effects this situation creates a major source of employment. One of the main component of tourism sector - the accommodation establishments is a major part of this employment. With this study it is expected to present the specifics of the employees working in this accommodation sectors such as sex, department, education, age and to discuss affairs related to personel and tourism sector. For this aim, a survey conducted with 123 accommodation establishments throughout Istanbul. With the data gathered it is aimed to identify the discrepancies among establishments under certain criteria.

**Keywords:** Tourism, İstanbul, Employment, Accomodation Facility.

## GİRİŞ

İnsanların yer değiştirme faaliyetleri ilk çağlardan günümüze kadar sürekli artmıştır. İnsanlar kimi zaman merak duygusundan, kimi zaman eğlenmek, dinlenmek veya alışveriş yapmak amacıyla buldukları yerden başka yerlere doğru hareket ederler. Bu tür seyahatler zamanla turizm adıyla anılmaya başlanmıştır. Bu çalışma ile konaklama tesislerinde çalışan personelin cinsiyet, çalıştıkları bölüm, eğitim durumu gibi özelliklerinin belirlenmesi; personel ve turizm sektörü ile ilgili değerlendirmelerin ortaya konulması amaçlanmıştır. Bu amaçla, İstanbul genelinde 123 konaklama tesisi ile anket uygulaması gerçekleştirilmiştir.

Çalışmanın ilk bölümünde turizm kavramı, turizm sektörünün yapısı, turizm sektörünün önemi ve kentsel turizmden bahsedilmiş; dünyadaki, Türkiye'deki ve İstanbul'daki turizm hareketinin gelişimi ortaya konulmuş ve turizm sektörü ile ilgili bilgiler verilmiştir. Daha sonra konaklama tesislerine uygulanan anket çalışması ile ilgili açıklamalar yapılmış, anket uygulanan örneğin seçimine yönelik yöntem, anketin uygulanma şekli ve anket soru formu ile ilgili bilgiler verilmiştir. Son bölümde, anketten elde edilen veriler analiz edilerek ortaya çıkan bulgular sunulmuştur.

Turizm kavramı ile ilgili birçok tanımlama vardır. Konuya eğilenlerin hareket noktalarının aynı olmaması, konuya yaklaşım açılarının ve önem verdikleri unsurların farklı olması turizmin çeşitli tanımlarının ortaya çıkmasına neden olmuştur (Toskay, 1983). Turizmin ilk tanımı Guyer-Feuler tarafından 1905 yılında yapılmıştır. Bu araştırmacılar turizmi, “gittikçe artan hava değişimi ve dinlenme gereksinimleri, doğa ve sanatla beslenen göz alıcı güzellikleri tanıma isteğine; doğanın insanlara mutluluk verdiği inancına dayanan ve özellikle ticaret ve sanayinin gelişmesi ve ulaşım araçlarının kusursuz hale gelmelerinin bir sonucu olarak ulusların ve toplulukların birbirine daha çok yaklaşmasına olanak veren modern çağa özgü bir olay” olarak tanımlamışlardır (Kozak, N. ve diğerleri, 2010). Günümüzde en çok sözü edilen ve OECD tarafından da benimsenen tanım ise, Prof. Dr. Walter Hunziker’in 1941 yılında yaptığı tanımıdır. Bu tanıma göre turizm; para kazanma amacına dayanmayan ve devamlı kalış biçimine dönüşmemek kaydıyla, yabancıların bir yerde konaklamalarından ve bir yere seyahatlerinden doğan olay ve ilgilerin tümüdür (Ürger, 1992). Bu tanım daha sonra Uluslararası Bilimsel Turizm Uzmanları Cemiyeti(AIEST) ve Dünya Turizm Örgütü(WTO) tarafından da kabul edilmiştir.

Günümüzde “Turizm” kavramının insanlara ilk çağrıştırdığı anlam oteller ve buralara tatil, eğlence ve diğer amaçlarla başka yerlerden gelen yerli ve yabancı turistlerdir. Turizm kavramına yüklenen bu anlam, belli bir oranda doğru olmakla birlikte önemli bir ölçüde de eksiktir. Turizm farklı faaliyetler, hizmetler ve sektörlerle iç içe girmiştir ve dolayısıyla turizm olayını bunlarla bir bütün olarak düşünmek gerekmektedir. Turizm sektörü özellikle ulaştırma, konaklama tesisleri, alışveriş ve diğer faaliyetler olmak üzere üç alt sektörden oluşmaktadır. Diğer ana sektörlerle iktisadi anlamdaki ilişkisi ise oldukça yoğundur. Bu anlamda bir turizm tanımı vermek gerekirse, turizm sektörü, kar amacı gütmeyen turizm organizasyonları, pazarlama faaliyetleri, perakende satış mağazaları ve diğer çeşitli etkinlikler gibi birbirinden farklı hizmet ve faaliyetlerin bir şemsiye altında toplayan, koruyucu, uyarıcı ve sürükleyici bir endüstri koludur. Turizm sektörünün yapısını oluşturan işletmeler genel olarak aşağıdaki gibi sınıflandırılabilir(Uzun, 2009):

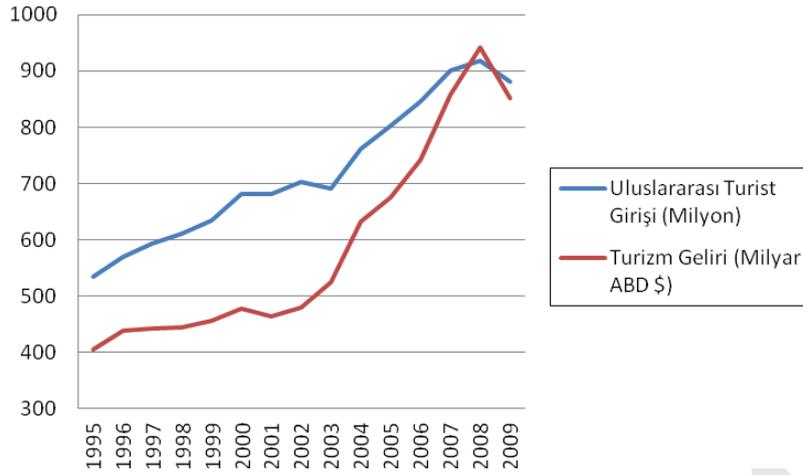
- Konaklama İşletmeleri: Otel, motel, pansiyon, tatil köyü, kamping, apart otel, kaplıca ve termal tesisleri gibi turistlerin konaklama ihtiyacına cevap veren işletmeleri kapsar.

- Ulaştırma İşletmeleri: Kara yolu, deniz yolu, demir yolu ve hava yolu ile ulaşımı sağlayan işletmeler ile tur operatörlerini ve seyahat acentelerini kapsar.

- Yan Hizmet İşletmeleri: Konaklama işletmeleri bünyesi dışında yer alan ve turistlere yeme-içme hizmetleri veren işletmeler, hediyelik eşya satan işletmeler, diskolar, barlar, kafeler, gece kulüpleri, müzeler, alış-veriş merkezleri gibi turizme yardımcı nitelikteki işletmeleri kapsar. Turizm sektörünün merkezinde yer alan turizm işletmeleri, geçici bir süre yer değiştirme olayının gerektirdiği seyahat, konaklama, yeme-içme ve benzeri gereksinimleri karşılamada son derece önemlidir. Turizm her ne kadar bir hizmet sektörü olarak değerlendirilse de; ulaştırma işletmeleri, konaklama işletmeleri ve hatta tarım işletmeleri ile birlikte aslında bir bütündür. Bu haliyle de diğer hizmet sektörlerinden ayrılmakta ve kendine has özellikler gösteren bir yapı sergilemektedir.

Turizm tüm dünyada giderek artan bir önemle gelişmektedir. Birçok sektör gelecekte var olma savaşı verirken, doğal afetler, nükleer kazalar, salgın hastalıklar ve savaş gibi olağanüstü gelişmeler olmadıkça, turizm gerileme tehlikesi göstermeyen bir sektör olarak karşımıza çıkmaktadır (Boz, 2006). Günümüzde turizmin yarattığı ekonomik, sosyal, kültürel ve politik etkiler, ülke ekonomilerinde ve özellikle uluslararası ekonomik ve politik ilişkilerde önemli sonuçlar doğurmaktadır. Bu durum yalnız, uluslararası turizm hareketlerinden büyük pay alan gelişmiş ülkelerde değil, aynı zamanda gelişmekte olan ülkelerde de turizme verilen önemi artırmaktadır. Özellikle gelişmekte olan ülkelerin karşılaştıkları ekonomik sorunların ve dar boğazların aşılmasında, gerekli olan döviz girdisini sağlama, yeni gelir yaratma ve istihdam olanaklarını artırma özelliği ile turizm öncelikli bir sektör haline gelmiştir. Uluslararası kuruluşlar, geri kalmış ve gelişmekte olan ülkelere ekonomik kalkınmalarını ancak planlı ve etkin bir turizm politikası uygulamaları ile gerçekleştirebileceğini söylemekte, bu yolla ekonomik kalkınmasını gerçekleştirmiş ülke olarak İspanya örneği verilmektedir. Öte yandan söz konusu kuruluşlar, Türkiye’nin turizm için elverişli bir potansiyele sahip olduğunu, bu nedenle ekonomik kalkınmasını turizm yolu ile tamamlayabileceğini belirtmekte ve turizmin ülkemiz için ne denli önemli olduğunu vurgulamaktadırlar (Körükçü, 1990). Turizm, bugün ülkelerin ekonomik yapılanmalarını sağlarken, yine bu ülkelerin sosyal ve kültürel yapılarında da etkili ve önemli bir yere sahiptir. Turizmin sosyo-kültürel etkileri turizm süreci içinde bir araya gelen turist ve yerli halkın toplumsal ilişkiler içinde “karşı karşıya gelmeleri” sonucu ortaya çıkmaktadır (Özdemir, 1992). Bilindiği gibi turizm, gelişmiş ülkelere doğru gelişmekte ve bu ilişkiler ağında turistler de gelişmiş ülkelerin değerlerinin taşıyıcısı konumundadır. Bu yolla turizm, gelişmiş toplumların değerlerini yaygınlaştırarak evrenselleştirilmektedir. Bu bakımdan, turistlerin yabancı bir ülkeye gelmesiyle doğan sosyal etkileşim ve değişmeyi, turizm olayının doğuşunda ve oluşumunda etken olan sosyolojik faktörleri ve turizm olayının yol açtığı etkileri göz ardı etmemek gerekir (Nasır, 2002).

Dünyada turizm hareketi artan bir eğilim izlemektedir. Bunun en temel sebebi gelişen ulaşım ve iletişim teknolojileri olsa da ücretli tatil hakkının yaygınlaşarak boş zamanın artması; gelirlerin artması ve kişiler arasındaki gelirlerin daha dengeli hale gelmesi; konaklama biçimlerinin yaygınlaşması ve çeşitliliği; tanıtma, reklam ve halkla iliksiler faaliyetlerinin olumlu etkisi; ikinci konutların yaygınlaşması; toplumda tatil düşüncesinin yaygınlaşması; paket turların yaygınlaşması ve talep görmesi; sınır geçiş işlemlerinde resmi işlemlerin azalması; tatilin bir lüks olarak değil bir ihtiyaç olarak görülmeyle başlanması da turizm hareketlerinin artmasına neden olan diğer etkenlerdir (Sivil, 2007).



**Şekil 1:** Yıllara Göre Dünya Turizm Hareketi

Dünya Turizm Örgütü'nün (2000-2009) verilerinden derlenerek oluşturulan Şekil 1'de görüldüğü gibi dünyadaki turizm hareketi genel olarak artan eğilim göstermesine rağmen zaman zaman bu hareket çeşitli nedenlerle yavaşlamakta ya da azalmaktadır. Küresel ekonomik kriz ve H1N1 virüsünden kaynaklanan salgın hastalık şüphesi 2009 yılında turizm hareketinin 2008'e göre ciddi şekilde azalmasına neden olmuştur (Dünya Turizm Örgütü, 2010).

Tarihi ve kültürel mirası ile birlikte doğal kaynakları da büyük bir zenginlik gösteren Türkiye özellikle 1980 yılından sonra turizm potansiyelinin değerlendirilmesi amacı ile turizm yatırım ve girişimlerine sağlanan desteklerle ve tanıtım çabaları ile beraber turizm sektörü ekonomik ve sosyal yaşamda ağırlıklı olarak yer almaya başlamıştır (Boz, 2006). Buna paralel olarak, 1980 yılından sonra Türkiye'yi ziyaret eden yabancı turist sayısı ve yabancı ziyaretçilerden elde edilen gelir yıllar itibarı ile hızlı bir şekilde artan eğilim göstermektedir. Bununla beraber turizm sektörü büyük bir gelişme göstererek; ülkenin ekonomik sıkıntılar yaşadığı dönemlerde büyük bir döviz girdisi sağlayarak döviz ihtiyacının giderilmesinde, işsizliğin azaltılmasında, ödemeler bilançosunun iyileştirilmesinde önemli bir paya sahip olmuştur.

**Çizelge 1:** Yıllara göre yabancı turist sayısı ve turizm geliri

| Yıllar | Yabancı Ziyaretçi Sayısı (Bin Kişi) | Yıllık Değişim (%) | Yabancı Ziyaretçi Harcaması (Milyon \$) | Yıllık Değişim (%) |
|--------|-------------------------------------|--------------------|---|--------------------|
| 2000   | 10 428                              | 11.4               | 7 636                                   |                    |
| 2001   | 11 619                              | 11.0               | 8 090                                   | 5.9                |
| 2002   | 13 248                              | 14.0               | 8 481                                   | 4.7                |
| 2003   | 13 956                              | 5.3                | 9 677                                   | 14.1               |
| 2004   | 17 548                              | 25.7               | 12 125                                  | 25.3               |
| 2005   | 21 125                              | 20.4               | 13 929                                  | 14.8               |
| 2006   | 19 819                              | -6.2               | 12 553                                  | -9.8               |
| 2007   | 23 341                              | 17.8               | 13 990                                  | 11.4               |
| 2008   | 26 337                              | 12.8               | 16 761                                  | 19.8               |
| 2009   | 27 077                              | 2.8                | 15 853                                  | -5.4               |
| 2010   | 28 511                              | 5.3                | 15 577                                  | -1.7               |

**Kaynak:** Türkiye İstatistik Kurumu Turizm Verilerinden (2000-2010) verilerinden derlenmiştir.

Türkiye İstatistik Kurumu(2000-2010)'nun verilerinden derlenerek oluşturulan Çizelge 1'de, 2000 ile 2010 yılları arasında, Türkiye'yi ziyaret eden yabancı turist sayısına, yabancı turistlerin Türkiye'de ki harcamalarına ve bunların yıllık değişim yüzdelerine yer verilmiştir.

Asya ve Avrupa kıtalarının kesişme noktasında yer alan İstanbul tarihi, kültürel, doğal ve iktisadi özelliklerinden dolayı dünyanın önemli merkezlerinden biridir. Dünyanın en kalabalık şehirlerinden olan İstanbul özellikle 1980'lerden sonra kentin sosyal, ekonomik ve kültürel hayatının canlanmasıyla beraber kente olan ilgi artmaya başlamıştır. Özellikle son yıllarda çeşitli uluslararası spor, sanat faaliyetleri düzenlenmesi; uluslararası ekonomik,

bilimsel, kültürel ve finansal etkinliklerin gerçekleştirilmesi; çeşitli fuar, festival ve kongrelerin artması kentin uluslararası tanınırlığını artırarak yabancıların ilgisinin artmasına neden olmuştur (Şahin, 2010). Türkiye İstatistik Kurumunun (2000-2009) verilerine göre İstanbul'a gelen yabancı ziyaretçi sayısı her yıl artmaktadır. 2000 yılında İstanbul'a gelen yabancı ziyaretçi sayısı 2 421 375 kişi iken, 2009 yılında bu rakam 7 510 470 kişiye yükselmiştir. 2000 yılında İstanbul'a gelen yabancı ziyaretçi sayısı Türkiye'ye gelen yabancı ziyaretçi sayısı oranı %23.2 iken bu oran 2009 yılında %27.7'dir. 2000 ile 2009 yılları arasında İstanbul'a gelen yabancı ziyaretçi sayısı yıllık ortalama %14.6'lık artış göstermiştir. En büyük artış bir önceki yıla göre %39.6'lık artışla 2005 yılında olmuştur. İstanbul, Antalya'dan sonra en fazla yabancı ziyaretçinin giriş yaptığı ildir.

## YÖNTEM

Bu çalışmada, İstanbul ilindeki konaklama tesislerinin yapıları ile ilgili bazı özelliklerin belirlenmesi; konaklama tesislerinde çalışan personelin cinsiyet, çalıştıkları bölüm, eğitim durumu, yaş, çalışma süresi gibi özelliklerinin belirlenmesi; tesislerde çalışan personel ve turizm sektörü ile ilgili değerlendirmelerin ortaya konulması amaçlanmaktadır. Ayrıca elde edilen veri ile konaklama tesislerinin çeşitli kriterlere göre farklılıkları belirlenmeye çalışılmaktadır. Bu amaçla 38 sorudan oluşan bir soru formu, seçilen örnekleme konaklama tesislerine uygulanmıştır. İstanbul ilindeki 368 adet turizm işletme belgesine sahip ve 755 adet belediye işletme belgesine sahip toplam 1123 konaklama tesisi araştırmanın popülasyonunu oluşturmaktadır.

Daha önce de belirtildiği üzere, turizm işletme belgeli konaklama tesisleri için yatak sayıları elde edilmiş olmasına rağmen belediye belgeli konaklama tesisleri için yatak sayıları elde edilememiştir. Bu amaçla, ön çalışma yapılarak örneklem büyüklüğünün belirlenmesinde gerekli olan yatak sayılarının standart sapması ve aritmetik ortalaması tahmin edilmiştir. Belediye işletme belgeli konaklama tesislerinin yatak sayılarının standart sapma ve aritmetik ortama tahminleri ile turizm belgeli konaklama tesislerinin yatak sayılarının standart sapma ve aritmetik ortalamaları Çizelge 2'de verilmiştir.

**Çizelge 2:** İşletme belgesine göre konaklama tesislerine ait bilgiler.

| Konaklama Tesisi | Tesis Sayısı | Standart Sapma | Aritmetik Ortalama |
|------------------|--------------|----------------|--------------------|
| İşletme Belgeli  | 368          | 161.72         | 156.8              |
| Belediye Belgeli | 755          | 16.19          | 37.48              |

Çizelge 2'deki değerlere göre konaklama tesislerinin varyasyon katsayısı (CV) %142.3 olarak tahmin edilmiştir. Varyasyon katsayısı bir popülasyon ve örneğe ait birimlerin değerlerinin homojen veya heterojen olup olmadığını göstermesi bakımından önemlidir. Varyasyon katsayısı %75'den büyük olduğu için tabakalı tesadüfi örnekleme yöntemi kullanılmıştır (Esin, Aydın, Bakır, Gürbüzsel (Yamane Çeviri), 2001). Soru formu üç bölüme ayrılmıştır. Birinci bölümde konaklama tesisinin genel yapısı ile ilgili bilgilerin toplanması, ikinci bölümde işletmede çalışan personelin yapısı ile ilgili bilgilerin toplanması ve son olarak üçüncü bölümde işletmenin ve sektörün değerlendirilmesine yönelik bilgilerin toplanması amaçlanmaktadır.

Anket yolu ile elde edilen veriler kullanılarak çalışmanın popülasyonunu oluşturan 1123 konaklama tesisine yönelik olarak tahminler ve çıkarımlar yapılmıştır. Bu çıkarım ve tahminler R Programı aracılığı ile yapılmıştır. Analiz sonucunda ortaya çıkan tahmin ve çıkarımlar bulgular bölümünde sunulmuştur. Anket soru formunun ilk kısmının 10. sorusundan elde edilen veriler kullanılarak; popülasyonda çalışan toplam personel sayısı ve Çizelge 2'de detayları verilen tabakalarda çalışan toplam personel sayılarının tahminleri yapılmıştır. Anket soru formunun ikinci kısmında yer alan sorulardan elde edilen veriler kullanılarak, popülasyondaki çalışanların çeşitli özelliklerine göre yüzdelik tahminler yapılmıştır. Örneğin popülasyonda çalışan personelin cinsiyetlerine yönelik yüzdelik tahminler yapılmıştır. Ayrıca bu bölümdeki veriler kullanılarak, konaklama tesislerinin ait oldukları sınıfların özelliklerinin yakınlıkları göz önüne alınarak oluşturulan gruplar arasında, çalışan personelin özelliklerine göre farklılıklar olup olmadığı sınımlanmıştır. Burada,

- 1.Grup: 4 ve 5 yıldızlı otelleri,
- 2.Grup: 1,2 ve 3 yıldızlı oteller ile butik oteller ve özel tesisleri,
- 3.Grup: Belediye işletme belgeli konaklama tesislerini

ifade etmektedir. Gruplar, konaklama tesislerinin ait oldukları sınıfların özelliklerinin yakınlıkları göz önüne alınarak oluşturulmuştur. Bu gruplara göre çalışılan personelin özellikleri karşılaştırılmıştır. Örneğin bu üç grupta çalışan personelin cinsiyetlerinin oranları arasında ilişki olup olmadığı sınımlanmıştır.

## BULGULAR

Anket uygulanan 123 konaklama tesisine ait bazı özellikler aşağıdaki çizelgede verilmiştir:

**Çizelge 3:** Örneklemdaki konaklama tesislerinin sınıf ve türlerine göre dağılımları

| Tesisin Tür ve Sınıfı | GRUPLAR                  |                        |         |         |      | Toplam | Toplam (%) |
|-----------------------|--------------------------|------------------------|---------|---------|------|--------|------------|
|                       | Belediye İşletme Belgeli | Turizm İşletme Belgeli |         |         |      |        |            |
|                       |                          | Yatak Kapasitesi       |         |         |      |        |            |
|                       |                          | 10-120                 | 121-240 | 241-480 | 480+ |        |            |
| Otel(Yıldız Yok)      | 55                       | 0                      | 0       | 0       | 0    | 55     | 44.7       |
| 1 Yıldızlı Otel       | 0                        | 4                      | 0       | 0       | 0    | 4      | 3.3        |
| 2 Yıldızlı Otel       | 0                        | 6                      | 1       | 0       | 0    | 7      | 5.7        |
| 3 Yıldızlı Otel       | 0                        | 8                      | 5       | 0       | 0    | 13     | 10.6       |
| 4 Yıldızlı Otel       | 0                        | 0                      | 6       | 7       | 0    | 13     | 10.6       |
| 5 Yıldızlı Otel       | 0                        | 0                      | 1       | 5       | 16   | 22     | 17.9       |
| Butik Otel            | 0                        | 1                      | 0       | 0       | 0    | 1      | 0.8        |
| Özel Tesis            | 0                        | 6                      | 0       | 2       | 0    | 8      | 6.5        |
| <b>Toplam</b>         | 55                       | 25                     | 13      | 14      | 16   | 123    | 100        |

Çizelgede görüldüğü üzere örneklemdaki konaklama tesislerinin % 44.7'sini Belediye İşletme Belgeli konaklama tesisleri oluşturmaktadır. Örneklemdaki beş yıldızlı otellerin oranı %17.9'tur. Örneklemda 1 adet butik otel bulunmaktadır. Yatak kapasitesi 480'den fazla olan Turizm İşletme Belgeli konaklama tesislerinin tamamı 5 yıldızlı otellerdir. Yatak kapasitesi 241 ile 480 arasında olan konaklama tesislerinin çoğunluğunu dört ve beş yıldızlı oteller oluşturmaktadır. Bu grupta 2 adet özel tesis bulunmaktadır.

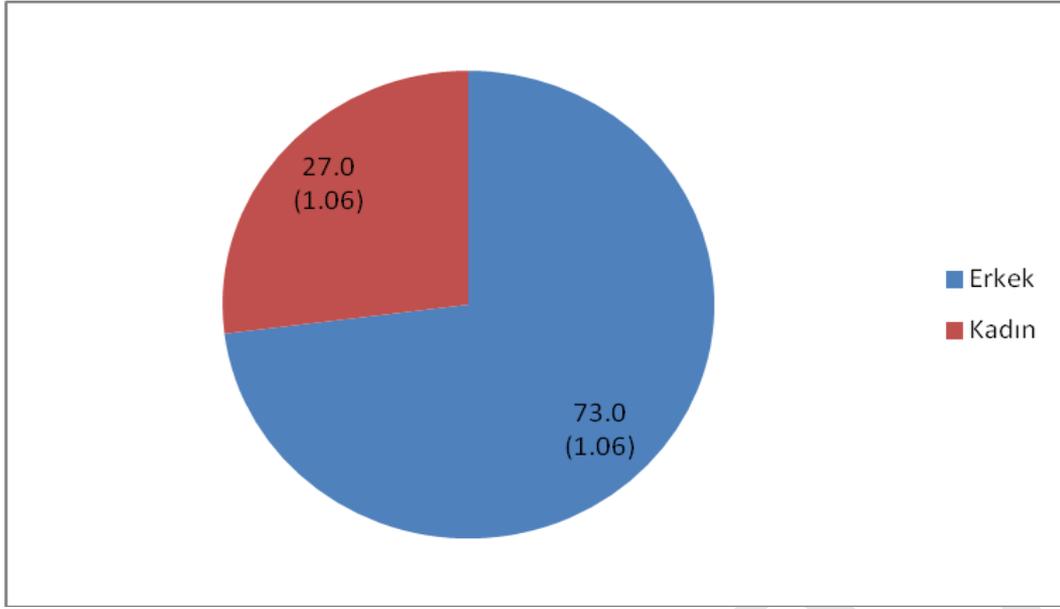
Anket soru formundan elde edilen verilerle kullanılarak, popülasyon ile ilgili ve işletme belgesi ayırımına göre ve yatak kapasitesine göre oluşturulan alt gruplara göre çalışan personel sayısı tahmin edilmiştir. İş sahibi ve ortaklar, ücretsiz çalışan aile fertleri ve işletmeye yardımcı faaliyetler için dışarıdan sağlanan hizmetlerde çalışanlar da dahil olmak üzere konaklama tesislerinde çalışan personel tahmin edilmiştir. Tahminlerin standart hataları parantez içinde verilmiştir.

**Çizelge 4:** İstihdam edilen personel sayısına ilişkin tahminler

|   | Belediye İşletme Belgeli | Turizm İşletme Belgeli (Yatak Kapasitesi) |                  |                   |                   | Toplam             |
|---|--------------------------|---|------------------|-------------------|-------------------|--------------------|
|   |                          | 10-120                                    | 121-240          | 241-480           | 480+              |                    |
| <b>İstihdam Edilen Toplam Kişi Sayısı</b>   | 5 367<br>(366.14)        | 4734<br>(630.88)                          | 3863<br>(617.28) | 6 695<br>(845.47) | 5733<br>(1122.61) | 26892<br>(1271.84) |
| <b>Tesis Sayısı</b>                         | 755                      | 215                                       | 87               | 46                | 20                | 1 123              |
| <b>İstihdam Edilen Ortalama Kişi Sayısı</b> | 7.1                      | 22.3                                      | 44.4             | 145.5             | 286.7             | 23.9               |
| <b>%</b>                                    | 20.3                     | 17.9                                      | 14.6             | 25.4              | 21.7              | 100                |

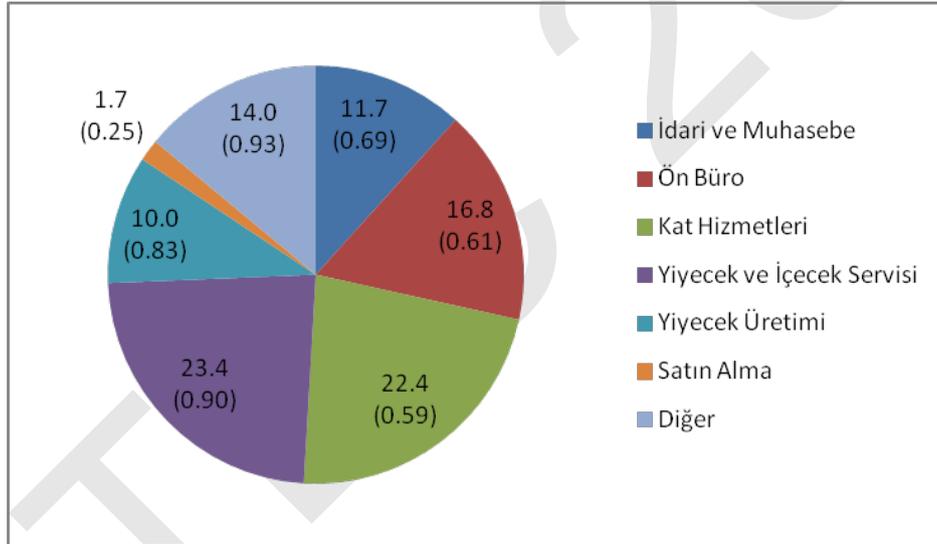
Çizelgede görüldüğü gibi İstanbul ilinde, çalışmanın popülasyonunu oluşturan 1123 konaklama tesisinde toplam 26 456 kişinin çalıştığı tahmin edilmiştir. Yatak kapasitesi 480'nin üzerinde olan 20 tesiste toplam 5 733 kişinin çalıştığı tahmin edilmiştir. İstihdamın %25.3'ünü oluşturan 241-480 arası yatak kapasiteli konaklama tesisleri istihdama en çok katkı yapan grup olarak tahmin edilmiştir. Bu tesislerde çalışan toplam kişi sayısı 6 695 kişi olarak tahmin edilmiştir. Belediye işletmeli belgeli konaklama tesislerinin sayısı turizm işletmeli belgeli konaklama tesislerinin yaklaşık 2 katı olmasına rağmen toplam çalışanların %79.8'inin turizm işletme belgeli tesislerde çalıştığı tahmin edilmiştir.

Şekil 2'de çalışmanın popülasyonunu oluşturan konaklama tesislerinde çalışan personelin cinsiyetlerine göre yüzdelik tahminleri verilmiştir. Parantez içinde verilen değerler ilgili yüzdelik tahminin standart hatasının tahminidir.



**Şekil 2:** Çalışanların cinsiyetlerine göre yüzdelik tahminleri

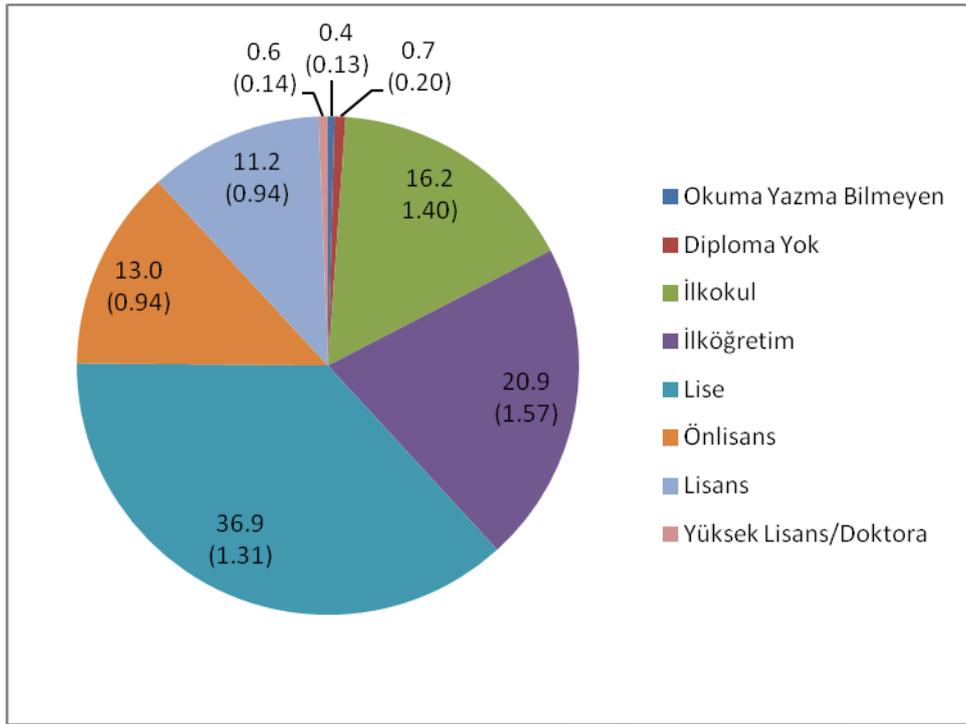
Şekilden de görüldüğü üzere konaklama tesislerinin büyük çoğunluğunu erkeklerin oluşturduğu tahmin edilmektedir. Popülasyonumuzdaki konaklama tesislerinde çalışanların % 27.0'ının kadın, %73.0'ının erkek olduğu tahmin edilmiştir.



**Şekil 3:** Çalışanların bölümlerine göre yüzdelik tahminleri (%)

Şekil 3'de görüldüğü üzere konaklama tesislerinde çalışanların büyük çoğunluğunun kat hizmetleri bölümünde, yiyecek içecek servisi bölümünde ve ön büro bölümünde çalıştıkları tahmin edilmektedir. Popülasyondaki konaklama tesislerinde personelin % 23.4'nün yiyecek ve içecek servisinde, %22.4'nün kat hizmetleri bölümünde, %16.8'inin ise ön büro bölümünde çalıştığı tahmin edilmektedir.

Aşağıdaki şekilde çalışmanın popülasyonunu oluşturan konaklama tesislerinde çalışan personelin eğitim durumlarına göre yüzdelik tahminleri verilmiştir. Parantez içinde verilen değerler ilgili yüzdelik tahminlerin standart hata tahminleridir.



Şekil 4: Çalışanların eğitim durumlarına göre yüzdeleri tahminleri (%)

Şekil 4'te görüldüğü gibi konaklama tesislerinde çalışanların büyük çoğunluğu lise mezunudur. Popülasyondaki konaklama tesislerinde çalışanların %36.9'unun lise mezunu olduğu tahmin edilmiştir. Çalışanların 20.9'unun ilköğretim(ortaokul dahil) mezunu olduğu, %16.2'sinin ilkokul mezunu olduğu, % 13.0'ının üniversitelerin önlisans bölümlerinden mezun olduğu ve %11.2'sinin üniversitelerin lisans bölümlerinden mezun olduğu tahmin edilmektedir.

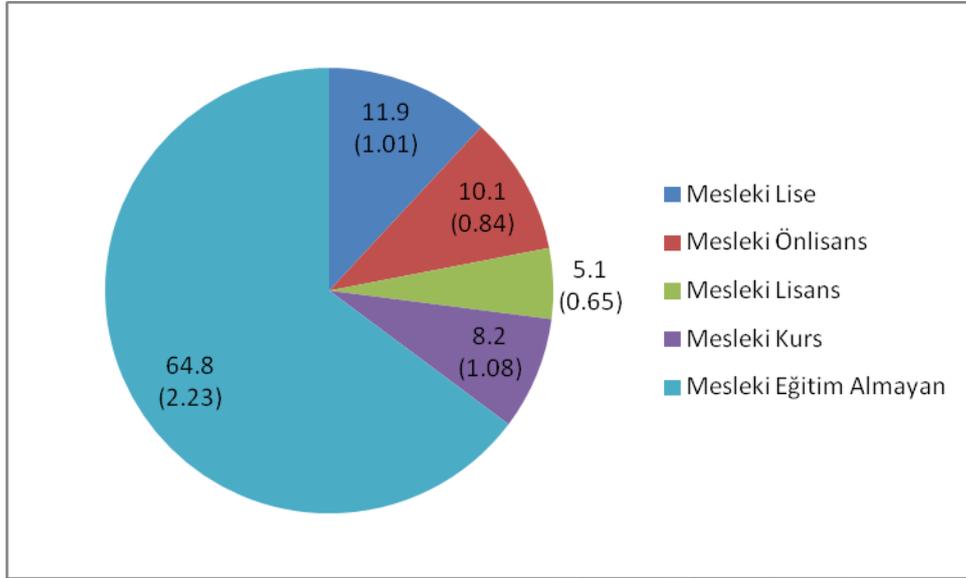
Çizelge 5'de grup ve eğitim durumuna göre gruplar içindeki yüzdeleri oranlarının tahminleri verilmiştir. Parantez içindeki değerler yüzdeleri tahminlerin standart hata tahminlerinin değerleridir.

Çizelge 5: Grup ve Eğitim Durumuna Göre Gruplar İçindeki Yüzdeleri Oran Tahminleri(%)

|                                 | 1.Grup         | 2.Grup         | 3.Grup         |
|---------------------------------|----------------|----------------|----------------|
| <b>Okuma Yazma Bilmeyen</b>     | 0.2<br>(0.11)  | 0.1<br>(0.13)  | 1.3<br>(0.51)  |
| <b>Diploma Yok (Okur Yazar)</b> | 1.08<br>(0.48) | 0.84<br>(0.49) | 0.78<br>(0.44) |
| <b>İlkokul</b>                  | 14.6<br>(2.14) | 20.7<br>(3.36) | 19.0<br>(3.97) |
| <b>İlköğretim</b>               | 19.5<br>(2.32) | 24.6<br>(3.52) | 22.9<br>(3.69) |
| <b>Lise</b>                     | 36.7<br>(2.14) | 35.8<br>(2.87) | 37.4<br>(3.45) |
| <b>Üniversite(Önlisans)</b>     | 15.0<br>(1.71) | 9.1<br>(1.76)  | 11.4<br>(2.05) |
| <b>Üniversite (Lisans)</b>      | 12.4<br>(1.31) | 8<br>(2.35)    | 7.3<br>(1.79)  |
| <b>Yüksek Lisans/Doktora</b>    | 0.6<br>(0.19)  | 0.8<br>(0.35)  | 0.0<br>(0.00)  |

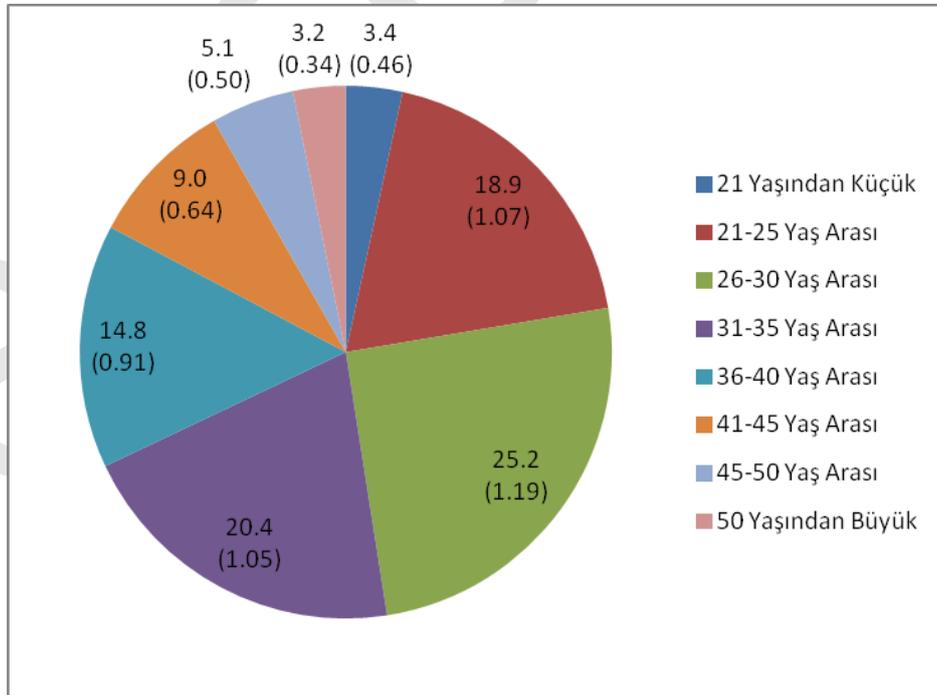
Çizelge 5'te görüldüğü üzere bütün gruplarda, çalışan personelin büyük çoğunluğu lise mezunudur. 1.Grupta çalışanların %36.7'sinin, 2.Grupta çalışanların %35.8'nin, 3.Grupta çalışanların %37.4'nün lise mezunu olduğu tahmin

edilmektedir. 1.Gruptakilerin %15.0'nın üniversitelerin ön lisans bölümlerinden mezun olduğu tahmin edilirken, 2.Gruptakilerin %9.1'nin 3.Gruptakilerin %11.4'nün üniversitelerin ön lisans bölümlerinden mezun oldukları tahmin edilmektedir. 1.Gruptakilerin %12.4'ünün üniversitelerin lisans bölümlerinden mezun olduğu tahmin edilmektedir. Şekilde çalışmanın popülasyonunu oluşturan konaklama tesislerinde çalışan personelin mesleki eğitim durumlarına göre yüzdelik tahminleri verilmiştir. Parantez içinde verilen değerler ilgili yüzdelik tahminlerin standart hata tahminleridir.



Şekil 5: Çalışanların mesleki eğitim durumlarına göre yüzdelik tahminleri (%)

Şekil 5'te görüldüğü üzere konaklama tesislerinde çalışanların büyük çoğunluğu mesleki eğitim almamıştır. Popülasyondaki konaklama tesislerinde çalışanların %64.8'inin turizm veya otelcilik ile ilgili mesleki eğitim almadığı tahmin edilmektedir. Çalışanların % 11.9'unun turizm veya otelcilik ile ilgili mesleki liselerden mezun olduğu, % 10.1'nin turizm veya otelcilik ile ilgili üniversitelerin önlisans bölümlerinden mezun olduğu, % 8.2'sinin turizm veya otelcilik ile ilgili mesleki kurs eğitimi aldığı tahmin edilmektedir.



Şekil 6: Çalışanların yaşlarına göre yüzdelik tahminleri (%)

Şekil 3.5'ten görüldüğü üzere konaklama tesislerinde çalışanların büyük çoğunluğu 21 ile 40 yaş arasındadır. Popülasyondaki konaklama tesislerinde çalışanların %25.2'sinin 26 ile 30 yaş arasında olduğu, % 20.4'ünün 31 ile 35 yaş arasında olduğu, %18.9'unun 21 ile 25 yaş arasında olduğu tahmin edilmektedir.

Çizelge 6’da grup ve yaş durumuna göre gruplar içindeki yüzdelik oranlarının tahminleri verilmiştir. Parantez içindeki değerler yüzdelik tahminlerin standart hata tahminlerinin değerleridir.

**Çizelge 6: Grup ve Yaş Durumuna Göre Gruplar İçindeki Yüzdelik Oran Tahminleri(%)**

|                          | <b>1.Grup</b>  | <b>2.Grup</b>  | <b>3.Grup</b>  |
|--------------------------|----------------|----------------|----------------|
| <b>20 Yaşından Küçük</b> | 3.5<br>(0.61)  | 3.3<br>(1.01)  | 2.8<br>(1.08)  |
| <b>20-25 Yaş Arası</b>   | 20.1<br>(1.57) | 14.9<br>(2.23) | 16.4<br>(2.73) |
| <b>26-30 Yaş Arası</b>   | 25.8<br>(1.82) | 24.6<br>(2.69) | 22.8<br>(3.27) |
| <b>31-35 Yaş Arası</b>   | 18.6<br>(1.33) | 24.4<br>(3.01) | 19.4<br>(2.86) |
| <b>36-40 Yaş Arası</b>   | 14.6<br>(1.07) | 15.1<br>(2.34) | 17.4<br>(2.96) |
| <b>41-45 Yaş Arası</b>   | 8.5<br>(0.77)  | 11.5<br>(1.74) | 9.2<br>(1.73)  |
| <b>46-50 Yaş Arası</b>   | 5.6<br>(0.77)  | 2.5<br>(0.78)  | 8.2<br>(1.77)  |
| <b>50 Yaşından Büyük</b> | 3.3<br>(0.54)  | 3.7<br>(0.95)  | 3.8<br>(0.97)  |

Çizelge 6’da görüldüğü gibi bütün gruplarda 20 yaşından küçük ve 50 yaşından büyük çalışanların oranları diğer yaş gruplarına göre daha düşüktür. Bütün gruplar için 26 ile 35 yaş arasında çalışanların oranı diğer yaş gruplarına göre daha fazladır. 1.Grupta çalışanların %25.8’nin, 2.Grupta çalışanların %24.6’sının, 3.Grupta çalışanların %22.8’inin 26 ile 30 yaş arasında olduğu tahmin edilmektedir.

Anket sonucuna göre konaklama tesislerinde çalışanların %94’ünün sürekli çalışan, %4’ünün geçici çalışan olduğu tahminine ulaşılmıştır. Gerek Türkiye İstatistik Kurumunun ürettiği diğer verilerdeki genel çerçeveye gerekse de sektörel istihdama ilişkin gözlemler bu verinin inandırıcılığına şüphe düşürmektedir.

Anket uygulamasında kullanılan soru formunun son bölümü konaklama tesislerine ilişkin bazı verilerin derlenmesini amaçlamaktadır. Buna göre konaklama tesislerinin yetkililerinin %64’ü çalıştıkları tesisin personel sayısının yeterli olduğunu, %36’sı yetersiz olduğunu belirtmiştir. Yine konaklama tesisi yetkililerinin beyanlarına göre konaklama tesislerinin %39.2’sinde çalışanların mesleki eğitim düzeyi yeterli, %25.6’sında yetersiz olduğu tahmin edilmektedir. Konaklama tesisi yetkililerinden elde edilen bir diğer veri, tesislerin %68.7’sinde işbaşı eğitimi verildiğidir. Tesis yetkililerinin %34.6’sı sektörde kriz olduğunu, %65.4’ü kriz olmadığını beyan etmişlerdir. Sektör yetkililerinin %70.2’si, turizm sektörünün geleceğinin mevcut duruma göre daha iyi olacağını belirtirken, %16.2’si aynı kalacağını, %13.6’sı daha kötü olacağını beyan etmişlerdir.

## SONUÇ VE DEĞERLENDİRME

Özellikle teknolojik ve ekonomik gelişmeler, bu değişimlerle beraber toplumun sosyal yapısının da değişmesi, turizm hareketinin dünyada sürekli olarak artmasına neden olmuştur. Bugün, turizm hareketi, büyük ekonomik küresel krizler, salgın hastalıklar ya da büyük felaketler olmadığı sürece küçülme tehlikesi olmayan bir hareket olarak görülmektedir. Türkiye bu hareketten önemli pay alan ülkelerden biridir. Özellikle 1980’li yılların ortalarından itibaren turizmin Türkiye’de bir politika olarak benimsenmesi ile beraber ülkeye gelen yabancı ziyaretçi sayısı yıllar içinde sürekli olarak artan bir eğilim göstermiştir. Turizm hareketinin son yıllardaki değişimi incelendiğinde, Türkiye’ye gelen yabancı turist sayısındaki yıllık ortalama değişim, Dünya’daki uluslararası turist gelişlerinin ortalama değişiminin oldukça üzerindedir. Bunun sonucu olarak, 2009 yılı itibari ile Türkiye dünyada en fazla yabancı turist çeken yedinci, turizmden en fazla gelir elde eden dokuzuncu ülke konumundadır.

Dünya’da turizm hareketinden bu denli önemli pay alan Türkiye’nin Antalya’dan sonra en çok yabancı turist çeken şehri İstanbul’dur. İstanbul tarihi, kültürel, doğal ve iktisadi özelliklerinden dolayı dünyanın en önemli

merkezlerinden biridir. Bunun yanında özellikle son yıllarda çeşitli uluslararası spor, sanat faaliyetleri düzenlenmesi; uluslararası ekonomik, bilimsel, kültürel ve finansal etkinliklerin gerçekleştirilmesi; çeşitli fuar, festival ve kongrelerin artması kentin uluslararası tanınırlığını artırarak yabancıların ilgisinin artmasına neden olmuştur. 2000 ve 2009 yılları arasında Türkiye'ye gelen yabancı ziyaretçilerin sayıları incelendiğinde, İstanbul'a giriş yapan yabancı turist sayısındaki yıllık ortalama artışın aynı dönemde hem Antalya'ya hem de Türkiye'ye giriş yapan yabancı ziyaretçi sayısının yıllık ortalama artış hızından daha fazla olduğu görülmektedir.

Turizm hareketinin zaman içinde sürekli olarak artan bir eğilim göstermesi, turizm sektörünün sürekli olarak büyümesine ve bu sektörün dünya ekonomisi üzerindeki etkilerinin de çoğalmasına neden olmaktadır. Bugün dünyadaki gelirin önemli denilecek bir kısmı dünya turizm hareketinden sağlanmaktadır. Turizm sektörü bugün birçok gelişmekte olan ülke için önemli bir gelir kaynağıdır.

Turizm sektörü pek çok faaliyet ile iç içe girmiştir. Turizm faaliyetine katılan insanların geçici bir süre konaklama, yeme, içme, vb. ihtiyaçlarını karşılamak amacıyla uğradıkları konaklama tesisleri turizm sektörünün en önemli bileşenlerindedir. Türkiye'deki turizm hareketinin artması ile beraber Türkiye'deki konaklama tesislerinin sayıları, buna bağlı olarak yatak ve oda sayıları da önemli şekilde artmıştır. Türkiye'de ve İstanbul'da her ihtiyaca cevap verebilecek nitelikte farklı türde ve sınıfta pek çok konaklama tesisi vardır. Bugün, konaklama tesisleri önemli sayılabilecek bir istihdam kaynağıdır. Pek çok farklı nitelikte insan konaklama tesislerinde çalışmaktadır. Bu çalışmanın amaçlarından biri İstanbul'daki konaklama tesislerinde çalışan personelin bazı niteliklerinin belirlenmesidir. Çalışmanın popülasyonunu, 2010 yılı Temmuz ayı itibarı ile İstanbul'daki turizm işletme belgesine ve belediye işletme belgesine sahip 1123 konaklama tesisi oluşturmaktadır. Örneklem belirlenirken, popülasyon beş tabakaya bölünmüştür. Turizm işletme belgeli konaklama tesisleri yatak sayısı kapasitesine göre dört tabaka, belediye işletme belgeli konaklama tesisleri bir tabaka olmak üzere popülasyon beş tabakaya ayrılmıştır. Yatak sayısının ortalamasının tahmini baz alınarak, %95 güven aralığı ve ortalama %5 sapma ile örneklem büyüklüğü Neyman yöntemi ile 123 olarak belirlenmiştir. Tabaka büyüklükleri belirlendikten sonra İl Turizm Müdürlüğü, İlçe Belediyeleri ve şehir rehberinden adresleri ve unvanları elde edilen konaklama tesisleri tesadüfi olarak çalışmanın örneklemi oluşturmuştur. Örneklemdeki konaklama tesislerine anket uygulandıktan sonra uygun yöntemler kullanılarak konaklama tesislerine ve tesislerde çalışan personele yönelik bulgular elde edilmiştir. Elde edilen veriler kullanılarak yapılan analiz sonucunda, çalışmanın popülasyonunu oluşturan 1123 tesiste toplam 26456 kişinin çalıştığı tahmin edilmiştir. Belediye işletme belgesine sahip konaklama tesislerinin sayısı turizm işletme belgesine sahip konaklama tesislerinin yaklaşık iki katı olmasına rağmen konaklama tesislerinde çalışanların yaklaşık % 80'ninin turizm işletme belgesine sahip konaklama tesislerinde çalıştığı tahmin edilmiştir. Turizm işletme belgesine sahip konaklama tesislerinin hem yatak kapasitelerinin daha fazla olması hem de sundukları hizmetlerin daha çeşitli olması bu durumun başlıca nedenidir.

Konaklama tesislerinde çalışan personelin çoğunluğunu erkekler oluşturmaktadır. Tesislerin ait oldukları sınıfların özelliklerinin yakınlıkları göz önüne alınarak oluşturulan gruplar arasında konaklama tesislerinde çalışanların oranlarına göre anlamlı bir fark olduğu tespit edilmiştir. Belediye işletme belgesine sahip konaklama tesisleri kadın çalışanı oranının en az olduğu grup olarak göze çarpmaktadır. Konaklama tesislerinde çalışanların büyük çoğunluğunun kat hizmetleri, yiyecek, içecek servisi ve ön büro bölümlerinde çalıştıkları tahmin edilmiştir. Konaklama tesislerinin ait oldukları sınıfların özelliklerinin yakınlıkları göz önüne alınarak oluşturulan gruplar arasında, çalışılan bölüme göre anlamlı fark olduğu belirlenmiştir. Özellikle belediye işletme belgesine sahip konaklama tesislerinde çalışanların çalıştıkları bölümlere göre oranları diğer iki gruptaki oranlara göre farklılık göstermektedir. Özellikle ön büro ve kat hizmetlerinde çalışanların oranı belediye işletme belgesine sahip konaklama tesislerinde diğer gruplardaki konaklama tesislerine göre daha fazla iken yiyecek, içecek servisi ve yiyecek üretimi bölümünde çalışanların oranı diğer gruplardan daha azdır.

Konaklama tesislerinde lise mezunu olanların çoğunlukta olduğu görülmektedir. Çalışanların üçte birinden fazlasının lise mezunu olduğu tahmin edilmiştir. Konaklama tesislerinde çalışanların büyük bölümünün turizm veya otelcilik ile ilgili mesleki eğitim almadığı tahmin edilmiştir. Mesleki eğitim alanların büyük çoğunluğu turizm veya otelcilik ile ilgili meslek liselerinden mezun olmuştur. Konaklama tesislerinin ait oldukları sınıfların özelliklerinin yakınlıkları göz önüne alınarak oluşturulan gruplar arasında, çalışanların eğitim durumuna göre anlamlı fark olduğu bulgusuna ulaşılmıştır. Özellikle birinci grupta yer alan konaklama tesislerinin yani 4 ve 5 yıldızlı konaklama tesislerinde çalışanların mesleki eğitim almayanların oranı diğer iki gruba göre daha düşük olduğu, meslek lisesi ve üniversitelerin mesleki ön lisans bölümlerinden mezun olanların oranlarının daha fazla olduğu tespit edilmiştir. Konaklama tesislerinde çalışanların büyük çoğunluğunun 21 ile 40 yaş arasında olduğu tahmin edilmiştir. Konaklama tesislerinin ait oldukları sınıfların özelliklerinin yakınlıkları göz önüne alınarak oluşturulan gruplar arasında, çalışanların yaşlarına göre anlamlı bir fark olmadığı görülmüştür.

Konaklama tesislerinde çalışanların çok büyük çoğunluğunun sürekli çalışan olduğu tahmin edilmiştir. Konaklama tesislerinin ait oldukları sınıfların özelliklerinin yakınlıkları göz önüne alınarak oluşturulan gruplar arasında, çalışanların süreklilik durumuna göre anlamlı bir fark olduğu verisine ulaşılmıştır. Özellikle Belediye İşletme Belgesine sahip konaklama tesislerinde geçici olarak çalışanların oranının daha fazla olduğu belirlenmiştir. Konaklama tesislerinin büyük çoğunluğunun çalışan sayısının yeterli olduğu tahmin edilmiştir. Çalışan sayısının en az yeterli olduğu bölümler olarak ön büro bölümü ve kat hizmetleri bölümleri olduğu tahmin edilmiştir. Yiyecek ve içecek servisi

bölmülerinde çalışanların sayılarının yeterli bulunma oranları sahip olunan işletme belgesine göre anlamlı şekilde farklılık göstermektedir. Belediye işletme belgesine sahip konaklama tesislerinin yiyecek içecek servisinden çalışanların sayıları turizm işletme belgesine sahip konaklama tesislerinin aynı bölümünde çalışanların sayılarına göre daha az yeterli olduğu bulunmuştur.

Konaklama tesislerinin yaklaşık üçte birinde mesleki eğitim alan personel çalışmadığı tahmin edilmiştir. Konaklama tesislerinin çoğunluğunda mesleki eğitim almış personelin eğitim düzeyinin yeterli olduğu tahmin edilmiştir. Konaklama tesislerinin ön büro, kat hizmetleri ve yiyecek ve içecek bölümlerinde çalışan mesleki eğitim almış personelin yeterliliği en az olan bölümler olarak tahmin edilmiştir. Konaklama tesislerinin çoğunluğunda işbaşı eğitimi verildiği tahmin edilmiştir. Konaklama tesislerinin ön büro, kat hizmetleri ve yiyecek içecek servisi bölümlerinde işbaşı eğitiminin diğer bölümlere göre daha fazla verildiği tahmin edilmiştir. Sahip olunan işletme belgesine göre ön büro bölümünde işbaşı eğitimi verilme oranları arasında anlamlı fark olduğu tespit edilmiştir. Turizm işletme belgesine sahip konaklama tesislerinde bu bölümlerde işbaşı eğitimi verilme oranı belediye işletme belgeli konaklama tesislerine göre daha fazla olduğu tahmin edilmiştir. Konaklama tesislerinin yetkililerinin büyük çoğunluğu turizm sektöründe kriz olmadığını beyan etmiştir. Sahip olunan belgeye göre sektörde krizin varlığı ile ilgili düşünceler arasında anlamlı fark olduğu görülmüştür. Özellikle belediye işletme belgesine sahip konaklama tesislerinin sektörde krizin var olduğuna dair düşüncesi olan yetkililerin oranı, turizm işletme belgesine sahip konaklama tesislerinin sektörde krizin var olduğuna dair düşüncesi olan yetkililerin oranına göre daha fazladır. Konaklama tesislerinin çoğunluğunun sektörde kriz olması durumunda personel sayısını azaltmadığı tahmin edilmiştir. Sektördeki kriz dönemlerinde en fazla kat hizmetleri ve yiyecek, içecek servisi bölümlerinde personel azaltıldığı bulgusu ortaya çıkmıştır. Konaklama tesislerinin yetkililerinin çoğunluğu turizm sektörünün geleceğinin daha iyi olacağını beklemektedirler. Turizm işletme belgesine sahip konaklama tesislerinin yetkililerinin belediye işletme belgesine sahip konaklama tesislerinin yetkililerine göre turizm sektörünün geleceği konusunda daha iyimser oldukları belirlenmiştir. Genel olarak bakıldığında özellikle belediye işletme belgesine sahip konaklama tesisleri ile turizm işletme belgesine sahip konaklama tesisleri arasında personel yapısı bakımından anlamlı farklılıklar bulunmuştur.

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# İŞLETMELERDE ÇAĞDAŞ SAĞLIK YÖNETİMİ İÇİN İŞ SAĞLIĞI, İŞYERİ HEKİMLİĞİ VE İŞ SAĞLIĞI HEMŞİRELİĞİ

Yrd.Doç.Dr.Gökhan OFLUOĞLU

İktisadi ve İdari Bilimler Fakültesi

Bülent Ecevit Üniversitesi

Zonguldak/Türkiye

[gofluoglu@yahoo.com](mailto:gofluoglu@yahoo.com)

Yrd.Doç.Dr.Sinem SOMUNOĞLU

Sağlık Hizmetleri MYO

Uludağ Üniversitesi

Bursa/Türkiye

[ssomunoglu@yahoo.com](mailto:ssomunoglu@yahoo.com)

**Özet:** Sağlık, üzerinde önemle durulması, korunması ve geliştirilmesi gereken konulardan biri olarak kabul edilmekte ve sağlık hizmeti, insan sağlığına zarar veren etmenlerin ortadan kaldırılması, toplumun bu etmenlerin olumsuz etkilerine karşı korunması ve hastalıkların tedavi ve rehabilite edilmesi için verilen hizmetlerin bütünüdür. İnsanların çalışma ortamında geçirdikleri sürenin uzun bir dönemi kapsadığı düşünüldüğünde, sağlık ve güvenlikleriyle ilgili sorunlarla karşılaşmaları da kaçınılmaz olmaktadır. Çalışma hayatının getirdiği bu sorunlar; çalışanların sağlık kapasitelerinin yükseltilmesi ve sağlıklarındaki bozulmaların önlenmesi amacıyla yönelik olarak yürütülen iş sağlığı alanındaki gelişmelerin hız kazanmasını da beraberinde getirmiştir. İşletmelerde verilen sağlık hizmeti, işyerinin veya işletmenin daha sağlıklı ve güvenli bir ortam haline getirilerek, çalışanların sağlığının korunması ve geliştirilmesi amacı ile işyeri veya işletme dışındaki meslek grupları tarafından sağlanan tıbbi ve teknik hizmetlerin bütünü olarak ifade edilmektedir. İşletmelerde işyeri hekiminin olması, kaza ve sık görülen hastalıklara bağlı olarak ortaya çıkan işgücü ve işgünü kayıplarının minimize edilmesine imkan verdiği gibi, tazminat, tedavi ve rehabilitasyon maliyetlerinin de kontrol altında tutulmasına büyük katkı sağlamaktadır. İş sağlığı hemşireliği de; çalışanların sağlığının korunması, geliştirilmesi ve sağlıklı çalışma çevresinin oluşturulması için yürütülen faaliyetleri içermektedir. İş sağlığı, işyeri hekimliği ve iş sağlığı hemşireliği faaliyetleri ile çalışanların fiziksel ve ruhsal sağlık durumlarını en üst düzeye getirilmesi amaçlanmakta, işletmelerin çağdaş sağlık yönetimi ve işletmecilik normları ile uluslararası çalışma standartlarına uygun hareket etmesi mümkün olmaktadır. Bu nedenle, iş sağlığı, işyeri hekimliği ve iş sağlığı hemşireliği faaliyetlerinin koordineli bir şekilde yürütülmesi büyük önem taşımaktadır.

Bu düşünceler çerçevesinde hazırlanan çalışmada iş sağlığı, işyeri hekimliği ve iş sağlığı hemşireliği konularına değinilerek Türkiye'deki mevcut duruma ve gelişmelere yer verilmiştir.

**Anahtar kelimeler:** Sağlık, iş sağlığı, iş güvenliği, işyeri hekimliği, iş sağlığı hemşireliği.

## Giriş

Toplumların daha hızlı büyümek ve güçlenmek için etkili sağlık hizmetini geliştirip uygulamaya geçirme yönündeki çabaları ile sağlığı olumsuz yönde etkileyen faktörlerin ortadan kaldırılmasına ilişkin yapılan düzenlemeler, iş sağlığı alanındaki gelişmelerin ortaya çıkması sonucunu doğurmuştur. İş sağlığı ve iş sağlığı alanındaki sorunlar, Dünya Sağlık Örgütü (DSÖ) ve Uluslararası Çalışma Örgütü (ILO) tarafından da önemli görülerek ele alınmış ve sonuçta iş sağlığının amaçlarına yönelik olarak bazı düzenlemeler yapılmıştır. Buna göre amaçlanan; çalışanların sağlık kapasitelerinin yükseltilmesi, çalışma ortamının olumsuz koşullarına bağlı olarak ortaya çıkan sağlıktaki bozulmanın önlenmesi, çalışanların fiziksel ve ruhsal yeteneklerine uygun işlerde çalıştırılması ve optimal verimin yakalanmasıdır. Sağlık hakkının tüm insan haklarının merkezinde yer aldığı ve çalışanların sağlık risklerinin denetlendiği iş

ortamlarında çalışma hakkına sahip olduğu düşüncesi de, bu konuda yürütülen faaliyetlerin artarak önem kazanmasını beraberinde getirmiştir. Bu açıdan bakıldığında; toplumun büyük bir kesimini oluşturan çalışanların, sağlığının korunması, geliştirilmesi ve sürdürülmesine yönelik olarak yürütülen iş sağlığı ve güvenliği faaliyetlerinin ülke genel sağlık hizmetinden bağımsız olarak değerlendirilmesi de mümkün olmamaktadır (Altıtepe, 2012, s.147-148).

Çalışma koşullarının gelişmesine ve teknolojik ilerlemelere paralel olarak ortaya çıkan riskler; çoğu Avrupa ülkesinde işverenlerin ve özellikle büyük işletme sahiplerinin iş sağlığı ve güvenliği alanında birtakım düzenlemeler yapmasının yasalarca zorunlu hale getirilmesine neden olmuştur (Altıtepe, 2012, s.150). 1961 yılında Torino'da imzaya açılan Avrupa Sosyal Şartı bu alanda yapılan düzenlemeler için temel bir örnek olarak kabul edilmekte ve Güvenli ve Sağlıklı Çalışma Koşulları Hakkı başlıklı 3.Maddesi'nde konuya ilişkin bazı düzenlemelere yer verilmektedir. Buna göre; iş güvenliği, iş sağlığı ve çalışma ortamı hakkında tutarlı bir ulusal politika oluşturulması, çalışma ortamının doğasından kaynaklanan tehlikelerin sebeplerinin en aza indirilerek hastalık ve kazaların önlenmesi ve iş sağlığı hizmetlerinin geliştirilmesi vb. alanlarda yapılan düzenlemeler büyük önem taşımaktadır (insanhaklarimerkezi.bilgi.edu.tr). Çalışanların sağlıklarının korunması ve sağlıklı bir ortamda çalışmalarına ilişkin düzenlemelerin yapılması aynı zamanda İş Hukukunun güncel ve önemli konuları arasında yer almakta, bu durum da, işyeri hekimliğinin önemli bir unsur olarak kabul edilmesine yol açmaktadır (Karagöz, 2006, s.361).

Çalışan sağlığının ön plana çıktığı, sağlığın korunması, geliştirilmesi ve sağlıklı bir çalışma ortamının sağlanması amacıyla yürütülen faaliyetlerin bir diğer ayağını da iş sağlığı hemşireliği oluşturmaktadır. Bu açıdan bakıldığında iş sağlığı hemşiresi; iş kazalarının ve meslek hastalıklarının önlenmesi, sağlık eğitimi vb. görevleri yerine getirmektedir (Güler ve Kubilay, 1998, s.17).

İş sağlığı ve iş güvenliği alanında yürütülen çalışmaların, önlemenin işyerinde başlaması temeline dayandığı düşünüldüğünde, işyerlerinin iş sağlığı ve iş güvenliği konusunda örgütlenmesinin, konuya ilişkin alınabilecek önlemler açısından büyük önem taşıdığı görülmektedir. Örgütlenmesini sağlam temellere oturtan işletmelerin, iş kazaları ve meslek hastalıklarının önlenmesi konusunda daha başarılı olduğu gerçeğinden hareket edildiğinde ise, iş sağlığı, işyeri hekimliği ve iş sağlığı hemşireliği konularına gösterilen ilginin nedeni daha net olarak anlaşılmaktadır. Bu düşüncelerden hareketle hazırlanan bu çalışmada da; iş sağlığı, işyeri hekimliği ve iş sağlığı hemşireliği konularına değinilerek, Türkiye'deki mevcut duruma ve gelişmelere yer verilmesi amaçlanmıştır.

## İşyeri Hekimliği

ILO tarafından işyeri hekimliğine ilişkin olarak yapılan tanıma bakıldığında, işçilerin gerek işlerinden gerekse işin yapıldığı koşullardan kaynaklanabilecek her türlü zarardan korunması, işin işçiye uygun hale getirilmesi ve işçilerin fiziksel ve ruhsal iyilik hallerinin sağlanması ve sürdürülmesi amacıyla yürütülen hizmetler şeklinde tanımlandığı görülmektedir (Devebakan, 2007, s.88).

27 Kasım 2010 tarihli ve 27768 sayılı Resmi Gazete'de yayımlanarak yürürlüğe giren İşyeri Hekimlerinin Görev, Yetki, Sorumluluk ve Eğitimleri Hakkındaki Yönetmeliğe göre de işyeri hekimi iş sağlığı ve güvenliği hizmetleri kapsamında; rehberlik ve danışmanlık, sağlık gözetimi, eğitim ve bilgilendirme görevlerini yapmakla yükümlüdür. Bu çerçevede bakıldığında işyeri hekimi, iş sağlığı ve güvenliğinin geliştirilmesi için işverene tavsiyede bulunmak, işyerinde sağlığa zararlı riskleri değerlendirmek, koruyucu sağlık muayenelerini yapmak, bulaşıcı hastalıkların kontrolü için önleme ve bağışıklama çalışmalarını yürütmek, iş kazasına uğrayan ve meslek hastalığına yakalanan çalışanların rehabilitasyonunu sağlamak ve iş sağlığı ve güvenliği konusunda eğitim vermek vb. faaliyetleri sürdürmektedir (<http://www.ttb.org.tr>). İşyeri hekimi sürekli olarak en az 50 işçi çalıştırılan işyerlerinde, Sosyal Sigortalar Kurumu'na sağlanan tedavi hizmetleri dışında, işçilerin sağlık durumlarını denetlemek, ilk yardım, acil tedavi ve diğer koruyucu sağlık hizmetlerini yürütmek üzere görev yapmaktadır. Yasal düzenlemeler açısından bakıldığında işyeri hekimi, işverenin, Umumi Hıfzıssıhha Kanunu'nun 180. ve Sosyal Sigortalar Kanunu'nun 114.Maddelerine göre yükümlü bulunduğu hekim sağlama zorunluluğu nedeniyle, kendisiyle hizmet sözleşmesi yapılan iş hekimliği alanında belirli deneyim sahibi hekim olarak ifade edilmektedir (Demircioğlu, 1997, s.203). İşyeri hekimi olarak görevlendirilecek hekimlerin Bakanlık tarafından verilen işyeri hekimliği sertifikasına sahip olması beklenmekte, bu sertifikanın da ancak iş müfettişliği yapılması, iş sağlığı bilim uzmanlığı veya doktorasının tamamlanması, iş ve meslek hastalıkları konusunda yan dal uzmanlığının alınması ve işyeri hekimliği sertifika programında başarılı olunması durumunda kazanılacağı ifade edilmektedir (Devebakan, 2007, s.90).

İşyeri hekimi, işverenin sorumluluğunda olan işçi sağlığının korunmasına yönelik olarak her konuda görüş ve bilgisi ile işverene danışmanlık yapmaktadır. Görevi doğrudan insan sağlığının korunmasına yönelik olduğu için, kendi alanına ilişkin uygulamalar konusunda emir almaması, faaliyetlerini yerine getirme amacı ile yaptıklarından dolayı mağdur olmaması, mesleki sırları saklayabilmesi ve sadece mesleki vicdanına tabi olarak görevini yapması büyük önem taşımaktadır. Bu açıdan bakıldığında, işyeri hekimliğinin doğası gereği mesleki bağımsızlığının sağlanması, işveren ve işçilere karşı da gerektiğinde bağımsızlığını koruyabilmesi beklenmektedir. Bunun yanında işyeri hekimi, iş sözleşmesindeki bağımlılık unsurunun sonucu olarak, işverene idari konularda bağımlı olarak görev yapmakta, bu duruma bağlı olarak da işyeri hekiminin çeşitli güçlüklerle karşı karşıya kalması ve kar amacı güden ve rekabete dayalı bir işletme ortamında görev yapması söz konusu olmaktadır. Bu açıdan bakıldığında işyeri hekimi, işçilik sıfatı ile hekimlik mesleğini bağdaştırmak durumunda olduğu gibi, tıbbi deontoloji kuralları ve mesleki bağımsızlık ilkesini işverene karşı da korumak zorundadır. İşyeri hekiminin görev yaptığı işyeri sağlık biriminin organizasyonu ve yönetimi incelendiğinde de, bu faaliyetlerin yürütülmesinin işverene bırakıldığı görülmektedir. Bu durum, konuya ilişkin farklı

bakış açılarının geliştirilmesine neden olmakta ve işverenler tarafından, zaman zaman işyeri hekimliğinin gereksiz bir yük, hatta sakıncalı ve pahalı bulunması sonucunu da beraberinde getirmektedir. Hatta bazı işverenlere göre, işyeri hekimliğinin etkinliğini sağlamak, işletmenin görevleri arasında yer almadığı gibi, işletmenin yararına da kabul edilmemektedir (Güzel, 2003, s.54).

Türkiye’de yapılan son düzenlemeler incelendiğinde; işyeri hekimlerinin görev, yetki, sorumluluk ve eğitimleri hakkındaki yönetmelik çerçevesinde, Toplum Sağlığı Merkezlerinde (TSM) işyeri hekimliği hizmeti sunulabilmesine ilişkin düzenlemelerin yapıldığı görülmektedir. Buna göre TSM, Çalışma ve Sosyal Güvenlik Bakanlığı’ndan “İşyeri Hekimliği Hizmeti Yetki Belgesi”ni alması durumunda, işyeri hekimliği hizmetine ihtiyaç duyan işletmelere bu hizmeti verebilecektir ([www.saglik.gov.tr](http://www.saglik.gov.tr)).

İşyeri hekimliğinin başlı başına bir hekimlik uğraşı olarak kabul edilmesi, işyeri koşulları ile işçi sayıları gözetilerek iş sağlığı örgütlenmesinin sağlanması sunulan hizmetin etkinliği açısından büyük önem taşımaktadır. Birinci basamak koruyucu ve tedavi edici sağlık hizmeti veren işyeri hekimliğinin, gerekli eğitimi almış istekli hekimlerin temel uğraş alanı olarak belirlenmesinin de, bu alanda yürütülen hizmetlerin başarıya ulaşma şansını yükselteceği düşünülmektedir. Sosyal Güvenlik Kurumu bünyesinde çalışan uzman ve pratisyen hekimler başta olmak üzere, birinci basamak sağlık hizmetlerinde görev alan tüm hekimlerin meslek hastalıkları ve ilgili mevzuatı öğrenmelerine yönelik eğitimlerin ve meslek hastalıkları uzmanlığının sürekli tıp eğitimi anlayışı ile yürütülmesinin de olumlu sonuçlar doğuracağı ifade edilmektedir. Genel tıp uygulamaları çerçevesinde, işçi sağlığı açısından denetleyici görevini en iyi şekilde yerine getirecek olanlar hekimler olduğu için, Çalışma Bakanlığı İş Teftiş Kurulu içinde, hekim iş müfettişlerin gerekli ve yeterli sayıda istihdamının sağlanmasına ilişkin düzenlemelerin yapılmasının da sürece katkısı söz konusudur (Karadağ v.d, 1998, s.18). Ayrıca, meslek hastalıkları hastaneleri ve hekim iş müfettişi istihdamıyla güçlendirilmiş denetim örgütlenmesinin fonksiyonel hale getirilmesinin, en az elli işçi sınırı olmaksızın tüm işyerlerini kapsayacak ortak sağlık birimlerinin düzenlenmesi ve örgütlenmesinin, iş sağlığı örgütlenme basamaklarının birbirleri ve denetim örgütüyle eşgüdümlü çalışmasının çalışan sağlığını olumlu yönde etkileyeceği düşünülmektedir (Şişli, 2007, s.218).

## İş Sağlığı Hemşireliği

İş sağlığı hemşireliği çalışanın sağlığını korumayı, geliştirmeyi ve sağlıklı çalışma ortamı oluşturmayı amaçlamaktadır. İş sağlığı hemşiresi; epidemiyoloji, toksikoloji, endüstriyel hijyen, iş güvenliği vb. konularda bilgi temeline sahip olmakla birlikte, uygulamada bakım verici, bakımı yönetici, eğitmen ve danışmanlık rollerini üstlenmektedir (İşçi ve Esin, 2009, s.40).

İş sağlığı hemşiresi, iş sağlığı ve güvenliği sisteminin önemli unsurlarından biri olarak kabul edilmekte ve sanayileşmiş ülkeler açısından ilk uygulama örneklerinin 19. yüzyıldan itibaren görülmeye başlandığına işaret edilmektedir. İlk iş sağlığı hemşiresinin 1895 yılında Amerika’da görev yaptığı ve işçilere sağlıklı yaşam alışkanlıkları, çocuk bakımı, ilkyardım hizmetleri vb. konularda hizmet verdiği ve hasta olan işçileri de evlerinde ziyaret ettiği ifade edilmektedir. Geçen zamana paralel olarak, verilen bu hizmetlerin geliştiği ve işçilerin işe devamsızlıklarının azaltılarak, onların daha üretken kılınmasına yönelik çabaların benimsendiği elde edilen diğer bilgiler arasında yer almaktadır. 1917 yılına gelindiğinde ise, iş sağlığı hemşireliğine ilişkin ilk özel eğitim programı Boston Üniversitesi’nde başlatılmış ve 1920’lerden itibaren birçok üniversitede sanayi hijyeni programları içinde sanayi hemşireliği eğitimleri yürütülmüştür. Bu çalışmanın altında yatan temel neden olarak da, hemşirelik uygulamalarında farklılıklar olması, hemşirelerin toplum kaynaklarını kullanmanın öneminin farkında olmaması ve işyeri hemşiresi açısından verilen eğitimin ve kurslarının yetersiz kalması gösterilmektedir. Bu sebeplerle başlatılan iş sağlığı hemşireliği çalışmaları, günümüzde binlerce sağlık çalışanını bünyesine dâhil etmiş organize ve büyük meslek örgütlerini oluşturmuştur (Akın, 2005, s.43).

Son yıllardaki gelişmelere kadar, züyük ve yönetmeliklerle düzenlenen bir zorunluluk olarak görülen iş sağlığı hemşireliğinin Türkiye’de ne yazık ki istenilen niteliğe kavuşmadığı ifade edilmektedir. Bunun altında yatan temel nedenin, sağlık alanındaki tüm yapılanmanın işyeri hekimliği üzerinden yürütülmesi ve daha alt düzeydeki birimlere gereken önemin gösterilmemesi olduğu düşünülmektedir. Bu durumun sonucunda iş sağlığı hemşireliği, iş sağlığına ilişkin yeterli bilgi ve beceri birikimine sahip olmayan hastane hemşireleri tarafından yürütülmüş (Akın, 2005, s.43), bu da daha çok tedavi edici hizmetlere odaklanması sonucunu doğurmuştur. Bu konuda yapılan araştırmalar iş sağlığı hemşiresi olarak görev yapan hemşirelerin eğitim eksiklikleri sebebiyle kendilerinden beklenen görevleri istendik düzeyde yerine getiremediklerini ortaya koymaktadır. Türkiye açısından bakıldığında; bugüne kadar iş sağlığı hemşireliğinin gelişiminin yeterli düzeyde olmaması, mesleğin kendi içindeki gelişme süreci ile de yakından ilgili görülmekte, hemşirelik meslek örgütleri ve üniversitelerin iş sağlığı hemşireliğine özgü mezuniyet sonrası eğitim programlarını geliştirmemiş olmalarının da bu süreci olumsuz etkilediğine dikkat çekilmektedir (Emiroğlu, 2005, s.9).

İşyeri Sağlık Birimleri ve İşyeri Hekimlerinin Görevleri ile Çalışma Usul ve Esasları Hakkında Yönetmeliğe göre iş sağlığı hemşiresinin görevleri;

- İş sağlığı ve güvenliği ile ilgili sorunların saptanması ve önceliklerin belirlenmesi çalışmalarında işyeri hekimine yardımcı olmak,
- Çalışanların sağlık düzeyleri ile ilgili veri toplanması, kaydedilmesi, işe giriş ve periyodik muayene formunun doldurulması ve fiziki muayene sırasında işyeri hekimine yardımcı olunması,
- İşyerinde sağlık taramalarının yapılması ve şüpheli vakaların hekime sevk edilmesi,

- Gebe ve emzikli kadınların izlenmesi, zararlı maddelerden korunması için çalışmaların yapılması, çocuk bakım hizmetleri ile ilgili çalışmaların planlanması, yürütülmesi ve kontrolünün sağlanması,
- Çalışanların hastaneye sevk edilmesi, tedavisinin izlenmesi ve rehabilitasyon hizmetlerine katılması,
- Yardımcı sağlık hizmetlerinin planlanması, değerlendirilmesi, izlenmesi vb. faaliyetlerin yürütülmesinde işyeri hekiminin önerileri doğrultusunda çalışılması ve gerekli kayıtların tutulması,
- İlk yardım hizmetlerinin organizasyonu ve yürütülmesi sırasında işyeri hekimine yardımcı olunması,
- İşyerinde çalışanların sağlık eğitiminde görev alınması şeklinde sıralanmaktadır (Emiroğlu, 1992, s.178).

İş sağlığı hizmetlerinin etkin bir şekilde yürütülmesinde, yeterli eğitim almış hemşirelerin rolünün büyük olduğu ifade edilmekte, özellikle gelişmiş ülkelerde iş sağlığı hemşireliğinin bilimsel, teknolojik ve toplumsal gelişmelerden etkilenecek büyük bir değişim içine girdiğine dikkat çekilmektedir. Yapılan araştırmalar sonucunda, iş sağlığı hemşirelerinin etkili bir biçimde faaliyette bulunmalarına bağlı olarak, işe devamsızlıkların azaldığı, koruyucu ve danışmanlık hizmeti alan işçilerin sayısının da artış gösterdiği ifade edilmektedir (Beşer, 2001, s.24).

## Sonuç

Günümüzde iş sağlığı ve iş güvenliği faaliyetlerinin işyerleri ve işletmeler düzeyinde yapılandırılması büyük önem taşımakta, bu çalışmaların temelini işyerlerinde kurulan iş sağlığı ve iş güvenliği birimleri oluşturmaktadır. İş sağlığı ve iş güvenliği çalışmalarının alanının genişlemesine paralel olarak da, bu alanda hizmet veren meslek gruplarının ve taşınması gereken özelliklerin artması ve yürütülmesi gereken görev, yetki ve sorumlulukların da çeşitlenmesi söz konusu olmaktadır. Bu meslek grupları incelendiğinde; işyeri hekimi, iş sağlığı hemşiresi, güvenlik uzmanı, psikolog, ergonomist, sosyal hizmet uzmanı vb. meslek gruplarının ilk aklı gelen meslekler arasında yer aldığı görülmektedir.

Sağlık alanında görev yapan çalışanların faaliyetlerini yerine getirirken dikkat etmeleri gereken en önemli nokta, ekip yaklaşımı içinde hareket edilmesi gerektiğidir. Çağdaş sağlık yönetiminin sağlanmasında, etkili ve verimli sağlık hizmetinin sunulmasında, çalışanların sağlığının korunması ve geliştirilmesinde, sağlık sektörü çalışanlarının bilgi, beceri, yetki ve sorumlulukları açısından birbirini tamamlamaları gerektiğinin bilincinde olmaları yaşamsal bir önem taşımaktadır.

İşyeri hekimi, iş sağlığı ve güvenliğinin sağlanması açısından temel sorumluluğa sahip olmakta ve örgütlenme açısından önemli görev, yetki ve işlevleri yürütmektedir. İşyeri hekimliğinin küçük ve orta ölçekli işyerlerinde ikinci bir mesleki uğraş olarak yerine getirilmesi ve özlük haklarına ilişkin sorunlar yaşanması bireysel iş hukuku açısından tartışmaları da beraberinde getirmektedir. İşyeri hekimlerinin iş sağlığı ve iş güvenliği alanındaki sorumluluklarını daha etkili bir şekilde sürdürebilmeleri için, karşılaşılan bu sorunların çözülmesinin önemli olduğu düşünülmektedir.

İş sağlığı ve iş güvenliği hizmetlerinin geliştirilmesinde sadece işyeri hekiminin değil, iş sağlığı hemşiresinin de önemli bir etkisi bulunmakta, konuya ilişkin sahip olunan bilgi birikimi ve beceri sunulan hizmetlerin etkinliğini artırmaktadır. Bu nedenle lisans eğitiminin iş sağlığı hemşireliği lisansüstü eğitim programı ile geliştirilmesi, iş sağlığı ve güvenliğine ilişkin faaliyetlerin planlanması, değerlendirilmesi, denetlenmesi ve yönlendirilmesinde işyeri hekimi ile yapıcı bir işbirliği içinde olunması büyük önem taşımaktadır. Bu sayede çalışma ortamında görülen sağlık sorunlarının ortadan kaldırılmasına yönelik önlemlerin alınması ile çalışanların sağlığının korunması ve geliştirilmesine yönelik etkili düzenlemelerin yapılması mümkün olabilecektir.

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# KABLOSUZ AĞ GÜVENLİĞİNE BİR TEHDİT: KABLOSUZ KORUMALI KURULUM(WPS - WİFİ PROTECTED SETUP) PROTOKOLÜ AÇIĞI

Deniz Mertkan GEZGİN  
Bilgisayar ve Öğretim Teknolojileri Eğitimi, Eğitim Fakültesi  
Trakya Üniversitesi  
Türkiye  
mertkan@trakya.edu.tr

Ercan BULUŞ  
Bilgisayar Mühendisliği, Mühendislik-Mimarlık Fakültesi  
Namık Kemal Üniversitesi  
Türkiye  
ercanbulus@nku.edu.tr

**Özet:** Kablosuz ağ teknolojilerinin gelişmesi ile kapsama alanları artmaktadır. Kapsama alanı arttıkça bunun paralelinde kablosuz ağ güvenliğinde de gelişmeler hızla artmaktadır. Fakat kablosuz ağlarda bu gelişmelere rağmen bazı güvenlik açıkları yayınlanmaktadır. Bu çalışmada kablosuz ağ teknolojilerinde, kablosuz yerel alan ağlarında kullanılan kablosuz ağ cihazlarından yönlendirici(router) ve modemlerin çoğunda bulunan, güvenlik ve kablosuz ağa bağlantı işlemleri konusunda tecrübesi olmayan son kullanıcıların kablosuz ağa kolayca bağlanmalarını sağlayan Kablosuz Korumalı Setup (WPS - (Wi-fi Protected Setup)) mekanizmasında patlak veren açığı, bu açığın giderilmesi için yapılması gerekenler, tehdit ettiği kablosuz ağların güvenliği hakkında öneri ve çözümler ele alınmıştır.

**Anahtar Sözcükler:** Kablosuz Ağlar, Güvenlik, Erişim Noktası, Yönlendirici, WPS

## Giriş

Kablosuz ağların kullanımı günümüzde çok yaygınlaşmıştır. Bunun sonucu olarak birçok kablosuz ağ cihazı üretilmiştir. Özellikle ev kullanıcıları ve küçük ofis ortamları için kablosuz modem, kablosuz erişim noktaları ve kablosuz yönlendiriciler çok kullanılmaktadır. Bu ortamlarda kablosuz güvenliği sağlamak ve ağa dahil olmak için belirli protokol ve politikalar izlenmektedir. Bunlar daha çok kablosuz ağ yapılandırmasını bilen ve bilgisayarı iyi kullanan kullanıcılar içindir. Bunlara örnek vermek gerekirse WEP(Wired Equivalent Privacy), WPA(Wi-Fi Protected Access), WPA-2(Wi-Fi Protected Access II) şifreleme protokolleri, MAC (Media Access Control) Filtreleme, SSID(Service Set Identification) gizlemedir.(Gezgin ve Buluş, 2009) Fakat bu konularda fazla bilgisi olmayan kullanıcıların ağa dahil olması, ağ konfigürasyonları ve güvenliği için Wi-fi Alliance çalışma grubu tarafından 2007 yılında WPS adında bir opsiyonel sertifika programı dizayn edilmiştir. Hali hazırda programın yayınlandığı Haziran 2007'den beri 200'den fazla üründe Wi-fi Sertifikası mevcut durumdadır. (Wi-fi Alliance, 2012) WPS bize ikisi opsiyonel dört bağlantı şekli sunmaktadır. Bunlardan ikisi ve en çok kullanılanları PIN(Personal Identification Number) yöntemi, WPS düğme yöntemidir. Opsiyonel olarak kullanılan diğer yöntemlerde Radyo Frekansı ile Tanımlama teknolojisi (RFID – Radio frequency Identification) kullanıla bilinir (Wikipedia,2012) yada bir USB bellek sayesinde uygulama çalıştırılabilmektedir. Dört yöntemi düşündüğümüzde ilk PIN yöntemi tüm sertifikası bulunan cihazlarda bulunması gerek bir özelliktir. İkinci yöntemde ise WPS butonu ağ cihazında bulunması gerekir fakat istemci tarafta WPS düğme olması zorunlu değildir. Aralık 2011'de ABD Bilgisayar Acil Durum Hazırlık Takımı (US-CERT) yaptığı bir uyarıda WPS sisteminde bulunan bir açık dolayısı ile saldırganların kablosuz ağ şifrenizi ele geçirebileceğini bildirmiştir.(US CERT, 2012) Bu uyarıda WPS protokolü, kablosuz ağlar konusunda bilgisi olmayan kullanıcıların cihazlarını ağa kolayca dahil edebilmesini ve ağ üzerinde güvenlik sağlayan bir yapı olmasına rağmen PIN doğrulama sisteminde yer alan bir tasarım hatası yüzünden saldırganlar, doğru PIN'i elde edebilmek için kaba kuvvet(brute force) saldırısı ile sisteme saldırmaktadır. Bu saldırılar PIN'i elde etmenin süresini büyük oranda azaltabilmektedir. Hata sayesinde saldırganlar sekiz haneden oluşan PIN'in ilk dört hanesinin ne zaman doğru olduğunu yakalayabilmektedir. Bunun yanında bazı ağ cihazlarında belirli sayıda yanlış PIN girişinden sonra sistemin gerekli kilit mekanizmasına sahip olması sistemi korurken, bazı ağ cihazları bu kilit mekanizmasına sahip olmadıkları yüzünden kaba kuvvet saldırısına karşı korumasız kalmaktadır.

## Wi-Fi Korumalı Kurulum (WPS - Wi- Fi Protected Setup)

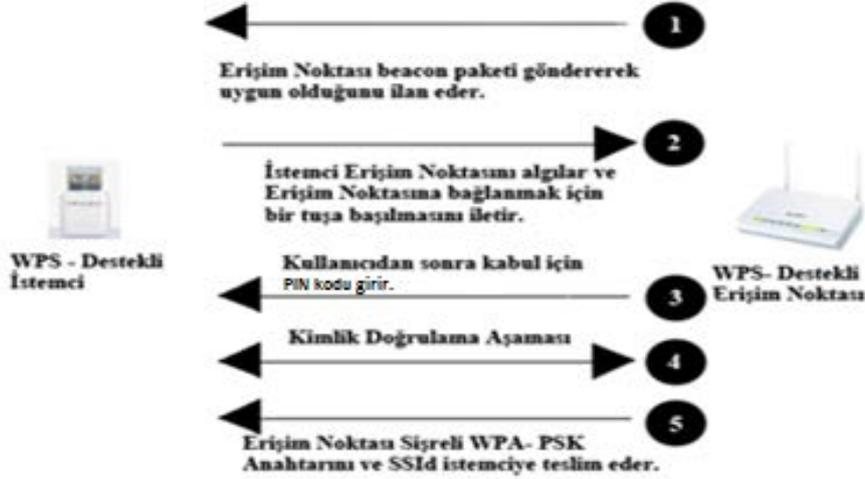
WPS, 2007 yılında Wi-fi Alliance tarafından dizayn edilip piyasaya sürülen opsiyonel bir sertifika programıdır. WPS, ağ güvenliği, ağa dahil olma ve ağı ayarlama konusunda bilgisi az olan kullanıcıların bu işlemleri yapabilmesi için ev ve küçük ofisler için tasarlanmıştır. WPS dört bağlantı şekli sunmaktadır. (En.Wikipedia,2012)

### PIN Methodu

PIN methodu, yeni kablosuz cihaz üründe görüntülenebilir ya da etiket olarak bu PIN okunabilir olmalıdır. Bu PIN numarası ağı erişim noktasına web ara yüzünden girilmelidir. Sırasıyla sonra istemciye girilmelidir. Bu metod temeldir. Her sertifikalı üründe bulunmalıdır.



Şekil 1: WPS-PIN Destekli Bir Erişim Noktası(Viehböck,2011)



Şekil 2: WPS-PIN metodunda Kablosuz Erişim Noktası ile Kablosuz İstemci arasındaki Tokalaşma

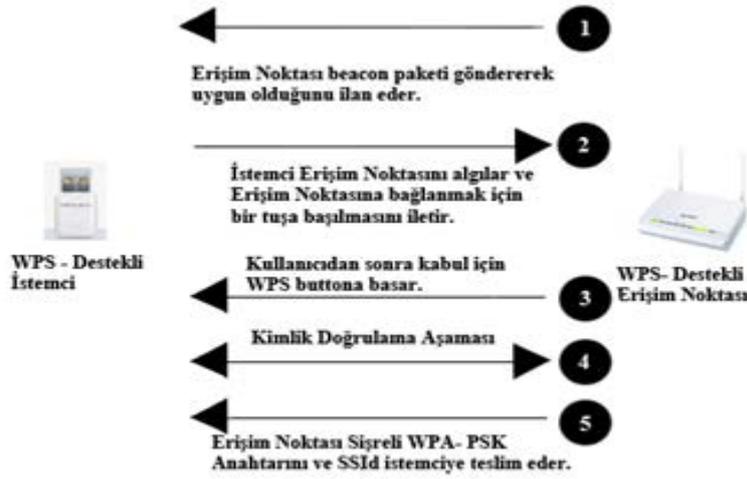
### Basılabilir - Düğme Methodu

Son kullanıcılar için en kullanışlı ve kolay kurulum yapısı WPS' de tanımlanmış olan PBS'dir. Birçok kablosuz ağ cihazı üreten firmalar pbs desteği sunmaktadır. Bunun için gerekli olan Erişim noktası ve kablosuz istemcide fiziksel olarak bir WPS butonu bulunmasıdır. Aşağıdaki şekilde bir Erişim noktası cihazında WPS düğmesi görülmektedir. (PCLabs ,2012)



**Şekil 3:** WPS Destekli Zyxel Wap3205 Kablosuz Erişim Noktası

PBS ile kurulumda önemli 3 işlem vardır. Bunlar Cihazların algılanması, Cihazların görüşmesi ve cihazların ağa kayıt olma işlemleridir. WPS destekli istemci ile WPS destekli kablosuz erişim noktası arasındaki işlemler aşağıdaki şekilde açıklanmaktadır.



**Şekil 4:** WPS – PBS metodunda Kablosuz Erişim Noktası ile Kablosuz İstemci arasındaki Tokalaşma

Bu sistem yapılandırılmasından sonra artık bilinen 4 mesaj ile kablosuz ağda doğrulama yapılan Wi-Fi Korunmalı Erişim(Wi-Fi Protected Access-WPA) tokalaşması başlar. (Johansson ve Krantz, 2007) Sonuç olarak ağa dâhil olma işlemleri bittikten sonra artık istemci internet ve diğer olanaklarından yararlanabilmektedir.

#### Yakın Alan İletişim Methodu

Bu methodu istemci ve erişim noktası arasında bağlantıya olanak sağlar. Yapılması gereken basittir. İstemciyi, erişim noktasının yanına getirmektir. Böylelikle bu metod da çalışan cihazlar bağlantıya geçmektedir. Bu metod opsiyoneldir ve RFID ile ilişki bir yapısı mevcuttur.

#### USB Methodu

Bu metotta, yeni istemci ile ağın erişim noktası arasında veri transfer etmek için USB flash bellekleri kullanılır. USB ile uygulama programları çalıştırılarak her iki cihazın birbiri ile iletişimi sağlanmaktadır Bu metotta opsiyoneldir, fakat daha onaylanmamıştır.

#### WPS Açığı ve Kaba kuvvet Atağı

WPS PIN mekanizmasında iki tane tasarım hatası görülmektedir. Bunlardan birincisi, İstemci PIN girdiğinde yani dışsal bir opsiyonda sistem PIN sağlamaktan hariç bir doğrulama gerektirmez. Buda bu sistemin kaba kuvvet saldırısı olarak da bilinen, aynı anda binlerce şifre denenerek doğru şifre tespit edilmeye çalışıldığı bir saldırı türüne zayıf olduğu anlamına gelmektedir. (Allar, 2011)

| Opsiyon / Kimlik doğrulama   | Fiziksel Erişim | Web Aravüzü | PIN |
|------------------------------|-----------------|-------------|-----|
| Basılabilir Düğme Bağlantısı | X               |             |     |
| PIN - İç İstemci             |                 | X           |     |
| PIN - Dış İstemci            |                 |             | X   |

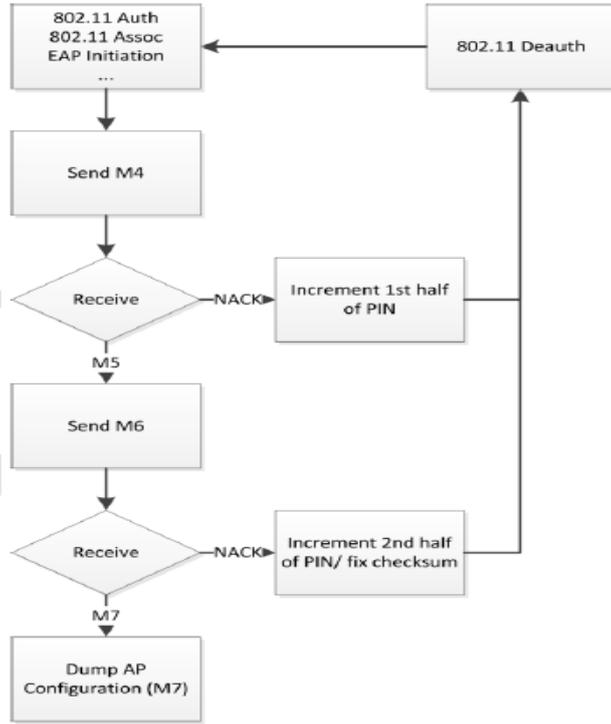
Şekil 5: WPS Opsiyonları(Viehböck,2011)

İkincisi ise WLAN kurulumu özelliğine sahip modemlerin PIN numaraları 8 hanelidir ve bu kod 4'er rakam ile 2 gruba ayrılmaktadır.

| 1                 | 2 | 3 | 4 | 5                    | 6 | 7 | 0 |
|-------------------|---|---|---|----------------------|---|---|---|
| PIN'in ilk yarısı |   |   |   | Sağlama Biti         |   |   |   |
|                   |   |   |   | PIN'in ikinci yarısı |   |   |   |

Şekil 6: PIN Yapısı(Viehböck,2011)

8 haneli bir PIN kodunun olası kombinasyonu  $10^8 = 100.000.000$  civarındadır. Bu bir PIN'in tahmin edilebilmesi için 6.3 yıl gibi bir süreye çıkabileceği anlamına gelmektedir. Fakat PIN 4'er rakam 2 gruba ayrıldığında, çarpıcı bir şekilde saldırının işi kolaylaşmaktadır.  $10^8$  olan kombinasyon değeri  $10^4 + 10^4 = 20.000$  kombinasyon değerine gerilemektedir. Dahası 1 bit değeri de sağlama biti (checksum) olduğu için saldırının PIN yakalaması için deneme kombinasyonu  $10^4 + 10^3 = 11.000$ 'e gerilemektedir. (Allar, 2011) Bu şu anlama gelmektedir ki bir saldırı birkaç saatte PIN'i elde edebilir. Eğer PIN 8 rakam kombinasyonu içinde olsaydı, bu süreç günlerce deneme yanılma ile devam edebilirdi. WPS PIN doğrulamasında bazı noktalarda hata oluştuğunda, erişim noktası bir EAP-NACK mesajı yollar. Bu mesajı alan saldırı PIN'in bölümlerinin doğruluğu hakkında bilgi edinebilmektedir. Aşağıda saldırının yaptığı atağın akış diyagramı görülmektedir.



Şekil 7: WPS PIN üzerinde Kaba Kuvvet Atağı akış Diyagramı (Viehböck,2011)

Saldırı bu saldırıda iki şeyi net anlamaktadır.

- Eğer M4 gönderdiğinde, erişim noktasından NACK mesajı alıyorsa PIN'in ilk 4 rakamının doğru olmadığını anlamaktadır.
- Eğer M6 gönderdiğinde, erişim noktasından NACK mesajı alıyorsa PIN'in ikinci 4 rakamının doğru olmadığını anlamaktadır. (Viehböck,2011)

## Sonuçlar ve Öneriler

Bu çalışmada da görüldüğü gibi sonuç olarak kaba kuvvet atakları WPS mekanizmasında bulunan çalışmada anlattığımız açık yüzünden bazı yönlendirici, erişim noktaları ve modemler üzerinde etkili olmaktadır. Bu açığı kapatmak ve ağ güvenliğini sağlamak adına bazı işlemler yapılabilir. Öte yandan unutulmamalıdır ki kablosuz ağlar olsun, ağ güvenliği olsun yüzde yüz güvenlik sağlamak mümkün olmamaktadır. Bu çalışmada ki WPS açığına karşı ağınızı korumak için alınacak tedbir ve öneriler aşağıda sıralanmıştır. (Chip Online, 2012)

- WPS destekli bir modem ya da yönlendirici alınmaması düşünülebilir.
- Cihazınızın SSID yayını kapatılabilir.
- Mac Filtrelemesi kullanılabilir. (Gezgin ve Buluş, 2009)
- Uzun ve rakam, karakter karışımı şifreler kullanılabilir.
- Fakat WPS destekli bir modem veya yönlendirici kullanıyorsanız WPS'yi kapatmak düşünülebilir.
- Firmwareinizi güncelleyebilirsiniz. Böylece ağ cihazınızı güvenli bir sürümde çalıştırabilirsiniz.
- WPS'yi desteklemeyen alternatif bir Firmware kullanılabılır. (TeaKolik,2012)

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# KADINLARDA DEMİR EKSİKLİĞİNE BAĞLI KANSIZLIK TANISINA İLİŞKİN BİR VERİ MADENCİLİĞİ ÇALIŞMASI

Yüksel Yurtay<sup>1</sup>, Ziyet Yılmaz<sup>2</sup>, Özgür Çiftçi<sup>1</sup>, Kayhan Ayar<sup>1</sup>

<sup>1</sup>Bilgisayar Mühendisliği Bölümü, Sakarya Üniversitesi, Türkiye.

<sup>2</sup>Elektrik Elektronik Mühendisliği Mühendisliği Bölümü, Sakarya Üniversitesi, Türkiye.

yyurtay@sakarya.edu.tr ziyet@sakarya.edu.tr ociftci@sakarya.edu.tr kayar@sakarya.edu.tr

## Özet

Tıp alanında kullanılan veri madenciliği uygulamaları; veri ambarları, karmaşık terimler, çok sayıda hasta ya da potansiyel hastadan elde edilen çok büyük sayıda verilerden oluşmaktadır. Karar destek sistemi kullanılarak bahsi geçen verileri iyi analiz ederek, doğru karar verebilmek oldukça önemlidir. Bu çalışmada, kadınlarda demir eksikliğine bağlı kansızlık tanısına ilişkin bir veri ambarı kullanılarak, Gini algoritması işletilmekte ve tıbbi karar ağacı elde edilmektedir. Karar ağacının başarısı ROC analizi ile irdelenmekte ve sonuçları açıklanmaktadır.

**Anahtar Kelimeler:** Demir eksikliği anemisi, veri madenciliği, gini algoritması, anemi teşhisi.

## DIAGNOSIS OF IRON DEFICIENCY ANEMIA WOMEN REGARDING A STUDY OF DATA MINING

### Abstract

In the medicine used data mining applications which consisting data warehouses, complex terms, a large number of data obtain from large numbers of patients or potential patients. Using a decision support system, mention data correct analyzing is very important to give the right decision. In this study, diagnose iron deficiency anemia in women related by using data warehouse, operated Gini algorithm and obtained medical decision tree. The success of the decision tree is evaluated by ROC analysis and the results describes.

**Keywords:** Iron deficiency anemia, data mining, gini algorithm, anemia diagnosis.

### Giriş

Kansızlık, kandaki kırmızı kan hücrelerinin miktarının veya hemoglobin oranının normalden daha az olması şeklinde tanımlanmaktadır. Tedavi edilmediği durumda birçok değişik kalp hastalıklarının oluşmasına neden olmaktadır. Anemi hastaları yaşamlarını olması gerektiği şekilde devam ettirememekte, vücut fonksiyonlarındaki düzensizlik nedeniyle de anemi hastalarının ölüm oranları artmaktadır.

2005 yılı TUIK istatistiklerine göre demir eksikliğine bağlı kansızlık tanısı konan kadın hastalar, tüm hastalıklar arasında % 12,2 lik bir yere sahiptir (Tuik, 2012). Bu sadece yatarak tedavi olan hasta sayısıdır. Ayakta tedavi edilen hasta sayısının daha çok olduğu tahmin edilmektedir. Demir eksikliği de kansızlığın en önemli sebeplerinden birisi olduğu bilinmektedir (Linker, 2003). Clark (2008), Amerika'da demir eksikliğine bağlı olarak gerçekleşen kansızlık değerlerini 1999-2000 yılları için, 12-49 yaş arası kadınlarda %12, 50-69 yaş için %9, 70 ve yukarı için de %6 olarak ifade etmiştir. Çocuklarda ve erkeklerde ise bu oranların daha düşük olduğu görülmüştür.

Özellikle tıbbi veri tabanlarında veri analizi, karar destek sistemlerinin oluşturulması, yönetim biriminde bilgilere etkili ve hızlı bir şekilde ulaşılabilmesi bakımından bilgisayarlar uzmanlara büyük kolaylıklar sağlamaktadır. Bu hedef doğrultusunda önceden bilinmeyen, ilk bakışta fark edilemeyen, veri içinde gizli kalmış anlamlı ve değerli

bilgiler elde edilebilmesinden dolayı veri madenciliği etkili bir çözüm olmuştur. Özellikle sınıflandırma işlemi, tıbbi karar destek sistemlerinde önemli bir yer tutar. Karar ağaçları da sınıflandırma yöntemlerinden biridir. Gini, Twoing, ID3, C4.5 gibi pek çok karar ağacı algoritması geliştirilmiştir( Hand ve diğerleri,2001).

Bu çalışmada demir eksikliğine bağlı kansızlık tanısı amacı ile Karar ağacı Gini algoritması ile geliştirilmiş ve %92,97 doğrulukla tanı sağlanmıştır.

## Metot

### Veri Kaynağı

Zonguldak Devlet Hastanesi'nin 2010 yılına ait 2640 adet kadın hastasının demir eksikliğine bağlı kansızlık tanısına yönelik laboratuvar kan analiz sonuçları kullanılmıştır. Bu veriler 567 kansızlık var, 2073 kansızlık yok tanısı içermektedir. (Yılmaz ve Bozkurt, 2011), RBC, HGB, HCT, MCV, MCH, MCHT değerlerini içeren laboratuvar verileri ile Feed forward networks (FFN), Cascade forward networks (CFN), Distributed delay networks (DDN), Time delay networks (TDN), Probabilistic neural network (PNN) ve Learning vector quantization (LVQ) yapay sinir ağlarını kullanmışlar ve sonuçlarını irdelemişlerdir. Bu çalışmada da kullanılan laboratuvar verilerinde yer alan hematolojik parametreler Tablo 1' de belirtilmiştir.

Tablo 1- Demir eksikliğine bağlı kansızlık için hematolojik parametreler (Özaslan and Delibaşı,2008,Yılmaz and Bozkurt, 2011).

| Parametre | Açıklama   | Değerler |
|-----------|--|----------|
| RBC       | Kırmızı Kan Hücreleri (Red Blood Cells)                                | 4,5-6    |
| HGB       | Hemoglobin   | 12-16    |
| HCT       | Hematokrit   | 36-48    |
| MCV       | Ana Korpuskuler Hacmi (Mean Corpuscular Volume)                        | 80-100   |
| MCH       | Ana Korpuskuler Hemoglobinin (Mean Corpuscular Hemoglobin)             | 27-34    |
| MCHC      | Ana Korpuskuler Hem. Hacmi (Mean Corpuscular Hemoglobin Concentration) | 31-37    |

## Yöntem

Gini Algoritması, ikili bölünmeler şeklinde gerçekleşen bir sınıflandırma yöntemi olup, ikili yinelemeli bölümlenme için en iyi bilinen kurallardandır. Her bir ağaç farklı bir stil ile gelişir. Algoritma nitelik değerlerinin sol ve sağda olmak üzere ikili bölünmeler şeklinde ayrılması temeline dayanır(Özkan,2008).

$L_i$ : Sol daldaki  $i$  grubundaki örnek(lerin) sayısı

$R_i$ : Sağ daldaki  $i$  grubundaki örnek(lerin) sayısı

$k$ : Sınıfların sayısı

$T$ : Düğümdeki örnekler

$|T_{sol}|$  : Sol daldaki örnek(lerin) sayısı

$|T_{sağ}|$  :Sağ daldaki örnek(lerin) sayısı

Tanımlamaları ile aşağıdaki bağıntılar hesaplanabilecektir.

$$Ginisol = 1 - \sum_{i=1}^k \left( \frac{L_i}{|T_{sol}|} \right)^2 \quad Ginişag = 1 - \sum_{i=1}^k \left( \frac{R_i}{|T_{sağ}|} \right)^2$$

Her bir j niteliği için n öğrenme setindeki eleman sayısı olmak üzere aşağıdaki bağıntı hesaplanır.

$$Gini_j = \frac{1}{n} (|T_{sol}|Gini_{sol} + |T_{sağ}|Gini_{sağ})$$

## Performans Değerlendirme

Bu çalışmanın performansı için ROC (Receiver Operating Characteric) analizinden faydalanılmıştır. ROC analizi II. Dünya Savaşı sırasında Britanya’da radarda tespit edilen sinyallerin doğru tanımlanması, dost ve düşman ayırımının sağlanması için geliştirilmiştir ve 1967 yılında tıpta karar vermede kullanımı önerilerek, 1969 yılında medikal görüntüleme cihazlarında kullanımını sağlamıştır. Sonraki yıllarda tıpta tanı testlerinin performansının değerlendirilmesinde kullanımı giderek yaygınlaşmıştır[1]. Tanı testlerinde olumlu ya da olumsuz kararın doğruluk derecesi önemlidir. Pozitif ya da negatif kararların her biri için doğruluk düzeyini gösteren ölçütler vardır[1]. ROC analizi de bu ölçütleri bulmayı sağlar.

Tablo 2. ROC analizi için kullanılan parametreler

| Test Sonucu | Gerçek Durum        |                     |               |
|-------------|---------------------|---------------------|---------------|
|             | Pozitif             | Negatif             | Toplam        |
| Pozitif     | Doğru pozitif (DP)  | Yanlış Pozitif (YP) | (DP+YP)       |
| Negatif     | Yanlış Negatif (YN) | Doğru Negatif (DN)  | (YN+DN)       |
| Toplam      | (DP+YN)             | (YP+DN)             | (DP+YN+YP+DN) |

Tablo 2’yer alan bu parametreler aşağıdaki gibi açıklanabilir:

DP: Gerçek durum pozitifken test sonucu da pozitif çıkan durumlar

YN: Gerçek durum pozitifken test sonucu negatif çıkan durumlar

YP: Gerçek durum negatifken test sonucu pozitif çıkan durumlar

DN: Gerçek durum negatifken test sonucu da negatif çıkan durumlar

Bu ROC parametreleri kullanılarak doğruluk değeri aşağıdaki formülle hesaplanır:

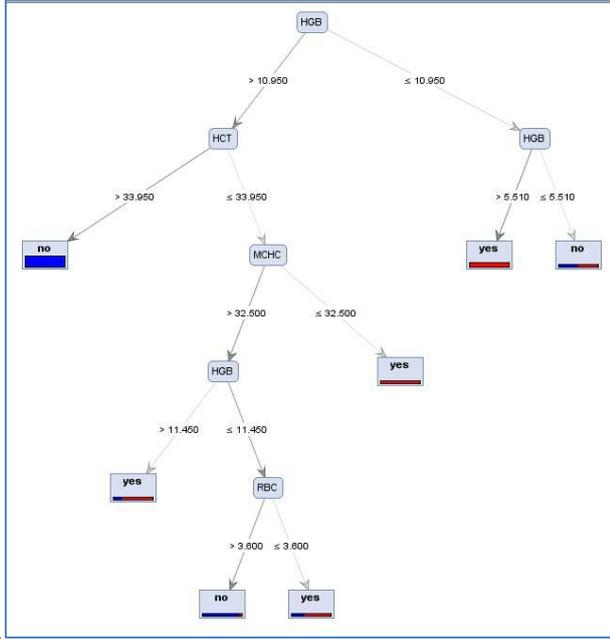
$$\text{Doğruluk} = (DP+DN) / (DP+YP+YN+DN)$$

Bu çalışmada 2640 adet veri temizlendikten sonra kalan 2599 adet veri 3 kutuya rastgele olarak ayrılmış ve 2 kutu eğitim ve 1 kutu test olasılıklarının tümü değerlendirilerek ortalama doğruluk değerleri elde edilmiştir. Tablo 3’de 3 kutu için olası durumlar ve doğruluk değerleri ve ortalama doğruluk değeri gösterilmektedir.

Tablo 3- Demir eksikliğine bağlı kansızlık verileri için Doğruluk değerleri

| Kutu seçimi(kutu1:867 kayıt, kutu2:866, kutu 3: 866) |           |             | Ortalama doğruluk değeri |
|--|-----------|-------------|--------------------------|
| Eğitim   | Test      | Doğruluk(%) |                          |
| 1- Kutu1+ Kutu 2                                     | 1- Kutu 3 | 89,5        |                          |
| 2- Kutu 1+ Kutu 3                                    | 2- Kutu 2 | 96,2        |                          |
| 3- Kutu 2+ Kutu 3                                    | 3- Kutu 1 | 93,2        |                          |

Şekil 1'de 2 nolu eğitim ve test seti için Rapidminer programı ile elde edilmiş karar ağacı gösterilmektedir(Rapidminer,2012). Bu karar ağacı 2 numaralı fold ile test edildiğinde %96,2 lik bir doğrulukla tanı yapabilecek kuralları içermektedir



Şekil 1. Demir eksikliğine bağlı kansızlık verileri için elde edilen karar ağacı

## Sonuç

Bu çalışmada, kadınlarda demir eksikliğine bağlı kansızlık hastalığı araştırılırken, bu hastalıkla ilgili benzer belirtileri gösteren kişilerin önceden kayıtlı bilgileri doğrultusunda bir veri madenciliği çalışması yapılmış, Gini algoritması uygulanarak karar ağacı çıkarılmıştır. Bu ağaç ve kuralları sayesinde yeni hastaların hangi gruba girdiği görülebilmektedir. Karar ağaçları belirlemede kullanılan diğer veri madenciliği algoritmaları da bu veriler üzerinde denenebilir ve olası başarıları yüksek görülmektedir.

Veri madenciliği kullanılıp oluşturulacak karar ağacı çalışmasında örnek sayısı çoğaldıkça elle çalışmak oldukça uzun ve zahmetli olabileceğinden bu tip çalışmalarda yazılımlar kullanmak ve büyük sayıda nitelik içeren öğrenme setine cevap verebilecek programlardan yararlanmak, sonuçların daha doğru ve kısa sürede alınması açısından daha faydalı olacaktır.

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## KARAÇAM (*PINUS NIGRA* ARNOLD) ORMANLARINDA RAKIMIN *IPS SEXDENTATUS* (BOERNER) POPULASYONU ÜZERİNE ETKİSİ

Erol Akkuzu<sup>1</sup> Hidayet Güzel<sup>2</sup>  
Kastamonu Üniversitesi  
Orman Fakültesi  
Türkiye

<sup>1</sup> eakkuzu@kastamonu.edu.tr

<sup>2</sup> h.guzel33@hotmail.com

**Özet:** Oniki dişli çam kabuki böceği (*Ips sexdentatus* (Boerner)) Avrupa, Kuzey Asya ve Uzak Doğu'nun bir bölümünde ladin ve çam türlerinin en önemli tahripçi türlerinden birisidir. İklim ve topoğrafik özellikler *I. sexdentatus*'un populasyon dinamiğini yakından etkilemektedir. Bu çalışmada, iki farklı rakımda (alt: 1100 m, üst: 1500 m). *I. sexdentatus* populasyonunun büyüklüğü ve zararlının boylarının karşılaştırılması yapılmıştır. Bu amaç için araştırma alanı olarak Kastamonu-Dikmen Orman İşletme Şefliği seçilmiştir. Araştırmada 10 adet çok hunili feromon tuzağı her birine beşer adet olmak üzere iki farklı karaçam (*Pinus nigra* Arnold) deneme alanına asılmıştır. Tuzaklar 2012'nin Haziran-Ağustos ayları arasında 7-10 günlük periyotlar halinde kontrol edilmiştir. Elde edilen sonuçlar, yakalanan *I. sexdentatus*'ların sayısı ve boyları açısından iki rakım arasında herhangi bir fark olup olmadığını tespit etmek için analiz edilmiştir.

**Anahtar Kelimeler:** *Ips sexdentatus*, yükselti, *Pinus nigra*, Türkiye.

## EFFECTS OF ELEVATION ON *IPS SEXDENTATUS* (BOERNER) POPULATIONS IN AUSTRIAN PINE (*PINUS NIGRA* ARNOLD) FORESTS

Erol Akkuzu<sup>1</sup> Hidayet Güzel<sup>2</sup>  
Faculty of Forestry  
Kastamonu University  
Turkey

<sup>1</sup> eakkuzu@kastamonu.edu.tr

<sup>2</sup> h.guzel33@hotmail.com

**Abstract:** Six-toothed bark beetle (*Ips sexdentatus* (Boerner)) is one of the most destructive pests of spruce and pine species in Europe, Northern and some part of Far East Asia. Population dynamics of *I. sexdentatus* are closely affected by climatic and topographic conditions in a given area. In this study, we examined the abundance and body length of *I. sexdentatus* between two different elevation levels (low: 1100 m, high 1500 m). For this purposes, the study area was selected from the management zone of Dikmen Forest Enterprise in Kastamonu Province of Turkey. A total of 10 multifunnel pheromone traps were deployed in 2 study plots (5 traps for each) dominated by Austrian Pine (*Pinus nigra* Arnold). Trap contents were collected at 7 to 10 day intervals from June to August, 2012. The findings were analyzed to determine if there was a difference between the two different elevation levels concerning the abundance and body length of *I. sexdentatus*.

**Key words:** *Ips sexdentatus*, elevation, *Pinus nigra*, Turkey.

# KARAR AĞACI TEKNİĞİNİN TİROİD HASTALIĞININ TANISINDA KULLANILMASINA İLİŞKİN BİR ÇALIŞMA

Nilüfer Yurtay<sup>1</sup>  
nyurtay@sakarya.edu.tr

M.Fatih Adak<sup>1</sup>  
fatihadak@sakarya.edu.tr

Deniz Dural<sup>1</sup>  
ddural@sakarya.edu.tr

Soydan Serttaş<sup>1</sup>  
nyurtay@sakarya.edu.tr

<sup>1</sup>Bilgisayar Müh. Bölümü  
Sakarya Üniversitesi,  
Türkiye

**Özet :** Verilerin sınıflandırma yöntemlerinden biri de karar ağaçlarıdır. Karar ağaçlarının oluşturulmasında çok sayıda öğrenme yöntemi mevcuttur. Bunlardan birisi de Gini algoritmasıdır. Bu çalışmada UCI veri setlerinden tiroid veri seti üzerinde yapılan bir karar ağacı uygulaması ve bu uygulamanın tiroid hastalığının teşhisindeki performansı irdelenmiştir.

**Anahtar kelimeler:** Karar ağacı, Gini algoritması, Tiroid tanısı

## A STUDY ON USE OF DECISION TREE METHOD IN THE DIAGNOSIS OF THYROID DISEASE

**Abstract:** Decision tree is one of the methods of data classification and contains many learning algorithms. Gini is one of these algorithms. UCI thyroid data sets were used in this study, developed a decision tree on this data sets and performance of the decision tree are investigated for diagnosis thyroid disease.

**Keywords:** Decision tree, Gini Algorithm, Thyroid diagnosis.

### Introduction

Data mining in Medicine is different from data mining in other fields because the data is heterogeneous. Methods of medical data mining have to take data resources in a heterogeneous manner due to both technical and social reasons (Cios and Moore, 2002). In a study, a data mining on two different medical data set is done by using three different Fuzzy methods which do not appear in commercial programs. The study has shown that the fuzzy method gives satisfactory results (Ghazavi and Liao, 2008). In the cases where the number of data set is limited, reliability of data mining is ensured using the method of Efron Bootstrap. By using bootstrap approach, reliability points can be determined for small data sets (Smith et al. 2009). Bellazzi and Zupan (2008) have stated that the predictive data mining has become a necessary tool during medical research. Through a data mining has done with using two-stage (Wand method and K-means method) clustering algorithm and decision tree analysis in Emergency department of Taiwan Medical Center, the nurses are better than doctors in abnormal diagnosis (Lin et al., 2010). Patients of chronic asthma should be followed constantly to avoid sudden attacks. To predict this situation of patients, Lee et al. (2011) has developed a data mining method that analyses bio-signals and environmental factors. In this method, a template-based decision tree and template-based class association rule have constructed. The data set of allergic asthma patients in a hospital in Taiwan has been used to get results, and consequently high accuracy rate was found in prediction of chronic asthma attacks. A data mining study has been made in Taiwan by using a web based reporting system on 725 patients. During the study, firstly, feature selection process has been applied and then 10 critical factors have been used to estimate dependent variables. To develop forecasting model about critical situations of patients, neural network was used and compared with multiple variable logistic regression by Lee et al. (2011). Therefore it was observed that neural networks gave better results than the former method. Another study done by Delen et al. (2009), neural networks and

decision trees used on 23 attributes and 193373 items for prediction. The large scale clinical data is basic experimental data for medical research. With using a warehouse which has been generated for traditional Chinese medicine, experimental data has been obtained (Zhou et al., 2010). Dialysis patients generally require re-treatment because of not healthy treatment conditions and long term dialysis treatment. Yeh et al., (2011) have developed a system by using decision trees in data mining to control treatment conditions of dialysis patients and report emergency treatment before hospital control.

In this study, decision tree in data mining has been used because of the success of decision trees as mentioned above in medical areas. The aim of this study is to diagnose thyroid disease.

## Method

### Data Source

There are a lot of works which intend providing decision support on thyroid diagnosis. Artificial intelligence techniques are widely used in these works. Polat et al. (2007), made classification by using artificial immune system with fuzzy to diagnose thyroid and obtained 85% accuracy. Kodaz et al. (2009), acquired 95.90% accuracy with their artificial immune system. Temurtas (2009), examined MLNN with LM (3 x FC), PNN (3 xFC), LVQ (3 xFC), and MLNN with LM (10 xFC), PNN (10 xFC) and LVQ (10 xFC) models' performance for the diagnosis of thyroid and gained successful results. On other study (Keleş and Keleş, 2008), 95.33% accuracy has gained with ESTDD (expert system for thyroid disease) on diagnosis. Doğantekin et al. (2010), attained 97.67% accuracy with ADSTG (automatic diagnosis system based on thyroid gland). On their subsequent work, Doğantekin et al. (2011), developed an expert system with using Generalized Discriminant Analysis and Wavelet Support Vector Machine System (GDA\_W SVM) method, and obtained a classification with 91.86% accuracy for the diagnosis of thyroid.

Learning set is the thyroid data set in UCI database. 6 attributes values in this data are shown in table 1. There are 5 inputs and 1 class attribute. Classes are determined as: normal, hyper and hypo (Uci, 2012). Data numbers in each class are:

|                   |     |
|-------------------|-----|
| Class 1: (normal) | 150 |
| Class 2: (hyper)  | 35  |
| Class 3: (hypo)   | 30  |

**Table 1:** Thyroid data set attributes

| Attribute number | Attribute value  |
|------------------|--|
| 1                | T3-resin uptake test   |
| 2                | Total Serum thyroxin as measured by the isotopic displacement method.  |
| 3                | Total serum triiodothyronine as measured by radio immunoassay.   |
| 4                | basal thyroid-stimulating hormone (TSH) as measured by radio immuno assay.   |
| 5                | Maximal absolute difference of TSH value after injection of 200 micrograms of thyrotropin-releasing hormone as compared to the basal value |
| 6                | Class attribute (1 = normal, 2 = hyper, 3 = hypo)  |

### Forming Decision Tree

Generally, data mining methods are divided into two categories: Prediction Methods and Description Methods. Classification is referred as the decomposing of data into its common attributes. Classification is based on a learning algorithm. The idea is the creating of classification model. It can be described as the process of determining unknown class of any data. Decision trees are one of the classification methods. A test set is used to determine the accuracy of model. The given data is divided into two parts as *learning set* and *test set*. Learning set is used to generate the model, and test set is used to verify the model. Different algorithms have been improved to create decision trees. One of these is Gini Algorithm.

Gini Algorithm is a classification method which is implemented as binary segmentation. It's a well-known algorithm for binary recursive subdivision. Every tree occurs with a different style. Algorithm is based on dividing attribute values as left and right side (Özkan,2008).

In this study, 215 data is divided into 3 subdivision. Gini Algorithm is used for 3 times; 2 subdivision for learning and 1 subdivision for test. One of the obtained trees is given in figure 1. (See Appendix A for other trees).

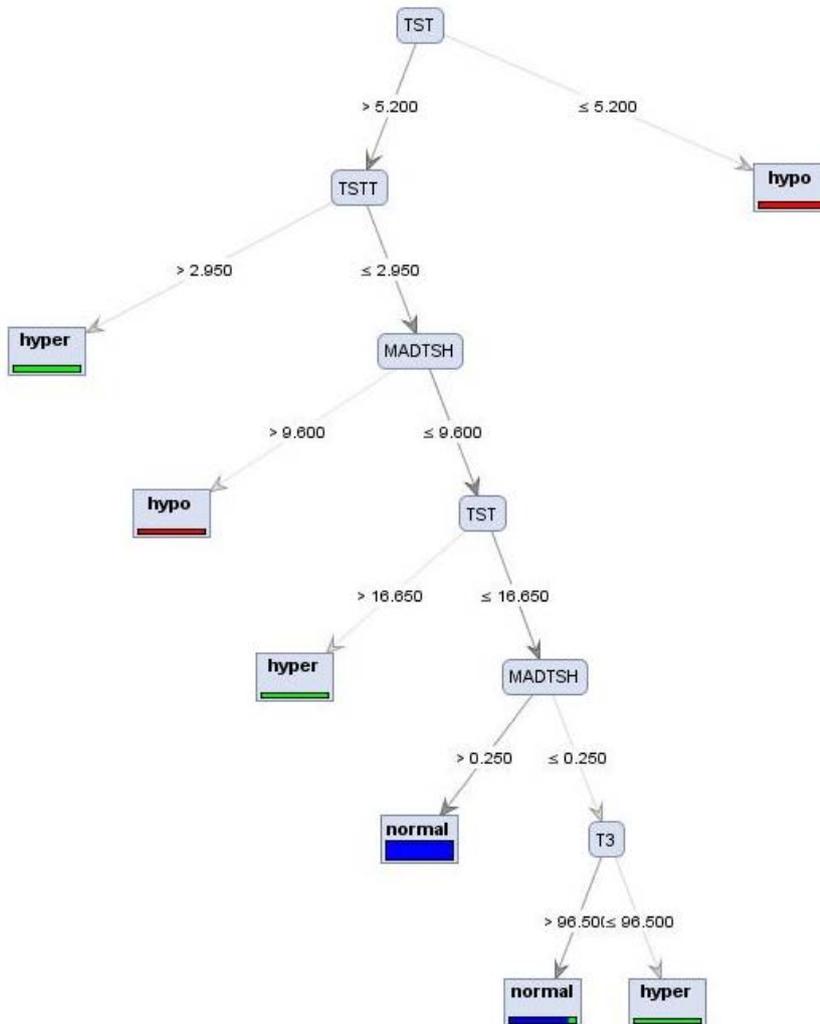


Figure 1: Decision tree by using 3-partitioned learning for Thyroid data

### Evaluate the Decision Tree-ROC analysis

ROC (Receiver Operating Characteric) analysis is a statistical evaluation method in order to eliminate the disadvantages of diagnose by using a value of the sensitivity and specificity (Tomak and Back, 2010). The accuracy of positive or negative decision is important for diagnostic tests. There are criteria to show the accuracy for each positive and negative decisions.

Table 2. Parameters for ROC Analysis

| Test Result | Real Case          |                     |         | Explanation   |
|-------------|--------------------|---------------------|---------|---|
|             | Positive           | Negative            | Total   |   |
| Positive    | True Positive (TP) | False Positive (FP) | (TP+FP) | TP: While real case is positive, the test result is positive. |
| Negative    | False Negative     | True Negative       | (FN+TN) |   |

|       |         |         |               |   |
|-------|---------|---------|---------------|---|
|       | (FN)    | (TN)    |               | <i>FN: While real case is positive, the test result is negative.</i><br><br><i>FP: While real case is negative, the test result is positive</i><br><br><i>TN: While real case is negative, the test result is negative.</i> |
| Total | (TP+FN) | (FP+TN) | (TP+FN+FP+TN) |   |

*Accuracy:  $(TP+TN) / (TP+FP+FN+TN)$*

*Sensitivity:  $TP/TP+FN$*

*Specificity:  $TN/TN+FP$*

Sensitivity specifies the ability of the test to separate the positive cases from the real positive cases. Specificity can be referred the ability of the test to separate the negative cases from the real negative cases. The values of the sensitivity and specificity determine how well the test separates the relevant or non relevant cases with investigated conditions from each other (Dirican, 2001).

According to these definitions, the results of sensitivity, accuracy and specificity that are obtained for the decision tree in figure 1, are shown in table 4. While preparing table 4, the cases that are specified in table 3, are considered at every test stages. The general obtained values are 94,5% for accuracy, 85,3% for sensitivity, and 97,3% for specificity.

**Table 3:** The using criteria to calculate the accuracy

| Original Result | Decision Tree Result |        |      |
|-----------------|----------------------|--------|------|
|                 | Hyper                | Normal | Hypo |
| Hyper           | TP                   | FN     | FN   |
| Normal          | FP                   | TN     | TN   |
| Hypo            | FP                   | TN     | TN   |

**Table 4:** According to test results, values of the accuracy, sensitivity and specificity

| Test No | Basic Variable | Accuracy (%) | Average test accuracy (%) | Average overall accuracy (%) | Sensitivity | Average overall sensitivity (%) | Specificity | Average overall specificity (%) |
|---------|----------------|--------------|---------------------------|------------------------------|-------------|---------------------------------|-------------|---------------------------------|
| 1       | Hyper          | 95,8         | 94,4                      | 94,5                         | 90,9        | 85,3                            | 96,0        | 97,3                            |
| 1       | normal         | 91,6         |                           |                              |             |                                 |             |                                 |
| 1       | Hypo           | 95,8         |                           |                              |             |                                 |             |                                 |
| 2       | Hyper          | 95,8         | 94,4                      |                              | 83,3        |                                 | 98,0        |                                 |
| 2       | normal         | 91,6         |                           |                              |             |                                 |             |                                 |
| 2       | Hypo           | 95,8         |                           |                              |             |                                 |             |                                 |
| 3       | Hyper          | 94,3         | 94,8                      | 81,8                         | 98,0        |                                 |             |                                 |
| 3       | normal         | 92,9         |                           |                              |             |                                 |             |                                 |
| 3       | Hypo           | 97,1         |                           |                              |             |                                 |             |                                 |

## Result

One of the developing fields of data mining usage is the medicine. Many data can be obtained from many people's laboratory results and operations. Through various algorithms, decision trees can be accessed with using these data. In this study, a decision tree is developed for diagnosis of thyroid disease, and the performance of this tree is analyzed.

Obtained decision trees do not differ from each other in terms of their performances. All of these trees can be used for thyroid diagnosis.

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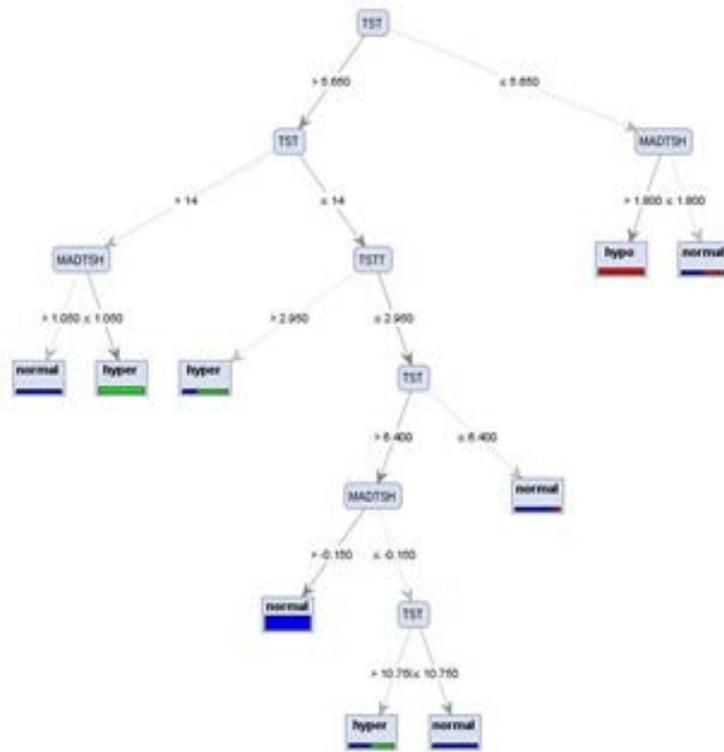
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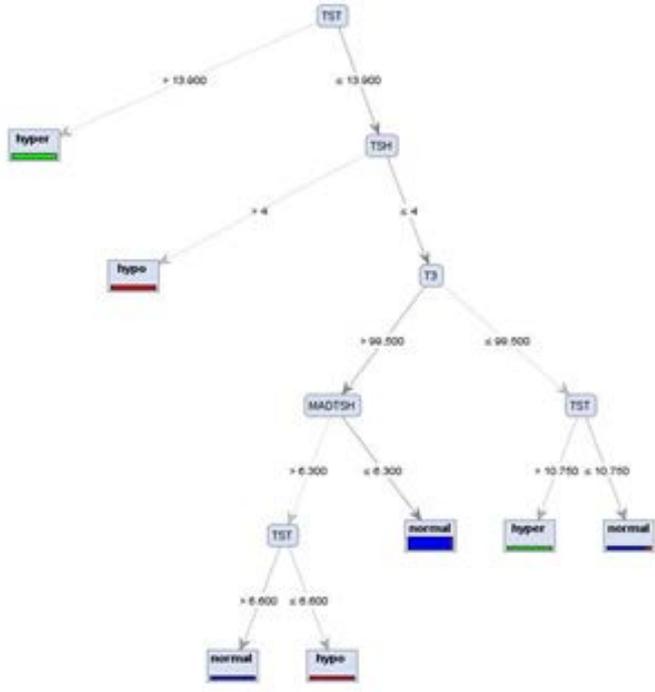
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Ek A



Şekil 2: 1-3 nolu bölümlerle eğitim için karar ağacı



Şekil 3: 2-3 nolu bölümlerle eğitim için karar ağacı

# KETEM' S ROLE FOR THE CERVICAL CANCER SCREENING IN TURKEY

**Öznur Körükcü,**

**Research Assistant,**

**Antalya Health School, Akdeniz University**

**oznurkorukcu@akdeniz.edu.tr**

**Kamile KUKULU**

**Associated Professor**

**Antalya Health School, Akdeniz University**

**kkamile@akdeniz.edu.tr**

**Abstract:** The aim of this study is to give information about KETEM's (Cancer Early Diagnosis, Screening and Education Center) role for cervical cancer screening in Turkey. Cervical cancer is the leading cause of cancer related death among women in Turkey like the other developing countries. Pap smear has an important value in the early diagnosis of cervical cancer that is a serious problem in women health. It was determined that the number of women who had a Pap smear was increasing with age, duration of marriage, number of birth, knowledge about Pap smear and perception of risk for cervical cancer.

**Keywords:** Cervical cancer, cancer screening, pap smear, public awareness

## **Introduction**

Cervical cancer is the 3rd most frequent type of cancers in women, after breast and rectal cancers. As recommended by the World Health Organization (WHO), necessary is the establishment and implementation of a national program on breast cancer and cervical cancer, which are prevalent in Turkey, and in which screening programs are efficient and cost-effective in reducing mortality and morbidity. KETEM conducts screening programs for breast, cervix, and colorectal cancers with "Early detection saves lives" catchword in Turkey. At the end of the 2008, 84 KETEM was established in Turkey. Physicians, nurses, midwives, X-ray technicians work in these centers. Aged between 35-65 years women, screen with pap test quinquennially like suggested by the Ministry of Health. Colposkopi is done as a result of suspicious Pap Smear test. Also KETEM organises the public health educations about cancer screening, healthy feeding and physical exercises.

In order to organize trainings aiming to inform the health personnel and the public on the issue of cancer and to raise awareness, to provide diagnosis in early stages through population based screening programs (on breast, cervical, colorectal cancers etc.) on identified risk groups in line with established screening standards. There is at least one KETEM in each province of Turkey. Each KETEM is integrated to one of the governmental hospitals in these provinces with the recent investments, now the total number of KETEMs reached to 122 across the whole country. Each KETEM is designed to render services for 250,000 populations. As such, the number of KETEMs is planned to be increased to 280 in total by the end of 2015.

Each KETEM performs population based screening for breast and cervical cancers according to national guidelines. Even though screening services are provided free of charge to those who do not possess necessary health insurance.

The Ministry of Health plans incorporation of family physicians into the population based cancer screenings. In Turkey, every citizen has a family physician. According to the estimates, if 2 patients are screened per day by a family physician, it totals 10 million people to be screened annually. Accordingly, 2012-2013 will be an integration year for KETEMs and family physicians for cancer screening. Additionally MoH will conduct several HPV Primary screening studies and according to the results, national screening policies may be adapted for primary HPV screening.

Since introduction of cytologic screening for cervical cancer using the Papanicolaou (Pap) test in the 1950s, the incidence of invasive cervical cancer in the United States has fallen more than 100%. Cervical cancer screening has successfully decreased cervical cancer incidence and mortality (Mishra, Pimple, & Shastri, 2011, p.125). The fundamental goal of cervical cancer screening is to prevent morbidity and mortality from cervical cancer. The optimal

screening strategy should identify those cervical cancer precursors likely to progress to invasive cancers (maximizing the benefits of screening) and avoid the detection and unnecessary treatment of transient HPV infection and its associated benign lesions that are not destined to become cancerous (minimizing the potential harms associated with screening (Saslow, 2012, p.517). Public health program such as screening women for precancerous changes, treating and follow-up care at early stages of the disease can potentially protect women from developing cervical cancer and thus reducing the incidence, morbidity and mortality from this condition (Jacqueline, & Christina, 2000).

.Based on literature, we recommend that an intense public health campaign be conducted on a recurring basis; providing cervical cancer education with emphasis on its etiology, risk factors and methods of prevention. Public service announcements promoting Pap smear test utilization and its benefits should be carried out by the government and other non-governmental organizations and schools alone or in conjunction with the government. Policies that encourage doctors to recommend the procedure to their female patients who meet the necessary requirements for commencing Pap smear test screening should be instituted. Policies should also be put in place that encourage or as appropriate mandate that all women coming for antenatal services are provided with the options of a Pap smear test. Cervical cancer education needs to be properly packaged so that the message delivered is complete. Finally facilities capable of carrying out Pap smear test be established, and more opportunistic screenings be done so that as many eligible women as possible can get at least one Pap smear test (Hyacinth HI, 2012, p.1).

Reis (2012, p.1469) stated that education that addresses culture-specific beliefs could be effective in increasing cervical cancer screening utilization among Turkish women. Culture-specific information could focus on not only the importance of receiving screening when one does not have symptoms but also the strategies to overcome the emotional discomfort and practical difficulties.

It is also important that health care workers are well informed about the national policy and develop institutional policy to implement national policy on Pap smear. Nurses have an important role in cancer prevention and health education (Ertem, 2009, p. 737). Therefore, knowledge and awareness of cervical cancer are the most important for our women, who were educated by nurses. For ultimate effectiveness the screening programs have to be integrated with the overall reproductive and primary health care programs.

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# KONSANTRİK TİP ISI DEĞİŞTİRİCİSİNE YERLEŞTİRİLEN YARIKLI KONİK ELEMANLARIN ISI TRANSFERİ ÜZERİNDEKİ ETKİSİ

Rasim BEHÇET

Batman Üniversitesi Mühendislik- Mimarlık Fakültesi  
Makine Mühendisliği Bölümü, Batman/Türkiye,  
rbehcet23@gmail.com

Mustafa İBEK

Batman TÜPRAŞ Rafinerisi

**Özet** Bu çalışmada, türbülans oluşturarak termal sınır tabakayı inceltmek ve ısı transferini artırmak amacıyla iç içe borulu ısı değiştiricisinin iç borusuna yarıklı konik-halka elemanlar yerleştirilerek elemanların ısı değiştirici performansı üzerindeki etkisi deneysel olarak araştırıldı. Deneysel ısı transfer edilen akışkan olarak su ve suya ısı transfer eden akışkan olarak da hava kullanıldı. Deneysel, önce boş boru olmak üzere 160 ve 320 mm adımlarındaki yarıklı konik elemanlar ısı değiştiricisinin iç borusuna yerleştirilerek 3000 ile 10000 arasında değişen Reynolds sayılarında hem paralel hem de zıt akış için gerçekleştirildi. Yarıklı konik eleman içermeyen (türbülatorsöz) ısı değiştiricisi ile yarıklı konik eleman içeren (türbülatorlü) ısı değiştiricisi değerleri karşılaştırıldığında; türbülatorsöz duruma nazaran türbülatorlü durumda ortalama olarak ısı transferindeki %70 lik artışa karşılık sürtünme kayıplarında da 2 kat artış olmuştur. Ayrıca, yapılan iyileştirme tekniğinin termodinamik açıdan avantajlı olup olmadığını belirlemek için entropi üretimi hesaplanmış ve entropi üretiminde de ortalama olarak %22 civarında azalma olduğu belirlenmiştir.

**Anahtar Kelimeler:** Isı değiştirgeci, Yarıklı konik halka elemanlar, ısı transferi, Sürtünme faktörü

## Giriş

Farklı sıcaklıktaki iki akışkan arasında ısı transferini sağlayan sistemler olarak tanımlanan ısı değiştiricileri, temelde ısıtma ve soğutma olmak üzere sanayinin birçok alanında (otomotiv, havacılık, elektronik, kimya vb gibi) yaygın olarak kullanılmaktadır. Isı transferini artırmaya ilgi, özellikle endüstriyel gelişme ile orantılı olarak hızla artmaktadır. Son yıllarda her konuda olduğu gibi ısı değiştiricileri konusunda da malzeme ve enerji tasarrufu yapmak amacıyla birçok çalışma yapılmaktadır. Çalışmalarda kullanılan teknikler, aktif (dış kuvvetlere ihtiyaç gösteren) ve pasif (dış kuvvetlere ihtiyaç göstermeyen) olmak üzere iki kısma ayrılmaktadır. Aktif tekniklerin büyük bölümü yüzey titreşimi, akışkan titreşimi, elektrostatik alanlar, enjeksiyon, emme ve mekanik yardımcıları gibi gruplardır. Pasif teknik tipleri ise dönmeli akışlar, genişletilmiş yüzeyler, pürüzlü yüzeyler, sisteme yerleştirilmiş ve yerleri değiştirilebilen ısı transferini artırıcı türbülator elemanları ile gaz veya sıvılar için katkı maddeleri gibi gruplardır (Yılmaz ve ark.1999) Promvonge ve Eiamsa (2006) Isı transferini artırmak için ısı transfer katsayısının iyileştirilmesi suretiyle iç içe borulu ısı değiştiricilerinin iç borusu içerisine değişik tip ve şekillerde elemanlar yerleştirilerek çalışmalar yapılmıştır. Zhu ve arkadaşları(1993) türbülanslı kanal akışında türbülator çeşitlerinin ısı transferi ve akış kayıplarındaki etkilerini araştırmış ve ortalama ısı transferi %16-19 arasında arttığı görülmüştür (Zhu ve ark. 1993). Algifri ve Bhardwaj ise test kısmının girişinde yer alan bükülmüş kısa şeritlerin meydana getirdiği türbülanslı dönmeli akıştaki ısı transfer karakteristiklerinin analitik bir incelemesini yaptılar (Algifri ve ark., 1988). Yılmaz ve arkadaşları(1999) ısı değiştiricisi içerisine farklı açılara göre ayarlanabilen türbülator yerleştirilerek azalan dönmeli akışta türbülatorün sürtünme faktörü ve ısı transferi üzerindeki etkisini deneysel olarak incelemişlerdir. Pervane tip türbülator ile dönmeli akış oluşturarak ısı transferini artırmak için yapılan çalışmalarda Argunhan ve arkadaşları(2007)'nin çalışması, iç içe borulu ısı değiştirgecinde boru girişine dönel akış oluşturmak üzere yerleştirilen türbülatorlerin ısı transferine ve basınç düşüşüne etkisi deneysel olarak araştırılması ile ilgilidir. Bu amaçla iç içe borulu ısı değiştirgecinin iç borusu girişine 55° açılı ve 2x7 mm ebadında düzgün ve çapraz sıralanmış dikdörtgen geometri delikler bulunan kanatlı türbülatorler yerleştirilerek, türbülatorlerin ısı transferi ve basınç düşüşüne etkileri farklı Reynolds sayılarında paralel ve zıt yönlü akış için deneysel olarak incelenmiştir. Behçet(1993), farklı adımlara sahip iki çeşit türbülans oluşturucu eleman (helisel yay ve konik halka türbülator)'ı ısı değiştiricisine yerleştirilerek 3500 ile 8500 arasında değişen Reynolds sayılarındaki elemanların ısı transferi ve basınç kaybı etkisini termodinamik analiz yaparak araştırmıştır. Küçük ve arkadaşları(2000), boru girişine yerleştirdikleri beş adet konik yüzey halkalı türbülator ile türbülanslı akışta yapmış oldukları deneysel çalışmada ısı transferinde %75 artış sağlamışlardır. Durmuş(2004), iç içe borulu ısı değiştiricinin iç borusu içerisine kesik konik türbülatorler

yerleştirilerek yaptığı deneysel çalışmada, türbülatorlerin ısı transferi, basınç kaybı ve enerji analizini incelemiştir. Konik-halka türbülator kullanılarak 6000 ile 26000 arasında değişen Reynolds sayılarında yapılan deneysel çalışmada %333 e kadar ısı transferinde artış sağlanmıştır(Promvong, 2008). Yakut ve Sahin(2004), farklı koniklik açılarını baz alarak değişik konik türbülatorler için türbülatorlerin ısı transferi ve basınç düşümü üzerindeki etkilerini inelenmişler. Sıcak akışkan olarak hava ve soğuk akışkan olarak su kullanılıp Isı transferini araştırmak amacıyla yapılan diğer çalışmalarda(Ayhan ve ark. 1991, Çomaklı ve ark. 1993, Ipek, 2006), ısı değiştiricinin iç borusu içerisine farklı çap, adım ve koniklik açısı baz alınarak belirli bir düzene göre gruplar halinde daralan-genişleyen yüzeyli silindirik boru içerisine yerleştirilerek deneysel çalışmalar yapılmıştır. Çalışmalarda elde edilen sonuçlara göre ısı transferinde %170-300 ve basınç düşümünde de 6 kat ile 20 kat arasında değişen artışlar gerçekleşmiştir. .

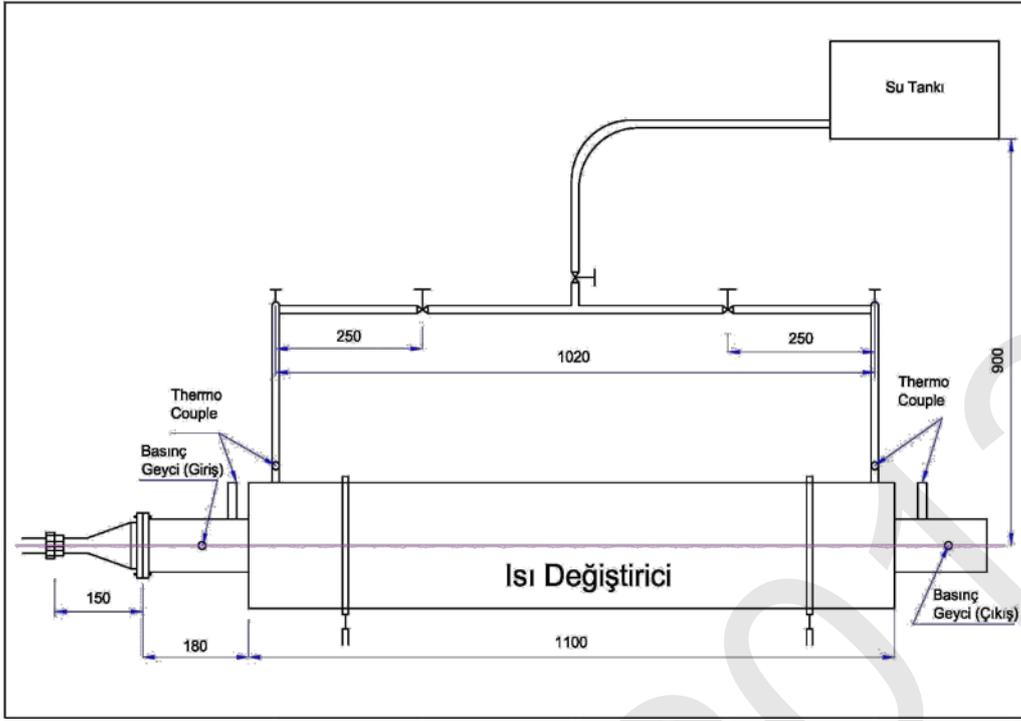
Bir ısı değiştiricisinin ekonomik tasarımı önemli olup, cihazın ısı kazancının yanında borulardaki akışkanın pompalanması için gerekli enerji sarfiyatının da dikkate alınması gerekir. Sistemlerin optimum çalışma aralığının belirlenmesi entropi üretim biriminin hesaplanması ile mümkün olmaktadır. Isı değiştirici etkinliğini artırmak için ısı transfer kayıpları ve sürtünme kayıplarını azaltarak entropi üretim birimi minimize edilmesi ile optimum boyutlar belirlenebilir(Çakmak ve Yıldız, 2011, Çakmak ve ark. 2011).

Bu çalışmada, iç içe borulu bir ısı değiştiricisindeki ısı transferi ve basınç düşümü deneysel olarak araştırıldı. Türbülans oluşturarak ısı transferini artırıcı eleman olarak, birbirleri ile bağlantılı 160 ve 320 mm adımlarındaki yarıklı konik halka elemanlar kullanıldı. Kullanılan türbülans oluşturucu elemanlar, ısı transferini artırırken basınç düşümünü artırmaktadır. Ancak basınç düşümünün artması istenmeyen bir durumdur. Bu nedenle konik elemanların çevresine yarıklar açılarak basınç düşümünün artışı engellenerek minimum seviyeye indirilmesi sağlandı. Yapılan işlemin termodinamik olarak avantajlı olup olmadığını belirlemek amacıyla da sistemin entropi üretimi hesaplandı.

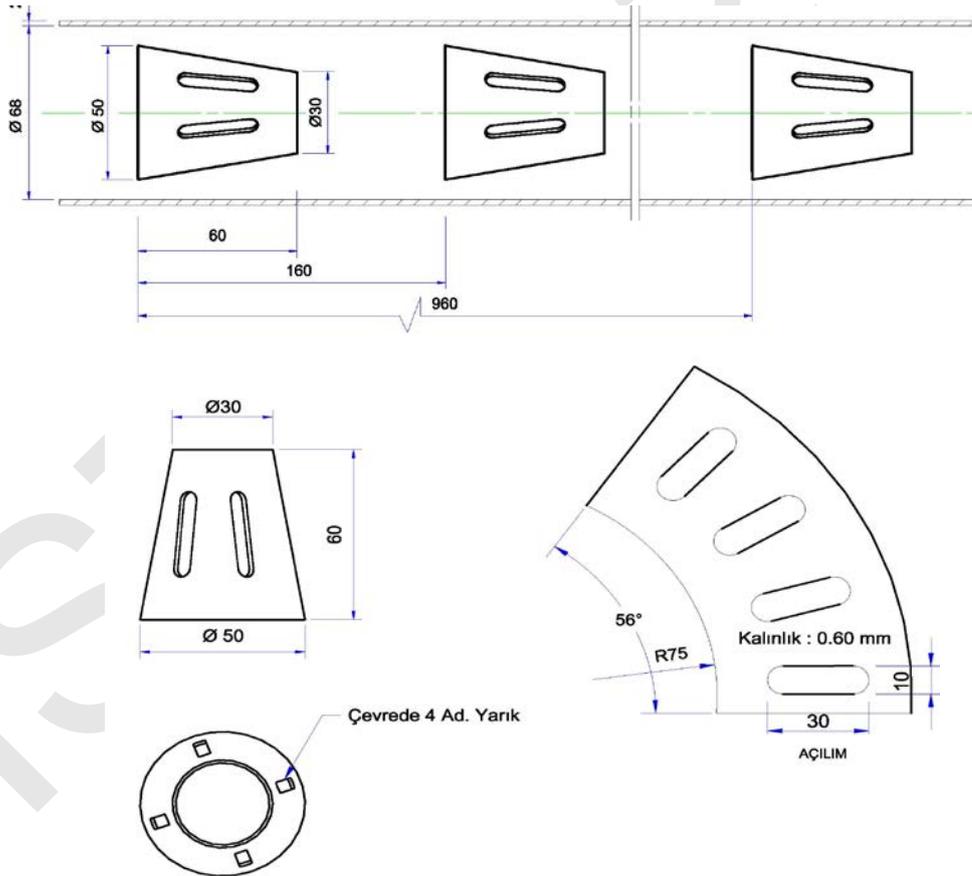
## Deney Düzenegi ve Deneysel Yöntem

Şekil 1 de deney düzeneginin şematik görünümü verilmiştir. Deney düzenegi; hava fanı, elektrikli hava ısıtıcısı, paralel ve zıt akışlı ısı değiştiricisi, basınç ölçer, 160 ve 320 mm adımlara sahip yarıklı konik elemanlar, su tankı ve diğer yardımcı elemanlar ile ölçüm aygıtlarından meydana gelmiştir. Şekil 1'de görüldüğü gibi paralel ve zıt akışlı olacak şekilde tasarlanan ve havadan suya ısı transferinin gerçekleştiği ısı değiştiricisi; çapları farklı iç içe girmiş iki boru sisteminden oluşmaktadır. Çelikten imal edilmiş dış boru içerisine iç çapı 68 mm, et kalınlığı 2 mm ve boyu 1100 mm olan çelik boru yerleştirilmiştir. İçerisinde sıcak akışkan geçen iç boru dış boru içerisine titizlikle merkezlenmiştir. Isı değiştirici devresi ısı iletkenliği düşük olan malzemelerle yataklanarak esas akış devresi ile irtibatı sağlanmıştır. Çevreye olan ısı transferini engellemek için de ısı değiştiricisi izole maddesi (cam yünü) ile tamamen izole edilmiş ve dış kısmı alüminyum folyu ile kaplanarak çevre ile ısı transferi önlenmiştir. İç ve dış boru arasında akan soğuk akışkanın paralel ve zıt akışı ve su debisinin ayarlanması sisteme ilave edilen vanalar ile sağlanmıştır.

İlk önce deney düzeneginin literatürdeki boş ısı değiştirici sonuçlarını sağlayıp sağlamadığını araştırmak için kalibre deneyleri yapılmıştır. Sonuçların güvenilirliğini sağlamak açısından deney düzeneginin performansları literatürde verilen bağıntılara uygun sonuçlar elde edildikten sonra deney sonuçlarının alınmasına başlanmıştır. Boş boruda elde edilen sonuçlar ile literatör sonuçları karşılaştırıldığında  $\pm$  %5-10 arasında değişen bir hata payının oluşu görülmüştür. Bunun sebebi ise sistemdeki kaçaklar ve ölçüm hatalarından olabileceği tahmin edilmektedir



Şekil 1: Deney düzeneğinin şematik resmi



Şekil 2: Isı değiştiricisine yerleştirilen yarıklı konik-halka yüzey elemanların genel boyut parametreleri

Deney düzeneğinde ısı transfer edilen akışkan olarak seçilen su, bir dinlenme tankından kendi serbest düşüşü ile alınarak ısı değiştiricisine girmektedir. Ayrıca suyun debisi bir vana yardımıyla ayarlanabilmektedir. Suya ısı aktaran akışkan olarak seçilen hava, hava fanı tarafından ortamdan emilerek hava ısıtıcısına gönderilmektedir. Burada istenen sıcaklığa kadar ısıtma sisteme bağlı varyak yardımıyla yapılmaktadır. Sisteme giren hava miktarı da bir vana yardımıyla ayarlanarak ısıtıcıya gönderilmektedir. Isıtıcıda ısınan hava tekrar ortama verilmektedir. Su ise ısı değiştiricisinin iç borusu ile dış borusu arasındaki kanaldan akarak ısınmaktadır. Isı transferinin iyileştirilmesi amacıyla deney düzeneğinde kullanılan yarıklı konik-halka elemanların genel boyutları şekil-2 de verilmiş olan birbirleri ile bağlantılı farklı iki adımda (160mm ve 320mm) ve  $t=0.6\text{mm}$  kalınlığındaki alüminyum saçdan imal edilmiştir.

Deneyler; önce boş boru olmak üzere farklı adımlardaki yarıklı konik elemanlar ısı değiştiricisine yerleştirilerek, sistem ısı bakımından kararlı hale geldikten sonra yapılmıştır. Sisteme giren hava miktarı maksimum olması için ısıtıcı ile fan arasındaki vana tamamen açılarak ilk ölçümlere başlanmıştır. Ölçümler 15 dakikada bir farklı debiler için alınmıştır. Isı değiştiricisine giren-çıkan hava ve suyun sıcaklıkları ile ısı değiştiricisinin giriş ve çıkışında hava tarafındaki cidar sıcaklıkları bakır-konstantan termoeleman çifti kullanılarak bir dijital sıcaklık ölçeri yardımı ile ölçülmüştür. Deney düzeneğine giren su debisi dereceli bir kap ve kronometre ile bulunmuştur. Ayrıca deney elemanlarının giriş-çıkışı arasındaki basınç farkı basınç ölçer (Magnetic Differential Pressure Gages) yardımıyla belirlenmiştir. Her bir deney 3000 ile 10000 arasında değişen 8 farklı Reynolds sayısında gerçekleştirilmiştir.

## Deney Sonuçlarının Hesabı

Deney ölçümlerinin hesaplanmasında kullanılan havanın fiziksel özellikleri ısı değiştiricisine giren-çıkan havanın aritmetik ortalama sıcaklıklarına göre alınmıştır. Herbir durum için suyun kütleli debisi, havanın suya verdiği ısı miktarı, havanın kütleli debisi, hava hızı, hava için Reynolds sayısı, logaritmik ortalama sıcaklık farkı, havanın ısı taşınım katsayısı, Nusselt sayısı ve entropi üretimi değerleri için hesaplamalar yapılmıştır.

Termodinamiğin birinci kanununa göre; sıcak akışkanın verdiği ısı soğuk akışkan tarafından transfer edildiği kabul edilerek paralel akışlı ısı değiştiricisi için alınan veya verilen ısı miktarı,

$$Q = m_h C_{ph} (T_{hg} - T_{hc}) = m_s C_{ps} (T_{sg} - T_{sc}) \quad (1)$$

bağıntısı ile ve hava için Reynolds sayısı ise

$$Re = \frac{U_m \cdot d}{\nu} \quad (2)$$

eşitliği ile hesaplanmıştır.

Ortalama ısı transferi katsayısı, akışkanlar arasında transfer edilen ısı miktarının akış kesiti ve logaritmik ortalama sıcaklık farkına bölünmesi ile bulunmuştur.

$$h_m = \frac{Q}{A \Delta T_m} \quad (3)$$

Buradaki A, sıcak akışkanın geçtiği kesit alanını ve  $\Delta T_m$  ise hava ile duvar arasındaki logaritmik ortalama sıcaklık farkı olup şu şekilde ifade edilmektedir.

$$\Delta T_m = \frac{(T_w - T_{hg}) - (T_w - T_{hc})}{\ln \frac{(T_w - T_{hg})}{(T_w - T_{hc})}} \quad (4)$$

Ortalama Nusselt sayısı, ince cidar yaklaşımından boru kalınlığının ısı direnci ihmal edilerek ve yalnızca akışkan sıcaklığından faydalanılmak suretiyle

$$Nu_m = \frac{h_m d}{k} \quad (5)$$

Teorik Nusset Sayısı aşağıda verilen Dittus-Boelter eşitliğinden yararlanılarak hesaplanmıştır[18].

$$Nu_T = 0,023 Re^{0,8} Pr^{1/3} \quad (6)$$

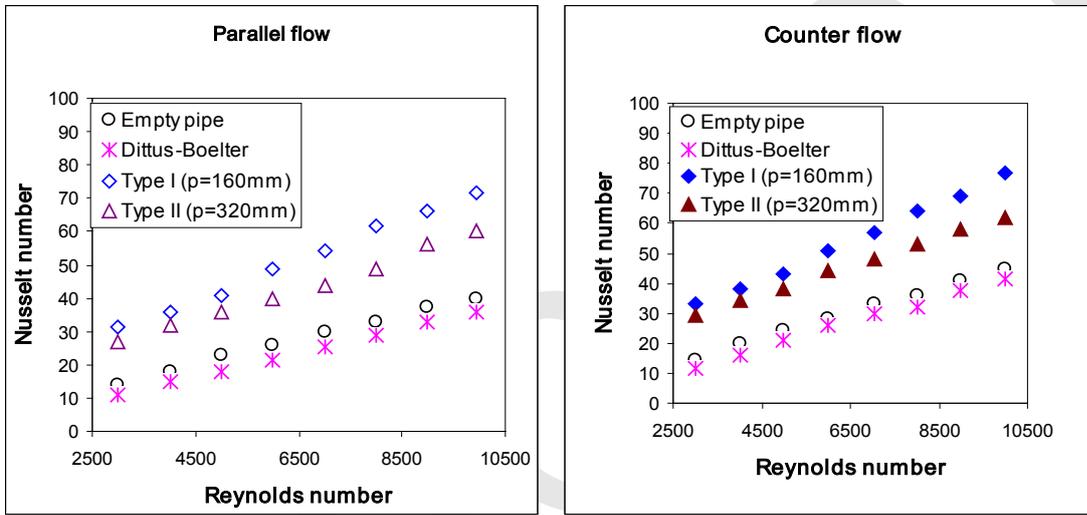
Isı değiştirici ile çevre arasında ısı transferi ihmal edilerek sisteme ait entropi üretimi değeri ise

$$\dot{S} = m_h C_{ph} \ln(T_{hc}/T_{hg}) + m_s C_{ps} \ln(T_{sc}/T_{sg}) - [m_h (v/T)_h \Delta P_h + m_s (v/T)_s \Delta P_s] \quad (7)$$

bağıntısı kullanılarak hesaplanmıştır(Yüncü, 1990).

## Sonuçlar ve tartışma

Isı değiştiricilerinde ısı tanferfer artışını belirleyen değer Nusselt sayısıdır. Şekil 3’de içi boş ısı değiştiricisi ile yarıklı konik eleman yerleştirilmiş ısı değiştirici için Nusselt sayısının nominal Reynolds sayısına bağlı değişimi gösterilmiştir. Şekilden de görüldüğü gibi yarıklı konik elemanların kullanılması sonucu meydana gelen türbülans nedeniyle sınır tabaka incelenerek ısı transferinde artış olmuştur.



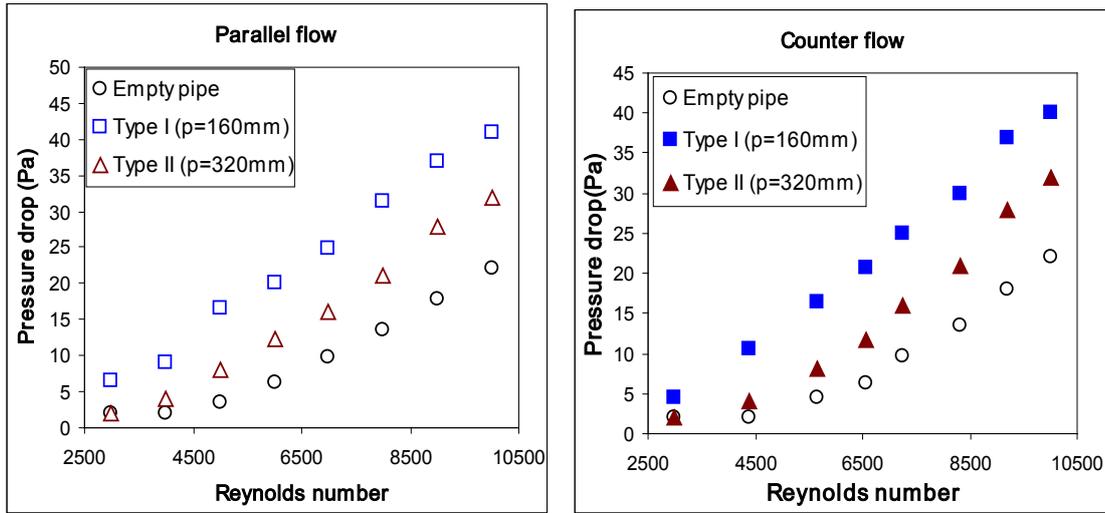
Şekil 3: Nusselt sayısının Reynolds Sayısı ile değişimi

Yarıklı konik eleman içeren ısı değiştiricisi ile yarıklı konik eleman içermeyen ısı değiştiricisi karşılaştırıldığında, ortalama olarak Nusselt sayısında içi boş ısı değiştiricisine göre paralel akışta; birinci tip yarıklı konik elemanda %85, ikinci tip yarıklı konik elemanda % 55 artış sağlanırken zıt akışta sırasıyla %86 ve %57 artış olmuştur. Düşük Reynolds sayılarında yarıklı konik elemanların ısı transferi üzerindeki etkisi az olmakta ancak Reynolds sayısının artması bu etki giderek artmaktadır. Tüm değerlerin ortalaması alındığında ısı transferinde meydana gelen artış miktarı %70 civarında olmuştur.

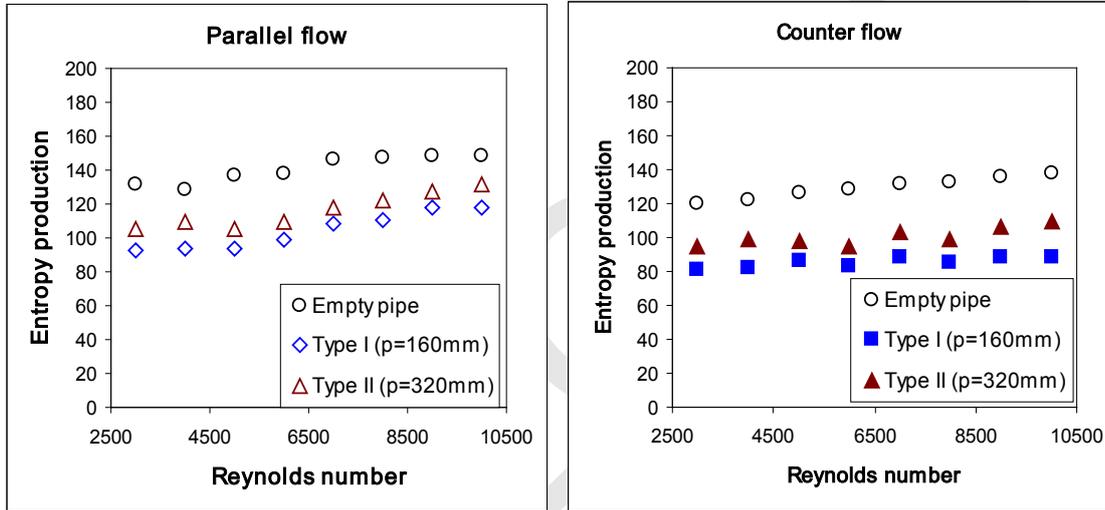
Şekil 4’de ısı değiştiricisi boyunca basınç düşüşü nominal Reynolds sayısının fonksiyonu olarak çizilmiştir. Yarıklı konik eleman bulunduran ısı değiştiricisinin basınç kayıpları ile içi boş ısı değiştiricisinin basınç kayıpları karşılaştırıldığında yaklaşık aynı Reynolds sayılarında paralel akış durumu için, birinci tip konik elemanda %245, ikinci tip konik elemanda ise %160, zıt akışta ise sırasıyla %236 ve %157 artış olmuştur. Şekil 4 deki grafikler incelendiğinde yarıklı konik halka yüzey elemanların adımı artması ile basınç kayıplarında da azalma olma olduğu görülecektir.

Isı transferi işlemleri doğal olarak tersinmez(sürekli entropi üreten) ve yararlı enerjiyi yok eden işlemlerdir. Bu nedenle ısı transferi işlemlerinin yararlı enerjiyi nasıl israf ettiğini ve bu israfı en aza indirmek için nelerin yapılması gerektiğini bilmek ve konveksiyonla ısı transferinde entropi üretimini en aza indirmekle mümkündür(Ko ve Ting 2005, Behçet ve ark., 2011, Argunhan ve ark., 2011,). Bir ısı değiştiricisi incelenirken ikinci kanuna dayanan entropi üretimi birimi ile açıklanması, enerjinin verimli bir şekilde kullanılması açısından yararlı olacağından şekil 5’de ise farklı adımlardaki yarıklı konik halka yüzey elemanlara ait entropi üretiminin Reynolds sayısına bağlı olarak değişimi çizilmiştir. Şekillerden de görüleceği gibi konik eleman içermeyen ısı değiştiricisinin entropi üretimi konik eleman içeren ısı değiştiricisine göre her iki durumda da daha fazla olmuştur. Yani türbülötörlerin kullanılması ile entropi üretiminde azalma meydana gelmiştir. Bu azalma miktarı ortalama olarak paralel akış durumunda %15,4 olurken zıt akış durumunda %28,4 olmuştur. Dolayısıyla konik elemanların

kullanılmasıyla entropi üretiminde meydana gelen azalma dikkate alındığında yarıkli konik elemanların kullanılması ile yapılan iyileştirme tekniği termodinamik olarak avantajlı olduğu söylenebilir.



Şekil 4: Basıç düşüşünün Reynolds Sayısı ile değişimi



Şekil 5: Entropi Üretiminin Reynolds Sayısı ile değişimi

## Sonuç

Sonuç olarak yarıkli konik türbülötörler iç içe borulu ısı değıştiricisinin iç borusunun içersine yerleřtirilerek yapılan çalıřmada türbülötörler sayesinde akıřkana türbülans kazandırılarak ısı transferinde iyileřmeler sađlanmıřtır. Türbülötörlü ısı değıştiricisi ile türbülötörsüz ısı değıştiricisi karřılařtırıldıđında, türbülötörlerin sisteme ilave edilmesi ile akıřkana kazandırılan türbülans ile türbülötörsüz ısı değıştiricisine nazaran ısı transferinde ortalama olarak, %70 civarında artma olmuřtur. Bu artma miktarı paralel akıř durumuna nazaran zıt akıřta %6,67 daha fazla olmuřtur. Entropi üretimi, ısı transferi iřlemlerinin kullanılabilirliđinin bir göstergesidir. Bu nedenle, bu çalıřmada ısı değıştiricisine yerleřtirilen yarıkli konik türbülötörlerin entropi üretimi üzerindeki etkisi incelenmiř ve türbülötörsüz duruma göre türbülötörlü durumda entropi üretiminde ortalama olarak %22 civarında azalma sađlanmıřtır. Türbülötörlü sistemlerin pasif yöntemle ısı transferinin iyileřtirilmesi açısından oldukça etkili olduđu ve iřletme açısından faydalı olduđu görülmektedir. Böylece, türbülans oluřturucu elemanların kullanımı ile daha küçük boyutlu sistemlerin tasarımı sađlanabildiđi gibi sistemin verimi iyileřtirilerek enerji tüketiminin azaltılması mümkün olacaktır.

## Semboller

$C_p$  = Sabit basınçtaki özgül ısı(J/kgK)

$d$  = Boru çapı (mm)

$\Delta T_m$  =Logaritmik ortalama sıcaklık farkı (°C)

$h_m$  =Ortalama ısı transfer katsıyısı ( $W/m^2 K$ )

$k$  = Isı iletim katsayısı (W/m K)  
 $L$  = Isı deęiřtiricisi boyu(m)  
 $m_h$  = Havanın kütlelel debisi (kg/s)  
 $m_s$  = Suyun kütlelel debisi (kg/s)  
 $Nu$  = Nusselt number  
 $\Delta P$  = Basınç düşümü (Pa)  
 $P$  = Yarıklı konik eleman adımı (mm)  
 $Pr$  = Prandtl sayısı  
 $Q_h$  = Havanın verdięi ısı (W)  
 $Q_s$  = Suyun aldıęı ısı (W)  
 $Re$  = Reynolds sayısı  
 $\dot{S}$  = Entropi üretimi  
 $T_{hg}$  = Hava giriş sıcaklıęı (°C)  
 $T_{hc}$  = Hava çıkıř sıcaklıęı (°C)  
 $T_{sg}$  = Su giriş sıcaklıęı (°C)  
 $T_{sc}$  = Su çıkıř sıcaklıęı (°C)  
 $U_\infty$  = Ortalama akıřkan hızı(m/s)  
 $\nu$  = Kinematik viskozite(m<sup>2</sup>/s)  
 $\rho$  = Özgöl kütle(kg/m<sup>3</sup>)

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# KURUMLARA YÖNELİK WEB TABANLI EVRAK TAKİP VE KAYIT YAZILIMI

## WEB BASED DOCUMENT TRACKING AND CATALOGING SOFTWARE FOR INSTITUTIONS

<sup>1</sup>Erhan AKBAL

<sup>2</sup>Mustafa ULAŞ

Fırat Üniversitesi Enformatik Bölümü, Elazığ-Türkiye  
Fırat University Department of Informatics, Elazığ-Turkey  
erhanakbal@firat.edu.tr

Fırat Üniversitesi Müh. Fak. Yazılım Mühendisliği Bölümü, Elazığ-Türkiye  
Fırat University Faculty of Engineering, Department of Software Engineering, Elazığ-Turkey  
mustafaulas@firat.edu.tr

**Özet:** Büyük kurum ve kuruluşlarda gelen giden evrakların takibi ve kayıt süreçleri kurum personelleri için oldukça büyük bir sorun teşkil etmektedir. Belgelerin kaybolması, zamanında işlem yapılamaması, istenilen evraka anında ulaşılmaması en büyük sorunların başındadır. Yapılan çalışma ile kurumlarda evrakların elektronik ortama aktarılması sağlanarak, belirtilen sorunların ortadan kaldırılması amaçlanmıştır. Çalışma web tabanlı olarak gerçekleştirilmiştir. İstemci sunucu mimarisi kullanmadan internet bağlantısı ve web tarayıcısı bulunan herhangi bir bilgisayardan kullanılabilmesi sağlanmıştır. Böylece kurum ve kuruluşların herhangi bir donanım maliyeti ve insan kaynağına gerek duymadan kullanması amaçlanmıştır. Veri tabanı yönetim olarak MS SQL Server, programlama dili olarak ASP(Active Server Pages) kullanılmıştır. Gerçekleştirilen yazılım bir devlet üniversitesinde kullanılmaktadır.

**Anahtar Kelimeler:** Evrak Takip, Yazılım, Web Tabanlı Yazılımlar

**Abstract:** In large corporations and institutions tracking and cataloging processes of correspondence documents are causing troubles for the staff working there. Disappearing documents, overdue processes and disability to get through to a record in time are chiefs among the biggest problems. In this study, it is aimed to put these mentioned problems away by means of delivering records from desk to electronic environment. The study has been performed as a web based application. The study has enabled this application through any computer with an internet connection and a web browser without client-server architecture. As a consequence, it is aimed that corporations and institutions have the availability to use the application without the need to extra staff and any new hardware cost. MS SQL Server has been used as database management, and ASP (Active Server Pages) has been used as programming language. The outcome software is currently being used in a state university.

**Keywords:** Document Tracking, Software, Web Based Software

### 1. Giriş

Günümüzde internet ve teknolojilerindeki hızlı gelişmeler beraberinde birçok faydayı getirmiştir. Bu faydaların kullanılabilceği bir alanda, kamu kurum ve kuruluşlarında yıllardır klasik yöntemlerle gerçekleştirilen evrak ve belge işlemlerinin dijital ortama aktarılması yöntemidir (Kılıçarslan, 2002). Özellikle kamu kurumlarında ve birçok iş alanında ihtiyaç duyulan işlemler bilgisayarlar üzerinden ve web ortamından yapılmaktadır. Kurumların bu alanda en büyük ihtiyacı bilgi ve belgelerinin saklanabilmesi, istenildiğinde ulaşılabilmesi ve düzenli arşivlenebilmesidir. Bu ihtiyaçlar doğrultusunda kurum bilgi işlem birimleri bu sorunlara çözüm üretmek için sürekli çaba göstermektedir.

Evrak kavramı sözlük anlamı olarak kağıt yapıları, basılı kağıt, kitap sayfaları, yazılmış kitaplar, mektuplar veya yazılar olarak ifade edilmektedir (Türk Dil Kurumu Türkçe Sözlük). Diğer bir anlamı ve bizim için önemli olan ise Resmi kurumlarda işlem gören belgelerdir. Bu kapsam içerisine kurumlar arası yazışmalar, gerçek kişi ile kurum yada kurum ile gerçek kişiler arasındaki tüm belgeler girmektedir (25658 sayılı Resmi Gazete). Bu yazıların amacı bilgi isteği, bilgi verme, belge isteme vb. şekillerde olabilmektedir.

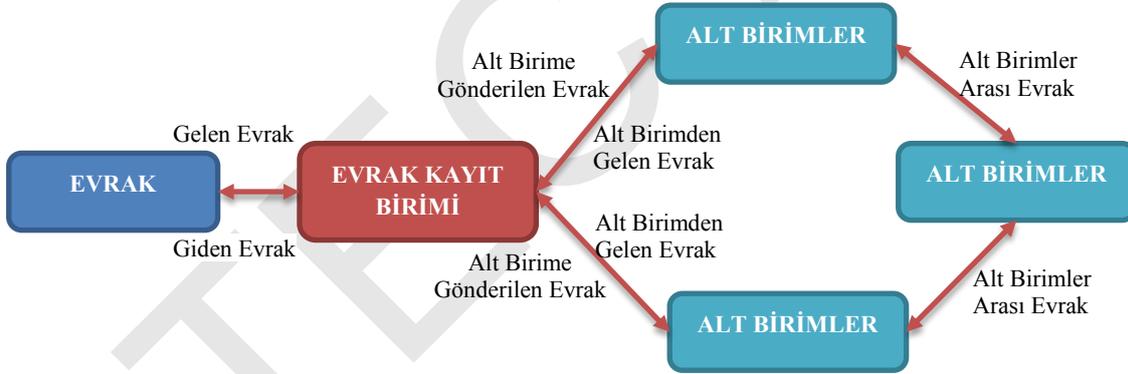
Evrak takip kavramı ise bir kuruma gelen ya da kurumdan çıkan evrakların tüm süreçlerinin kayıt altına alınması ve takip edilmesi olarak tanımlanmaktadır. Evrakın türüne ve amacına bakılmaksızın devlet kurumlarının evrakın tüm dolaşımını kayıt altına alması gerekmektedir. Kayıt altına alma işlemi evrakların çeşitli ayırt edici özellikleri ile sağlanmaktadır.

Klasik yöntemler ile evrak takip ve kayıt (ETK) işlemleri kurumlarda evrak kayıt defterlerinde yada basit bilgisayar dosyalarında yapılmaktadır. Bu yöntemlerde süreç işlese de birçok isteği karşılamaktan oldukça yoksundur. Örneğin herhangi bir evraka ulaşmak istendiğinde evrak arşivdeki defterlerden aranacak, kayıt numaraları ve benzeri bilgilere ulaşıldıktan sonra, evrakın döngü sürecindeki tüm defterlerden akıbeti ile ilgili bilgilere ulaşılmaya çalışılacaktır. Buda zaman, doğruluk, hızlı erişim gibi birçok duruma engel olmaktadır.

Elektronik olarak evrakların kayıt ve takip işlemlerinin yapılması durumunda evrakın kurumdaki tüm süreçlerinin bilgisayarlar üzerinden takip edilebilmesi, saklanabilmesi, istenildiğinde ulaşılabilmesi sağlanabilmektedir. Bu alanda daha önceden yapılan çalışmalarda genellikle çözüm nesne tabanlı yazılım çözümleriyle sağlanmaya çalışılmıştır. Nesne tabanlı gerçekleştirilen yazılımlar kurumlara belirli faydalar sağlasa da, istenilen yerde ve zamanda bilgiye ulaşılabilmesi, kullanıcı bilgisayarlarına kurulması gerekliliği, belirli donanım altyapısı gereksinimi gibi sorunları beraberinde getirmiştir (Yıldıztepe, 2007). Bu çalışmada kurumların belirtilen sorunlarını ortadan kaldıracak web tabanlı bir evrak kayıt ve takip yazılımı gerçekleştirilmiştir. Yazılımda veri tabanı olarak MS SQL server, programlama dili olarak da ASP programlama dili kullanılmıştır. Yazılım elektronik imza entegrasyonu (Boyacı, 2007) ve diğer kurumlarla evrak alışverişinin sağlanabilmesi için geliştirilebilecek yapıdadır.

## 2. Evrak Takip ve Kayıt Süreci

Kurumlarda ETK süreçleri belirli bir sistematığe göre işlemektedir. Kurumlar kendilerine gelen ve giden tüm evrak bilgilerine belirli zamanlarda ihtiyaç duyabilmektedir. Kurumun yaptığı yazışmalar çoğunlukla bir önceki yazının devamı yada cevabı niteliğindedir (Yıldıztepe, 2007). Kuruma gelen evrak ana evrak kayıt birimi tarafından alınmakta ve buradan hedef alt birimlere gönderilmektedir. Alt birimlere giden evraklar eğer başka bir alt birime gönderilmesi gerekiyorsa diğer alt birime, kurumdan dışarıya gitmesi gerekiyorsa evrak kayıt birimine gönderilerek hedefine gönderilmektedir. Sürecin işleyişi Şekil 1’de gösterilmektedir. Gerçekleştirilen yazılım ile belirtilen süreçlerdeki evrak kayıt biriminin ve alt birimlerin kullanımı sağlanmaktadır. Kurumdan kurum dışına gönderilecek evraklar ise evrak kayıt biriminden hedefine gönderilmektedir. Ayrıca evraklar kurum içi evrak da olabilmektedir. Alt birimden çıkan evrak başka bir alt birime gitmesi gerekliliğinde hedef olarak diğer alt birim yazılarak evrak kayıt birimine uğramadan alt birimler arasında evrak alış veriş sağlanabilmektedir.



Şekil 1. Kurumdaki evrak akış süreci

Belirtilen süreçlerdeki kurumların yaşadığı birçok sorun bulunmaktadır. Herhangi bir tarih, birim yada sayı numarasına sahip bir evrak aranmak istendiğinde evrak defterlerden el ile aranarak arşivdeki yerine veya evrakın nerede olduğu bilgisine ulaşılarak evraka ulaşılmaya çalışılır. Buda kurum açısından oldukça zahmetli ve zor bir süreçtir. Bazı durumlarda kuruma gelen evrakın kaybolması yada bulunamaması da rastlanılan bir diğer problemdir. Ayrıca kurum dışından herhangi bir evrakın durumu ile ilgili bilgi edinilmek istendiğinde klasik yöntemlerle herhangi bir çözüm bulunamamaktadır. ETK işlemi geliştirilen web tabanlı yazılım üzerinden yapıldığında belirtilen sorunlar ortadan kalkmış olmaktadır.

Günümüzde birçok kurumda tüm iş süreçlerinde bilgisayarlar aktif olarak kullanılmaktadır. Bunun nedeni bilgisayarların kullanımından doğan faydaların iş sahiplerine veya kurum yöneticilerine büyük kolaylıklar sağlamasıdır. Bilginin analiz edilebilmesi, raporlamalar yapılabilmesi ve istenildiği zaman ulaşılabilmesi bu faydaların başında gelmektedir. Kurumlarda diğer iş süreçlerinde kullanılmakta olan hali hazırda bir bilgisayar altyapısı mevcuttur. Ek bir yatırım maliyeti getirmeden, mevcut kaynaklar üzerinden ETK süreçlerinin yapılması şüphesiz ki kuruma birçok avantaj sağlamaktadır. Yazılımın web tabanlı geliştirilmiş olması, kullanıcı bilgisayarlarında ki bir web tarayıcıyla kullanılabilmesi anlamına gelmektedir. Buda kuruma herhangi bir ek maliyet getirmemektedir.

## 3. Web Tabanlı ETK Yazılımının Yapısı

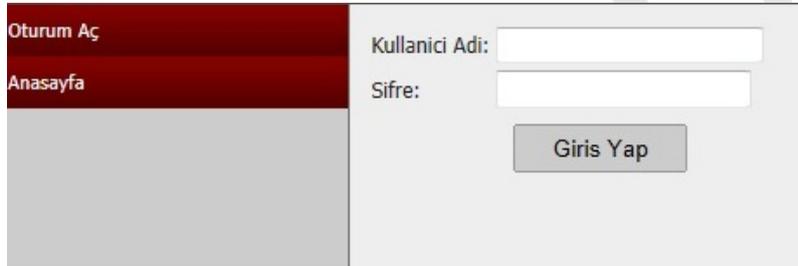
Geliştirilen yazılım web tabanlı olarak çalışmaktadır. Basit web ara yüzleriyle ileri seviye bilgisayar bilgisine sahip olmayan personelin kullanımına olanak tanımaktadır. Yazılım 8 ana bölümden oluşmaktadır. Bunlar;

- Kullanıcı Giriş Ekranı
- Birim Ekleme
- Gelen Evrak Kayıt
- Giden Evrak Kayıt
- Evrak Takibi
- Detaylı Arama
- Raporlama

şeklindedir.

### 3.1. Kullanıcı Giriş Ekranı

Sistemde yönetici tarafından tanımlanan kullanıcının, kullanıcı adı ve şifresi ile giriş yaptığı ana giriş ekranıdır. Kullanıcı bu ekranı geçtikten sonra yazılımı kullanmaya başlayabilmektedir. Kullanıcı giriş ekranının görüntüsü Şekil 2’de gösterilmiştir.



Şekil 2. Kullanıcı Giriş Ekranı

Kullanıcı girişinden geçildikten sonra, yazılımda bir menü açılmakta ve kullanıcı menü üzerinde istediği işlemle ilgili seçimi yaparak ilerlemektedir

### 3.2. Birim Ekleme

Birim ekleme seçeneği kurumda bulunan ve yazılımı kullanacak olan birimlerin eklendiği bölümdür. Kurum/yönetici buradan, birimin adını girerek tanımlama yapabilmektedir. Eklenen birim daha sonra kurum içerisinde ETK sürecinde kullanılacak alt birim olarak kullanılabilir. Birim ekleme sürecinin ara yüz görüntüsü Şekil 3’de gösterilmiştir.



Şekil 3. Birim Ekleme Ara yüz Görüntüsü

### 3.3. Gelen Evrak Kayıt

Gelen evrak kayıt bölümü kuruma gelen yada alt birimler arasından gelen evrakların sisteme kaydedildiği yerdir. Evrak kayıt altına alınırken evrakın kayıt tarihi ve belge numarası sistem tarafından otomatik verilmektedir. Evrak kayıt edilirken diğer bilgi olarak;

- Belgenin tarihi
- Belgenin Gelen Sayı numarası
- Belgenin Türü
- Belgenin Özeti
- Gönderilecek Birim
- Belge Ek sayısı
- Varsa ve tarayıcıdan taranmışsa Belgenin kendisi

gibi bilgiler girildikten sonra evrak sisteme kaydedilmektedir.

| GELEN EVRAK KAYIT                          |  |
|--|--|
| Kayıt Tarihi                               | 02.12.2012<br><small>Belgenin işlem Yapıldığı Tarih.</small>   |
| Belge Tarihi                               | <input type="text"/><br><small>Belgenin Kuruma Geldiği Tarih.</small>  |
| Belge Numarası                             | 8733<br><small>Sistemi Belge Sayı Numarası.</small>  |
| Belge Sayı Numarası                        | <input type="text"/><br><small>Belge Üzerindeki Sayı ve Tanımlayıcı Karakterleri Girebilirsiniz.</small>                         |
| Belge Cinsi                                | YAZI   |
| Belgenin Özeti                             | <input type="text"/><br><small>Belge Hakkında Sisteme Eklenecek İstenen Açıklamaları Detaylı Bir Sekilde Yazabilirsiniz.</small> |
| Gonderen Birim                             | <input type="text"/><br><small>Belgeyi Alan Birim-Birim Listede Yoksa Diğer Seçerek Birim Adını Yazınız.</small>                 |
| Belge Ek Sayısı                            | <input type="text"/><br><small>Belgenin Eki Varsa Seçiniz ve Ek Sayısını Giriniz</small>   |
| Belge                                      | <input type="text"/> <input type="button" value="Gözet..."/><br><small>Lütfen Belgenin Aslını Seçiniz.</small>                   |
| <input type="button" value="Kaydı Bitir"/> |  |

Şekil 4. Gelen Evrak Kayıt Ara yüz Görüntüsü

Sisteme kaydedilen evrak gönderilecek birimde seçilen birimin kullanıcı ekranında görünecektir. Böylece evrak kayıt birimine gelen evrak bilgileri alındıktan sonra hedef birime gönderilmiş olmaktadır. Gelen evrakın kayıt işleminin yapıldığı ara yüz görüntüsü Şekil 4'de gösterilmiştir.

### 3.4. Giden Evrak Kayıt

Giden evrak kayıt bölümü kurumdan gönderilen yada alt birimlere giden evrakların sisteme kaydedildiği yerdir. Bu bölümde de gelen evrak kayıt bölümündeki aynı bilgiler sisteme kaydedilerek evrak ilgili birime gönderilmektedir.

Anasayfa

Yeni Birim Ekle

Evrak Takibi 0

Evrak Kayıt

Gelen Evrak Kayıt

Giden Evrak Kayıt

Rapor Al

Detaylı Arama

Oturum Kapat

### GİDEN EVRAK KAYIT

**Kayıt Tarihi**   
Belgenin işlem yapıldığı Tarih.

**Belge Tarihi**   
Belgenin Kuruma Geldiği Tarih.

**Belge Numarası**   
Sistemdeki Belge Sayı Numarası.

**Belge Sayı Numarası**   
Belge Üzerindeki Sayı ve Tanımlayıcı Karakterleri Girebilirsiniz.

**Belge Cinsi**

**Belgenin Özeti**   
Belge Hakkında Sisteme Eklenmek İstenen Açıklamaları Detaylı Bir Sekilde Yazabilirsiniz.

**Alan Birim**   
Belgeyi Alan Birim-Birim Listede Yoksa Diğer Seçerek Birim Adını Yazınız.

**Belge Ek Sayısı**   
Belgenin Eki Varsa Seçiniz ve Ek Sayısını Giriniz

**Belge**    
Lütfen Belgenin Aslini Seçiniz.

Şekil 5. Giden Evrak Kayıt Ara yüz Görüntüsü

Şekil 5’de giden evrak kayıt işleminin ara yüz görüntüsü gösterilmektedir.

### 3.5. Evrak Takibi

Evrak takibi bölümü birimle ilgili evrakların süreçlerinin kontrol ve takip edildiği birimdir. Yazılımın kullanıldığı birimdeki kullanıcı kendi birimiyle alakalı (aldığı yada gönderdiği) evrakları evrak takibi alanından kontrol edebilmekte ve durumun görebilmektedir. Evrak takip işlemi gelen ve giden evraklar için ayrı ayrı yapılmaktadır. Birime gelen yada gönderilen evrakların takibinin yapıldığı arayüz görüntüsü Şekil 6’da gösterilmiştir.

Anasayfa

Yeni Birim Ekle

Evrak Takibi 0

Gelen Evrak Takibi

Giden Evrak Takibi

Evrak Kayıt

Rapor Al

Detaylı Arama

Oturum Kapat

**Gelen Belgeleri Görüntülemektесiniz.**

| BelgeNo | Gonderen Birim  | Açıklama     | Ekleme Tarihi |
|---------|---|--------------|---------------|
| 8732    | SAĞLIK BAKANLIĞI (TÜRKİYE KAMU HASTANELERİ KURUMU) ANKARA | HAKAN GÖRGÖZ | 30.11.2012    |

Şekil 6. Gelen/Giden Evrak Takibi Ara yüz Görüntüsü

Kullanıcı gelen evraklarıyla ilgili durumlarını görmek istediği evrakın bilgisine tıklayarak evrak ile ilgili alt bilgilere ve işlemlere ulaşabilmektedir. Böylece evrak üzerinde kurumdaki diğer birimlerde yapılan işlemler görülmüş olacaktır. Bir evrakın alt bilgileriyle ilgili ekran görüntüsü Şekil 7’de gösterilmektedir.

Gonder
Belge Eki Ekle
Duzenle

**Belgenin Asli :** 2012.12.03-15.40.05-Belgeid-19142-EVRAK.txt

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**Belgenin Ekleri :** Belgenin Eki Yoktur.

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|                |  |
|----------------|--|
| Belge Sira No  | 8754                                   |
| Belge No       | 21134                                  |
| Kayıt Tarihi   | 03.12.2012                             |
| Belge Tarihi   | 28.11.2012                             |
| Belge Cinsi    | YAZI                                   |
| Belge Konusu   | ÖYP LİSANSÜSTÜ EĞİTİM 2013 BAHAR       |
| Ek Sayısı      | Yok                                    |
| Gonderen Birim | YÜKSEKÖĞRETİM KURULU BAŞKANLIĞI ANKARA |
| Alan Birim     | PERSONEL DAİRE BAŞKANLIĞI              |

---

**Mesajlar :**

Belge ile ilgili Bir Notunuz Varsa LÜTFEN Asagiya Yaziniz...

Mesaji Gönder

Şekil 7. Evrak alt bilgi ekranı

### 3.6. Detaylı Arama

Detaylı arama bölümü kurumun kayıtlarında bulunan evraklar içerisinde arama yapabildiği ve evrak ile ilgili bilgilere ulaştığı bölümdür. Tarih aralığı, gelen belgeler yada giden belgelerden, belge türü, okunan yada okunmaya belgeler arasından kullanıcı/yönetici arama yaparak istediği evraka ulaşması sağlanmaktadır. Arama sonucunda kullanıcı ekranın belge listesi görüntülenmekte ve belge seçildiğinde belgeyle ilgili alt bilgilere ulaşılabilmektedir. Detaylı arama ekranının görüntüsü Şekil 8’de gösterilmiştir.

Anasayfa

Yeni Birim Ekle

Evrak Takibi 0

Evrak Kayıt

Rapor Al

Detaylı Arama

Oturum Kapat

**Lütfen Arama Kriterlerini Seçip Butonu Tıklayınız.**

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Tarih Araligi  &

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Belge Durumu

Tüm Belgeler

Gelen Belgeler

Giden Belgeler

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Belge Cinsi

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Okunma Durumu

Tüm Belgeler

Okunan Belgeler

Okunmayan Belgeler

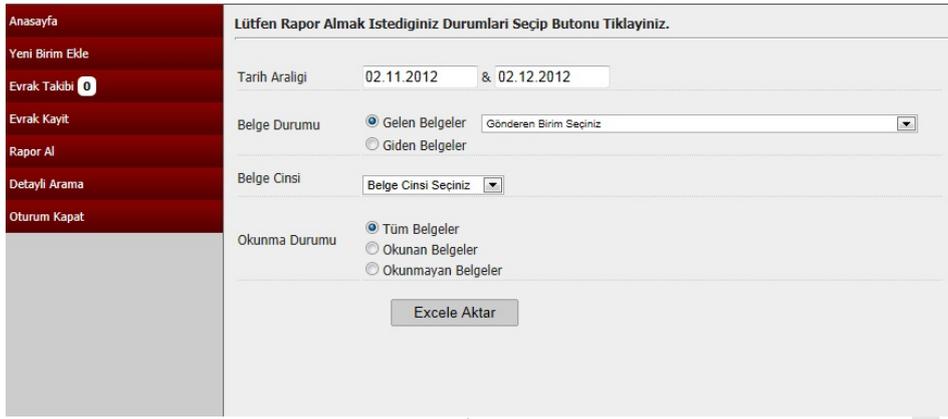
---

Ara

Şekil 8. Detaylı Arama Ekran Görüntüsü

### 3.7. Raporlama

Raporlama bölümü kurumun belirli zamanlarda kayıtlarındaki evrak envanterinin çıktı olarak saklayabilmesine olanak tanıyan bölümdür. Bu bölümde kullanıcı/yönetici belirli tarih aralıkları, birim, gelen-giden belgeler gibi seçeneklerden seçim yaparak istemiş olduğu kayıtları excel formatında elde edebilmektedir. Böylece kurumun evrak envanteri yazıcı çıktısı olarak istenildiğinde alınabilmektedir. Raporlama işleminin ekran görüntüsü Şekil 9’da gösterilmiştir.



Şekil 9. Raporlama İşlem Ekran Görüntüsü

#### 4. Sonuç

Sonuç olarak özellikle kamu kurum ve kuruluşlarında evrak takip ve kayıt işlemlerinin el ile defterlere yazılması yoluyla yapılması oldukça zahmetli ve birçok faydadan yoksun yöntemlerdir. Bilgisayar teknolojilerinin bu kadar geliştiği günümüzde bu işlemlerin klasik yöntemle yapılması var olan imkanları kullanmamak anlamına gelmektedir. ETK sürecinin bilgisayar destekli hale getirilmesi tüm kurumlarda istenen ve olması gereken bir yapıya gelmiştir. Birçok yazılım üreten firma bu konuyla ilgili çözümler sunsa da yazılımların web tabanlı olmayışı, kurumun işleyişine uygun olmaması, büyük maliyetler çıkarması devlet kurumlarında fazla rağbet görmemesine neden olmuştur. Genellikle büyük özel sektör kuruluşlarında tercih edilmektedir. Bu nedenle gerçekleştirilen yazılım ile basit, yatırım maliyeti olmayan, ileri derece bilgisayar bilgisi gerektirmeden devlet kurumlarının sorunları çözülmeye çalışılmıştır. Yazılımın web tabanlı olması herhangi bir internet bağlantısı olan yerden kullanımına, bilgisayar destekli olması istenildiğinde evraka hızlı ulaşılmasını, evrak kayıplarını ve arşivleme gibi sorunları ortadan kaldırmaktadır. Yazılımın geliştirilmesi sürecinde elektronik imza entegrasyonu, kuruma gelen yada giden tüm evrakların hızlı tarayıcılar ile kayıt altına alınması amaçlanmaktadır.

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# KURUMLARIN BİLİŞİM ALTYAPISINA UYGUN OLARAK YEDEKLEME MODELİNİN OLUŞTURULMASI

## INSTALLATION OF BACKUP MODEL CONSISTENT WITH INFORMATICS INFRASTRUCTURE OF THE INSTITUTIONS

<sup>1</sup>Aytug BOYACI

<sup>2</sup>Erhan AKBAL

Fırat Üniversitesi Enformatik Bölümü, Elazığ-Türkiye  
Fırat University Department of Informatics, Elazığ-Turkey  
aytugboyaci@firat.edu.tr

Fırat Üniversitesi Enformatik Bölümü, Elazığ-Türkiye  
Fırat University Department of Informatics, Elazığ-Turkey  
erhanakbal@firat.edu.tr

**Özet:** Teknolojinin hızlı gelişimi ile birlikte kurumlar ve bireyler için bilgi paylaşımı, kullanımı ve yeni bilgilerin elde edilmesinde yönelik olarak bilişim teknolojilerinin kullanması vazgeçilmez bir hale gelmiştir. Bu bağlamda bilişim teknolojileri kullanılarak verilen hizmetlerin hızlı, kaliteli, düşük maliyetli ve en önemlisi kesintisiz olması gerekliliği açıktır. Kurumların kesintisiz hizmet verebilmesi için veri kaybının önlenmesi önemli bir parametredir. Verinin herhangi bir sebeple bozulması veya kaybolması kurumlara ciddi zararlar verebilmektedir. Veri kaybını önlemek için verilerin düzenli olarak yedeklenmesi gerekmektedir. Bilgi işlem birimlerinin en önemli sorunlarından birisi yedeklenecek verilerin ve sunucuların belirlenmesi, yedekleme periyotlarının oluşturulması, yedeklerin depolanacağı alanların tespiti konusudur. Kurumların bilişim teknolojilerini kullanarak vermiş oldukları hizmetlere göre uygulama çeşitliliği, sunucu havuzundaki çeşitlilik, yedeklenecek olan dosyaların boyutu, maliyet ve yedekleme için harcanan iş gücü bilgi işlem birimlerinin işini zorlaştırmaktadır. Bu sebeple yedeklenecek olan verilerin sınıflandırılması ve kayıpsız bir yedekleme planı oluşturulmalıdır. Bu çalışmada kurumların veri kaybından dolayı hizmetlerinin kesintiye uğramaması için oluşturulan yedekleme yöntemlerine değinilerek kurumların bilişim altyapısına uygun olarak bir yedekleme modeli ortaya konacaktır.

**Anahtar Kelimeler:** Yedekleme mimarileri, veri bütünlüğü, optimizasyon, veri yedekleme, yedekleme altyapısı

**Abstract:** With rapid developments in technology, usage of information technologies has been indispensable for knowledge sharing and usage and to reach current knowledge for institutions and individuals. In this context, using information technologies, it is obvious that the services given should be rapid, qualified, low-cost and most importantly uninterrupted. Prevention of data loss is an important parameter for the institutions to give uninterrupted services. The breakup and loss of the data because of any reason could give serious damage to the institutions. In order to prevent data loss, data should be backed up regularly. One of the most important problems data processing units encounter is to determine the data and servers to be backed up, to install backup periods and to establish the areas where the backups would be stored. According to the services the institutions give by using information technologies, application varieties, variety in server pool, the size of the files to be backed up, workforce used for cost and backup make the performance of data processing units difficult. Therefore, classification of the data to be backed up and a lossless backup plan should be established. In this study, mentioning backup methods installed not to interrupt the services because of data loss of the institutions, a backup model consistent with the informatics infrastructure of the institutions will be introduced.

**Keywords:** Backup architecture, data integrity, optimization, data backup, backup infrastructure

### 1. Giriş

Günümüzde bilişim teknolojileri kullanılarak depolanmış verilerin herhangi bir sebeple bozulması veya kaybolması kurumların çalışma süreçleri üzerinde hayati risk oluşturmaktadır. (Nakamura, 2003) Birçok kurum muhtemel yaşanacak olan arıza yada veri kayıpları sonrası için yapılması gerekenler ile ilgili belirli bir prosedür oluşturmamış ve hatta öncesinde bir yedekleme çözümü oluşturmamıştır. Bu yüzden bilgi kayıplarının en aza indirilmesi için kurumların çalışma süreçlerine ve altyapılarına uygun olarak yedekleme prosedürlerinin belirlenerek yedekleme modelinin oluşturulması ve düzenli bir şekilde yedekleme işleminin gerçekleştirilmesi gerekmektedir (Liu, 2003). Yine birçok kurumda uzman personel sayısının yetersiz olmasından dolayı veri yedekleme işlemlerinin büyük işgücü kaybına neden olmaktadır.

Bu çalışmada uzman bilişim personeli yetersiz olan kurumlar için yedekleme yöntemlerine değinilerek basit anlamda yedekleme işlemlerinin herhangi bir işgücü harcamadan yapılmasına olanak sağlayacak bir model üzerinde durulacaktır.

## 2. Veri Yedekleme Modelinin Oluşturulması

Kurum için uygulanacak olan yedekleme modelinin yapısı kurumun altyapısına, uygulama çeşitliliğine, yedeklenecek olan veri miktarına, yedekleme sıklığına, maliyet ve iş gücü gibi kriterlere göre değişiklik gösterebilmektedir. Bir kurumda oluşturulacak veri yedekleme modeli Şekil 1’de gösterilmiştir.



Şekil 1. Veri Yedekleme Modeli Süreçleri

### 2.1. Sistem Analizi

Yedekleme işleminde öncelikli olarak yedeklenecek olan verilerin tespiti son derece önemlidir. Bu yüzden ilk aşamada hangi uygulamaların ve hangi sunucuların yedekleneceğinin tespitinin yapılması gerekmektedir. Bu aşamada yaşanan en önemli zorluk sunucuların ve uygulama havuzunun çeşitliliğidir(Kawai, 2003). Kurumlarda birden çok sunucu olabilir. Bu sunucuların işletim sistemleri farklılık gösterebilir. Sunucularda barındırılan uygulamalara göre yedeklenmesi gereken veri tipleri ve yapıları farklılık gösterebilir. Buda yedeklenecek olan dosya türlerinin çeşitliliği anlamına gelmektedir. Yine sunucu içerisinde sanallaştırma yapılmış olabilir. Buda bir sunucu içerisinde birden çok ve birbirinden tamamen farklı uygulamalar için oluşturulmuş işletim sistemi olması anlamına gelmektedir. Ayrıca yedeklenecek olan veriler sunucuların içerisinde değilde depolama alanları üzerinde de olabilir. Bu yüzden yedekleme modelinin oluşturulabilmesi için sunucu ve uygulamaların analiz edilerek hangi verilerin yedekleneceği tespit edilmelidir.

### 2.2. Yedekleme Türünün Belirlenmesi

Yedeklenecek olan veriler tespit edildikten sonra yedekleme işlemi yapılacak dosyanın yapısına göre yedekleme türü seçilmelidir. Tam yedekleme, fark yedekleme ve artan yedekleme olmak üzere üç yedekleme türü bulunmaktadır(Dinçkan, 2008).

- **Tam Yedekleme:** Yedeği alınacak olan verinin bir bütün olarak kopyalanması işlemidir. Bu tür yedekleme genellikle arşiv amaçlı dosya yedeklemesi için kullanılmaktadır. Bu yedekleme türünde yedeklenmiş dosyanın boyutu orjinal dosya boyutu ile aynıdır. Bu sebeple yedekleme süreci dosya boyutu ile doğru orantılı bir şekilde artmaktadır(Kawai, 2003).

- **Fark Yedekleme:** Bu yöntemde önceden alınmış yedek ile o an içerisinde alınacak olan yedek arasındaki fark veriler yedeklenmektedir. Fark yedekleme log dosyaları gibi veri boyutunun sürekli olarak değiştiği uygulamalarda kullanılmaktadır. Amaç sürekli olarak değişen dosyanın bir benzer kopyasının depolama alanında saklanmasıdır. Bu yedekleme türünde sadece bir önceki yedekleme işleminden farklar depolama alanına gönderileceği için tam yedeklemeye göre çok daha hızlı bir şekilde yedekleme işlemi gerçekleştirilebilmektedir. Fark yedekleme yapılabilmesi için ilk yedekleme işleminde tam yedekleme işleminin gerçekleştirilmiş olması gerekmektedir(Dinçkan, 2008).
- **Artan Yedekleme:** Artan yedekleme yöntemi fark yedekleme ile benzer bir yapıdadır. Artan yedeklemenin tek farkı sadece veri üzerinde yapılan değişikliklerin yedeklenmesidir. Bu yedekleme türü en yüksek yedekleme hızı, en az depolama alanı kullanımına sahip olmasına rağmen ana dosyadaki bozulmadan dolayı yedek dosyadan ana dosyayı tekrar oluşturma anlamında en zor olan yöntemdir(Kawai, 2003).

Kurumlar analiz sürecinde belirlemiş oldukları yedeklenecek olan verileri bu aşamada hangi yedekleme türü ile yedekleyeceklerini belirlemesi depolama alanında ciddi anlamda tasarruf sağlayacaktır.

### 2.3. Yedekleme Periyotlarının Oluşturulması

Yedekleme altyapısı oluşturulması ve yapılacak olan yatırımın belirlenmesi için en önemli kriter yedeklenecek olan verilerin yedekleme periyotlarının hesabı ve bu hesaba uygun olarak yedekleme mimarisinin belirlenmesidir(Dinçkan, 2008). Bu işlem için öncelikle yedeklenecek olan dosyalar uygulamanın yapısına ve kullanım sıklığına göre kategorilere ayrılmalıdır. Örneğin bir ftp sunucusundaki dosyalar eğer çok fazla değişiklik göstermiyor ise haftada bir yedekleniyorken bir veritabanı saatlik periyotlar ile yedeklenmesi gerekebilir. Bu yüzden yedeklenecek olan dosyaların yedekleme periyotlarının belirlenmesi son derece önemlidir. Ayrıca bu işlem sonunda hazırlanacak olan otomatik yedekleme için görev tanımları ile iş gücü anlamında da büyük tasarruf sağlanmış olacaktır.

### 2.4. Depolama Alanının Tespiti

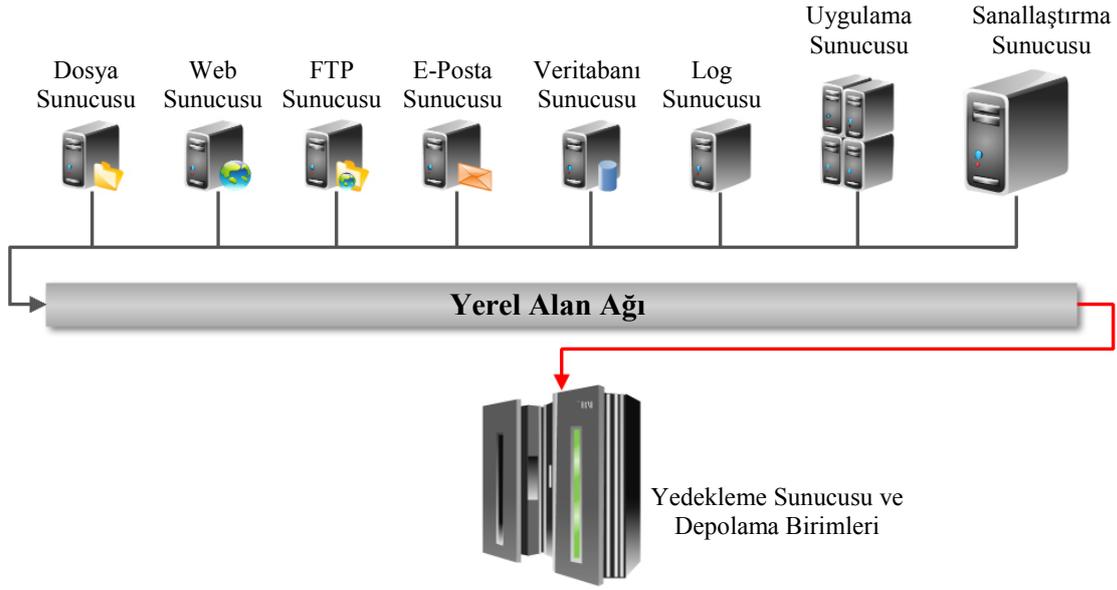
Yedeklenecek olan veri büyüklüğüne, önemine, kurumun yapısına, maliyete, bilgi işlem altyapısına göre farklı şekillerde yedeklenebilmektedir. Depolama alanının tespiti aşaması yedekleme modelinin yönetilebilirliği açısından en önemli başlıklarındandır. Yedekleme işlemi sürücüler üzerinden teyp yada disklere yapılabileceği gibi, sunucunun kendi üzerindeki bir alana, ağ üzerindeki başka bir sunucuya hatta günümüzün güncel yedekleme süreçlerinden olan bulut üzerindeki bir noktaya yapılabilir(Stephen, 2012). Depolama alanlarının yapısına göre yedekleme işlemi üç farklı şekilde yapılmaktadır.

#### 2.4.1. Teyp, DVD Sürücülerini Üzerinden Yedekleme:

Bu yedekleme türü genellikle tek bir sunucunun veya bir uygulamanın yedeği alınırken kullanılmaktadır. Yedeklenecek olan veri sunucu üzerindeki teyp yada DVD sürücülerini üzerinden manyetik ortamlara kaydedilmektedir. Bu işlem iş gücünün yoğunluğu, yedekleme sürecinin takibi gibi birçok zorluk sebebi ile büyük sistemlerde kullanışlı değildir.

#### 2.4.2. Yerel Alan Ağı Üzerindeki Bir Alana Yedekleme:

Günümüzde en sık kullanılan yöntem ağ üzerindeki bir yedekleme sunucusuna yada yedek depolama alanına verilerin yedeklenmesi işlemidir(Miller, 2003). Bu işlem hem ağ üzerinden verinin aktarılması işleminin daha hızlı gerçekleşmesi hemde yedekleme periyotlarının zamanlanmış görevler üzerinden otomatik bir şekilde yapılması açısından ilk yönteme göre çok daha hızlı ve güvenilir bir yöntemdir. Bu yöntemde sistem üzerindeki yedeklenecek tüm sunucu ve dosyaların yedekleme işlemi, yedekleme sunucusu üzerindeki disklere veya yedekleme sunucusu üzerinden tanımlanmış olan depolama aygıtlarına yapılır. Bu işlem log sunucusu yada veritabanı sunucusu gibi özellikle yedekleme periyotları sık olan verilerinin yedeklenmesi işlemini son derece kolaylaştırmaktadır. Yerel alan ağı üzerindeki bir alana yedekleme işleminin gerçekleştirilmesi Şekil 2'de gösterilmektedir.

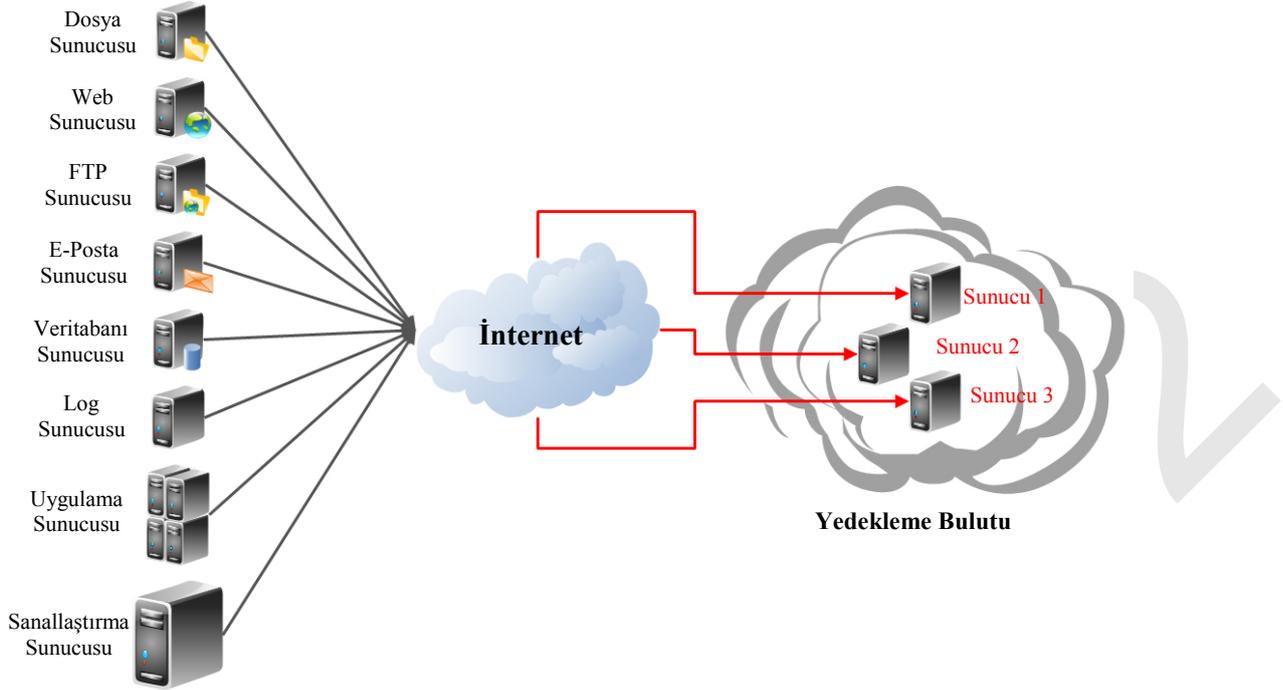


Şekil 2. Yerel Alan Ağı Üzerindeki Bir Alana Yedekleme

### 2.4.3. Bulut Üzerindeki Bir Alana Yedekleme:

Kurumun ölçeğinin büyümesi ve farklı lokasyonlar içerisinde birimlerinin oluşması sunucuların ve uygulamaların dağıtık bir yapı oluşturarak genişlemesine neden olmaktadır. Buda her yerel alan ağı için bir yedekleme altyapısı oluşturulması anlamına gelmektedir. Yerel alan ağı üzerindeki bir alana yedekleme modeli tek bir ağ içerisinde veri yedekleme yaparken birçok avantaj sunmasına rağmen farklı yerel ağlar üzerinden yedeklenmesi gerekliliği ortaya çıktığında ihtiyaçlara karşılık verememekte yada maliyet çok artmaktadır (Stephen, 2012). Ayrıca yerel alan ağı içerisinde çok fazla veri depolama ve bu verilerin yedeklenmesi gerekiyorsa yüksek performanslı veri depolama cihazları ve sunucular kullanılması gerekmektedir. Buda yüksek satın alma maliyetlerini ortaya çıkarmaktadır (Josef, 2012). Buna ek olarak birlikte ömürleri sınırlı olan bu cihazları barındırmak için uygun fiziksel ortam sağlama, enerji ve personel giderleri farklı yerel alan ağları üzerindeki verilerin yedekleme sürecini oldukça zorlaştırmaktadır.

Teknolojinin ve internet altyapısının gelişmesi ile birlikte büyük kurumların farklı lokasyonlardaki verilerini yedekleme ihtiyacını yerel alan ağı üzerindeki yedekleme alanı üzerine yapmak yerine internet bulutu üzerindeki ortak bir alana yedekleme sistemlerinin kurulması ve tüm sunucu ve uygulamaların yedeklerinin bu alana yapılması daha cazip hale gelmiştir. Bulut üzerindeki bir alana yedekleme işleminin gerçekleştirilmesi Şekil 3'te gösterilmiştir.



**Şekil 3.** Bulut Üzerindeki Bir Alana Yedekleme

Bulut üzerindeki bir alana yedekleme altyapısı oluşturulmasının yerel alan ağı üzerinde yedekleme altyapısı oluşturulmasına göre birçok avantajı bulunmaktadır. Bunlar;

- Bulut yedekleme altyapısı için ilk kurulum ve satın alma maliyeti yoktur. Bunun yerine depolama alanı kiralama yoluna gidilmektedir.
- Cihazların arızalanması veya yeni cihazlara ihtiyaç doğması ek maliyet getirmez.
- Bulut yedekleme sisteminin içinde yedekleme ve kurtarma sistemleride bulunmaktadır.
- Yedekleme için personel veya herhangi bir işgücü gerekmez.
- Dünyanın her tarafındaki kurum lokasyonlarının aynı alana yedek alması sağlanır. Yine aynı şekilde dünyanın her tarafından buradaki depolama alanlarına erişim mümkündür.

şeklinde sıralanabilir (Md, 2012). Bulut üzerindeki bir alana yedekleme altyapısı oluşturmanın bu avantajlarına rağmen birçok dezavantajı bulunmaktadır. Bunlar;

- Bulut üzerinde veri depolamak için büyük bant genişliğine ihtiyaç duyulmaktadır. Bu yedekleme işlemi yerel alan ağı içerisindeki yedekleme işlemine göre 10 ila 100 kat arasında daha yavaştır.
- Küresel internet kesintileri yaşandığında yedekleme sistemine ulaşılamaz.
- Bulut üzerindeki veri depolama alanları kısıtlı olabilir.
- Kurum için özel olan dosyaların kurum dışında bir ortamda saklanması veri güvenliğini tehlikeye sokmaktadır.

şeklinde (Sean, 2011). Kurum ihtiyaç analizinden çıkan sonuca göre bulut üzerindeki bir depolama alanına yada kendi yerel alan ağı üzerindeki bir alana yedekleme sistemi kurabilir. Yada oluşabilecek felaketlere karşı iki yöntemin karması bir yapı oluşturabilir.

## 2.5. Yedeklenecek Olan Verinin Sıkıştırılması

Yedeklenecek olan veriler yedekleme türüne tam yedekleme seçilmiş ise sıkıştırılarak depolama alanı üzerinde daha az yer kaplaması sağlanabilir. Bu bağlamda yedekleme işlemi gerçekleştirilirken analiz sürecinde yedeklenecek olan dosyaların sıkıştırma işlemi yapıp yapılmayacağını belirlemek önemlidir (Miller, 2003). Ayrıca arşiv amaçlı saklanacak olan bu tür dosyaların sıkıştırma işlemi ile birlikte şifrelenmeside verinin gizliliği açısından önem taşımaktadır. Bu aşamada sıkıştırılacak olan verilerin hangilerinin şifreleneceğinin tespit edilerek şifreleme işleminin dosyaya uygulanması gerekmektedir.

## 2.6. Hiyerarşik Depolama Alanının Oluşturulması

Kurumların büyümesine paralel olarak yedeklenecek veri boyutuda artmaktadır. Artan veri boyutu, sunucu ve uygulama çeşitliliğini beraberinde getirmektedir. Yedeklenecek olan verilerde belli bir sistematik oluşturulmamış ise bir süre sonra oluşturulan yedeklerin arşivleri düzensizleşmeye başlayacak ve alınmış olan yedeklerin bulunmasında bir takım zorluklar yaşanacaktır. Bu anlamda oluşturulacak olan yedekler önceden belirlenecek parametrik isimlendirmeler ile oluşturulmalıdır. Örneğin yedeğin oluşturulacağı dizin isminde yedeği alınacak olan uygulamanın adı, hangi sunucudan alınan yedek olduğunu belirten bir parametre, oluşturma tarihi ve gerekiyorsa versiyon numarası gibi parametreler olmalıdır. Yine yedeklenmiş dosyanın adında dosyanın ön ismi, oluşturma tarihi, uygulama tipi, versiyon numarası, yedekleme tipi gibi belli parametreleri barındırmalıdır. Bu sayede oluşturulacak olan yedekleme sisteminde, oluşturulmuş olan yedeği bulmak çok daha kolaylaşacaktır.

## 2.7. Yedeğin Oluşturulması

Bu aşamada belirlenen kriterlere göre yedek istenilen alana oluşturulmalıdır. Bu işlem kurumun yapısına göre bir personel tarafından yapılabileceği gibi küçük sistemlerde zamanlanmış görevler ile otomatik hale getirilebilir. Kurumun büyüklüğüne göre yedekleme programlarından yararlanılabilir yada bulut üzerinde yedekleme yapılacaksa iş gücü olmaksızın uzaktaki depolama alanı için oluşturulacak görevler ve yedekleme programları ile bu işlem gerçekleştirilebilir.

## 2.8. Veri Doğruluğunun Kontrolü

Yedekleme işlemi bir program aracılığı ile otomatik olarak gerçekleştiriliyorsa, yedekleme işlemi gerçekleşirken ağ üzerinde oluşacak herhangi bir aksaklıktan dolayı yedekleme işlemi tam olarak gerçekleşmeyebilir yada dosya bozulmuş olabilir (Chakravarthy, 2008). Yedekleme sürecindeki bu durum dosya kontrol edilmedikçe fark edilemez. Bu yüzden yedeklenmiş dosyaların belli periyotlar ile kontrol edilmesi son derece önemlidir.

## 3. Sonuç

Kurumların bilişim altyapılarında oluşabilecek beklenmedik durumlar karşısında veri kayıpları ve buna paralel olarak yaşanacak zararları en aza indirmek amacı ile sunucu ve kurumsal verilerinin düzenli olarak yedeklenmesi gerekmektedir. Bu yüzden kurumlar altyapılarına ve büyüklüklerine göre web, uygulama, veritabanı, ftp, log vb gibi sunucuları üzerindeki dosyaları yedeklemesi kritik öneme sahiptir. Bu çalışmada kurumların kendi yapılarına uygun olarak bir yedekleme modelini oluşturması ve yedekleme altyapısını bu modele göre şekillendirmesi gerekliliği ortaya konulmuştur. Sonuç olarak farklı amaçlar için oluşturulmuş sunucuların ve uygulamaların analiz edilerek hangi verilerin yedeklenmesi gerekliliğinin tespiti, yapılan yedeklemenin hangi tür yedekleme olacağını ortaya konması, yapılacak olan yedekleme işleminde yedeklenecek dosyaların yedekleme periyotlarının tespit edilerek kategorilere ayrılması gerekliliği, kurumların büyüklüğüne uygun yedekleme mimarisine karar verilmesinin son derece önemli olduğuna, verilerin sıkıştırılarak yedekleme sunucusunda daha az yer kaplayacağına, yedeklenmiş dosyalara daha rahat bir erişim için hiyerarşik bir depolama yapısının oluşturulması ve yedeklenmiş verinin doğruluğunun tespit edilmesi gerektiği ortaya çıkmıştır.

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## KURUMSAL YÖNETİM VE FİNANSAL TABLOLARIN GÜVENİLİRLİĞİ

Nermin Akyel  
Sakarya Üniversitesi  
Geyve Meslek Yüksekokulu  
TÜRKİYE  
nakyel@sakarya.edu.tr

**Özet:** Uluslararasılaşmayla birlikte işletme faaliyet ve fonksiyonlarından bir çoğunda iyileştirme ve düzenlemelerin yapılması ihtiyacı gündeme gelmiş olup işletme literatürüne giren ve giderek önem kazanan kavramlardan biri de kurumsal yönetimdir. Kurumsal yönetimin özünde şirketlerin yönetim kurulu üyeleri, yöneticileri, çalışanları ve iletişim kurduğu üçüncü kişi ve kuruluşlar arasındaki ilişkilerin belirli standartlar ve kurallar çerçevesinde sürdürülmesi gerektiği vurgulanmaktadır. Muhasebe, işletmelerde parasal nitelik taşıyan olayları kaydetmek, sınıflandırmak, özetlemek ve analiz etmek suretiyle ilgililere bilgi vermeyi amaçlayan bir bilgi sistemi olup muhasebede üretilecek bilgiler şirketlerin faaliyetlerinin sonuçlarının değerlendirilmesinde önemli yer tutmaktadır. Yönetime karar almada yardımcı olacak doğru, dürüst, güvenilir bilginin üretilmesi ancak hata ve hilelerin olmadığı güvenilir finansal tablolar ile mümkündür. Bu çalışmada kurumsal yönetim ve finansal tabloların güvenilirliğinin önemi üzerinde durularak finansal tabloların güvenilirliğini etkileyen unsurlardan biri olan hile ele alınmıştır.

**Anahtar Kelimeler:** Kurumsal yönetim, finansal tabloların güvenilirliği, muhasebe hileleri

# KÜLTÜRLERARASILIK VE KÜRESELLEŞME SÜRECİNDE EĞİTİM

Ertuğrul Aydın  
Doğu Akdeniz Üniversitesi  
Eğitim Fakültesi Türkçe Eğitimi Bölümü, Gazimağusa-KKTC  
ertugrul.aydin@emu.edu.tr, ertugrulaydin@gmail.com.

**Abstract:** Multicultural is a notion that recognizes co-existence of different cultures in the same environment. This notion has a reaction-attitude within itself, and it also reveals the need for modernity that multicultural education refers to in the 21<sup>st</sup> century education system. This century gives way to creation of a new environment for creation of multicultural societies by means of the development of new technology tools, proliferation of living conditions and social relations, migrations and population growth. Together with new advances in information technologies and changes and developments in multicultural ethos, it seems that education, which has an active role in globalization, forces individuals to embark on new quests. In this new century, the rise of new learning needs brings along the need for educating individuals who are competent in using technology, who can suggest solutions to world problems and voice new ideas, and who can take decisions in accordance with societal rights, rules and regulations.

Being regarded as one of the central notions of social psychology, *attitude* determines the framework of individuals' behaviors. *Attitude change(s)*, which can also be defined as cognitive consistency or message-learning approach, should be considered within the cognitive mapping of multicultural education. The aim of the present study is to draw inferences belonging to future through the analysis of theories and practical samples of such values and concepts as social ego and identity, social influence and causality, and social construction of reality.

**Keywords:** Multiculturalism, cultural adaptation, coexistence, globalization, intercultural psychology, social construction of reality

**Özet:** Çok kültürlülük (multicultural), bir toplumda yer alan farklı kültürlerin bir arada yaşamasına onay veren bir tanınma (recognition) olgusudur. İçeriğinde bir tavır-tutum barındıran bu yaklaşım, XXI. yüzyıl eğitim sisteminde *çok-kültürlü eğitimin* başvurduğu yenilik ihtiyacını da açığa çıkarmaktadır. Yaşadığımız yüzyıl, dünyanın yeni teknolojiler aracılığıyla değiştirilmesi, sosyal ilişki ve yaşama biçimlerinin çoğalması, nüfus gelişimi ve göçlerle, çok kültürlü toplum yapılarının oluşmasına ortam hazırlamıştır.

Küreselleşmede etkin rolü olan eğitimin, çok-kültürlü ortam ve iletişim teknolojilerinde yaşanan gelişmelerle birlikte, toplum ve bireyleri yeni arayışlar geliştirmeye zorladığını göstermektedir. Bu yeni yüzyılda, öğrenme ihtiyaçlarının değişkenliği/değişmesi, dünya problemlerine çözümler üretebilen, toplumsal hak ve kurallara uygun kararlar verebilen, teknolojiye hâkim, yeni fikirler önerebilen bireyler yetiştirmek zorunluluğunu da beraberinde getirmektedir.

Sosyal psikolojinin merkezî kavramlarından biri sayılan *tutum* (attitude), bireylerdeki mevcut davranışların çatısını belirler. Bilişsel tutarlılık yaklaşımı ya da mesaj öğrenme yaklaşımı diye özetleyeceğimiz *tutum değişimlerini*, çok-kültürlü eğitimin zihinsel haritası içinde ele almak gerekir.

Bu çalışmamızdaki temel amaç, sosyal benlik, çalışma, sosyal etki, kimlik, nedensellik ve sosyal gerçekliğin inşası (social construction of reality) gibi değer ve yaklaşımlarla örtüşen teori ve uygulama örnekleriyle analiz yaparak; gelecek yıllara ait çeşitli çıkarımlarda bulunmaktadır.

**Anahtar Kelimeler:** Çok Kültürlülük, Kültürel Uyum, Birlikte Yaşamak, Küreselleşme, Kültürlerarası Psikoloji, Sosyal Karşılaştırma, Sosyal Gerçekliğin İnşası.

## Giriş

Küreselleşmede etkin rolü olan eğitimin, çok-kültürlü ortam ve iletişim teknolojilerinde yaşanan gelişmelerle birlikte, toplum ve bireyleri yeni arayışlar geliştirmeye zorladığını göstermektedir. Bu yeni yüzyılda, öğrenme ihtiyaçlarının değişkenliği/değişmesi, dünya problemlerine çözümler üretebilen, toplumsal hak ve kurallara uygun kararlar verebilen, teknolojiye hâkim, yeni fikirler önerebilen bireyler yetiştirmek zorunluluğunu da beraberinde getirmektedir.

Küreselleşme sonrasında toplumlar arasında hem *bütünleşme*, hem de *farklılaşma* göze çarpmaktadır. Küreselleşmenin meydana getirdiği hızlı değişim ve onun ortaya koyduğu istikrarsızlık birçok problemi doğurmaktadır. Bunların başında

da, çok dilli ve çok-kültürlü yapı, demografik yapının değişimi ve değişimden kaynaklanan belirsizlik gelmektedir. Öte yandan, küreselleşmenin yol açtığı kültürler arasındaki *uyum* ya da *bütünleşme*, eğitim, iş ve çalışma değerleri açısından bazı olumlu işaretleri karşımıza çıkarır. Böylelikle, açıklık, esneklik, duyarlılık gibi tezler, rekabet ve işbirliği eğilimleri ortaya çıkar.

Bu çalışmamızdaki temel amaçların başında, kültürlerarası ya da farklı kültürlerin bir arada ve hiyerarşi içinde tanımlanmadan yaşayabileceği bir yapıyı çözümlenmek gelmektedir. Bunun dışında, sosyal benlik, çalışma, sosyal etki, kimlik, nedensellik ve sosyal gerçekliğin inşası (social construction of reality) gibi değer ve yaklaşımlarla örtüşen teori ve uygulama örnekleriyle analiz yaparak; gelecek yıllara ait çeşitli çıkarımlarda düşüncesindeyiz.

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Çok kültürlü ya da *çok kültüre dayalı* eğitimi, eğitim sistemindeki mevcut eksiklik ve ayrımcılık pratikleri üzerine yapılan eleştiriden ortaya çıkan bir bakış açısı olarak tanımlayabiliriz. Farklı dil, kültür ve dinlere mensup olan göçmenlerin batı toplumlarındaki yerleşik ve kalıcı yaşama geçmesiyle birlikte, çok kültürlü toplum yapıları oluşmuştur. Böylece, baskın kültür ile bu baskınlığın yanı başında farklı kültürlerin varlığı, fenomen ile olgu arasındaki çizgide yerini almıştır.

Küreselleşme sonrasında toplumlar arasında hem *bütünleşme*, hem de *farklılaşma* göze çarpmaktadır. Küreselleşmenin meydana getirdiği hızlı değişim ve onun ortaya koyduğu istikrarsızlık birçok problemi doğurmaktadır. Bunların başında da, çok dilli ve çok-kültürlü yapı, demografik yapının değişimi ve değişimden kaynaklanan belirsizlik gelmektedir. Öte yandan, küreselleşmenin yol açtığı kültürler arasındaki *uyum* ya da *bütünleşme*, eğitim, iş ve çalışma değerleri açısından bazı olumlu işaretleri karşımıza çıkarır. Böylelikle, açıklık, esneklik, duyarlılık gibi tezler, rekabet ve işbirliği eğilimleri ortaya çıkar.

XXI. yüzyıl, dünyanın yeni teknolojiler aracılığıyla değiştirilmesi, sosyal ilişki ve yaşama biçimlerinin çoğalması, nüfus gelişimi ve göçlerle, çok kültürlü toplum yapılarının oluşmasına ortam hazırlamaktadır. Çok kültürlülük, küreselleşme ve iletişim teknolojilerinde yaşanan gelişmeler, hem toplumu, hem de bireyleri yeni arayışlar geliştirmeye zorlamıştır. Birlikte yaşamak ise, bireyi, diğer insanlarla aynı kuralları izleme ve aynı değerleri paylaşmaya götürmüştür.

Çok kültürlü eğitimin temelinde, bütün bireylerin, kendi potansiyelini ortaya koyabilmeleri ve topluma aktif olarak katılmaları için dil, din, köken, ırk ve cinsiyete bakılmaksızın eşit fırsatlara sahip olabilme fikri yatmaktadır. Zaten, çok kültürlü yaklaşımda, iki ya da daha çok kültür, karşılıklı etkileşimin sonunda değişime uğrar ve yeni dinamikler ortaya çıkar.

Zorunlu *asimilasyonu* öngörmeyen çok kültürlü eğitimin iç içe olduğu problemlerden biri de, *çok dille yapılan eğitimi*dir. Bu durumda, bireyin çok dilli ve çok kültürlü atmosfer içinde kaybolma risk ve endişesi vardır. Bu yüzden de, küresel toplum düzleminde herhangi bir grubun kimliğini olduğu gibi savunmaya çalışması, o topluluk içerisindeki yeri hâkim grupların dayattığı bir dışlanma sistemince tanımlanmasından ötürü, grubun kendini marjinalleşmiş ve gettolaşmış bir varoşa mahkum edebileceği düşüncesi güncelliğini korumaktadır.

## Kavramsal Çerçeve:

Küreselleşme ile birlikte değişen toplum yapıları, bireyin gelişim ve eğitiminde, *interaktif* destekle pek çok kaynağa kısa zamanda ulaşma başta olmak üzere, çok kanallı bilgi akış ve desteğini devreye sokar. Böylece, toplumların kendisini oluşturan bireylere belli bir kültürü aktarma/kazandırma, eğitim yoluyla bilgilerin sorgulanışı, motivasyon, çaba ve problem çözebilme ilkeleri kendini açığa çıkarır.

Çok-kültürlü eğitim ortam ve süreçleri ile çok kültürlü bir toplumda yaşamak, göçe dayalı hareketlilik ve değişim olgusunu beraberinde getirdiği için sadece eğitimi değil, sosyolojiyi de ilgilendiren bir durumdur. Bireylerin toplumsal kurum ve konumlarındaki değişim ve dönüşümleri ele alan sosyologlar, göçlerin meydana getirdiği çok kültürlü toplum yapıları içinde *kültür*, *kimlik* ve *çok kültürlülük* gibi kavramlar üzerinde dururlar. Toplumbilimciler, bu kavramları da kapsayan eğitim sistemine yönelik politikalar ile göçe dayalı toplumsal değişimi de analiz ederler. Bu toplumsal değişimleri değerlendirmek ve değişimlerin getirdiği yeni durumlara ayak uydurmak ise başlı başına bir araştırma/inceleme alanıdır.

Türkiye'nin Avrupa Birliği üyelik süreci, pek çok konu başlığının yanında eğitime yönelik, tutum, ölçü ve değişimlerin de dikkate alınması gerektiğini ortaya çıkarmıştır. Artık ülkemizde, dünya problemlerine çözümler üretebilen, toplumsal hak ve kurallara uygun kararlar verebilen, teknolojiye hâkim, yeni fikirler önerebilen bireyler yetiştirmek zorundayız. Bu durum sadece Türkiye için değil, Avrupa'da yaşayan Türkler için de geçerlidir.

Bilimsel ve teknolojik gelişmelerin hızlı yaşandığı XXI. yüzyılda, Türkiye'nin Avrupa'yla bütünleşmesi önemlidir. Zaten, çok kültürlü ve küreselleşen dünyada, batı dünyasının antropolojik eğilimlerini yansıtan psikolojik bilgilerin çeşitli kültürlerde sınanması, incelenen olguların farklı kültürlerdeki görünüşlerinin ortaya konması noktasında, Avrupalı Türklerle özel görevler düşmektedir.

Farklı millet ve kültürlerin birbirlerini yakından tanımlarının zorunlu şartı olan karşılıklı iletişim, tarihsel deneyim ve kültüre dayalı etkileşim, *öz* ve *yabancı* kültürler arasındaki bağlantıyı kolaylaştırmaktadır. Ki, iletişim, bir zihnin diğer zihinleri etkileme yollarının tamamı özelliğiyle, kişilerarası ilişkilerin prensiplerini de belirlemiş olur. Hem bireyler, hem toplumsal gruplar, hem de ulusal kültürler, başlangıçta kendilerine yabancı olanı kendi geliştirdikleri yaşayış bilgisi çerçevesinde tanıyarak değerlendirirler. Öte yandan, tanışma ortam ve şartları, kendilerine yabancı olanı tanımayı ve *tanımlamayı* kolaylaştırır.

Günümüzde Paris, Londra, Brüksel, Berlin ve Amsterdam gibi Avrupa'nın büyük kentleri çok kültürlü şehirler durumuna gelmiştir. Hem bu kentlerde, hem de Avrupa'nın diğer merkezlerinde kültürlerarası öğrenim, bir çalışma ve öğretim ilkesi olarak ele alınıp; öğretim programlarının kültürlerin birbirlerini olduğu gibi kabullenmesi sağlanmalıdır. Bu bağlamda, son yıllarda Belçika'daki üniversitelerde Türkçe açılımının olduğuna memnuniyetle tanık olmaktadır.

Kültürlerarası öğrenme, ulusallığın yanı sıra, evrensel değerleri özümseme ve onları benimseyip savunma bilinci kazandırır. Bu nedenle, farklı toplumların kendi öz kültürlerini koruyabilmeleri, onların kendi ana dillerini tam ve doğru olarak öğrenebilmeleri sonucunda kültürlerarası öğrenme olumlu yönde gelişecektir. Çok kültürlü/çok dilli yaşayış şartlarına, *alt kimlik* ve kültürleri de koruyarak; içinde bulunulan şartlara uyum sağlamak esas ve önemlidir.

XX. yüzyılda pozitivizm, var/oluşçuluk, eleştirel teori, post-modernizm gibi düşünce akımlarından etkilenen eğitim görüşleri ve eğitim-bilim yaklaşımları bulunmaktadır. Sosyoloji ve psikoloji alanları, çok kültürlülük terminolojisinin başta *kimlik*, *evrensellik* ve *özgürleşme* açılımlarını yakından analiz eder. Yeni bir dil öğrenmede temel becerilerin neler olduğu, dil öğrenme süreci ile kültürel farklılıklar arasındaki bağlantının tespiti, *ikinci bir dil* öğretiminde hangi öğretim modellerinin öne çıkacağı eğitim bilimleri kadar; toplumbilim ve psikolojiyi de yakından ilgilendirmektedir.

Küreselleşme ile birlikte, bilim ve teknolojiye hızlı gelişmeler, insan ve toplumları da değiştirmektedir. Çok kültürlü bir toplumun gerçeklerine uygun olarak eğitim-öğretim plân ve programlarının hazırlanması gerekmektedir. Bireyler arasında, kültürlerarası öğrenmeye aykırı olmayan bir biçimde, ön yargısız davranma, değişik gruplara ait öğrencilere fırsatlar sunma gibi çok kültürcü yaklaşımlar esas alınmalıdır.

## Bulgular:

Dünya üzerindeki kültürel akış, küreselleşmenin kültüre dayalı yanını da ortaya çıkarmıştır. Artık, kültüre ait değerler, internet ve teknolojinin sağladığı olanaklar aracılığıyla, önceki dönemlerle kıyaslanmayacak ölçü ve serbestlikle dünyayı dolaşmaktadır. Üstelik bu yeni durum, insan hayatını değiştirme ve yönlendirmede etkili olmaktadır. Öyle ki, bugün, ortaya çıkan küresel kültür değerler ve nüfus hareketleri (göç), *yurttaşlık* ve *ulusal kimlik* kavramlarının yeniden tanımlanmasına neden olacak boyuta gelmiştir.

Günümüzde, kültürel "türdeş"lik, tek-kültürlülük ya da kültürel türdeşlik tezini savunan teorisyenlerle, çok kültürlülük ve çok dillilik tezini savunanlar arasında ciddi görüş ayrılığı ortaya çıkmıştır. Gelişen küresel kültürde 'aynı olma' ile 'farklı olma' arasında gerilim yaşanmaktadır. Sosyal teorisyen Francis Fukuyama, kültürel küreselleşmeyi, bir demokrasi ve serbest piyasanın yayılmasıyla eşdeğer gördüğünden olumlu ve iyimser bir durum olarak değerlendirir. (Steger: 2006). Öte yandan, Fukuyama gibi düşünmeyen bazı teorisyenler ise, batı norm ve yaşama biçimlerinin daha savunmasız durumdaki kültürleri bastırıldığını düşünmektedir.

Ülkemizde sosyoloji biliminin kurucusu olan Ziya Gökalp, her milletin kendine ait *değer yargılarının* olduğunun ve bunların 'kültür' şemsiyesi altında toplumda yer edindiğinin altını çizer (Gökalp, 1997). Buna paralel olarak, çok kültürlülük, akıl felsefesi, psikoloji ve politika alanlarında ciddi çalışmalara imza atan Charles Taylor da, farklı kültürlerin, toplulukların modern bir toplum içinde onurlarından taviz vermeksizin bir arada yaşayabilmelerini savunur. Çok kültürlülük, eğitim-kültür bağlamında düşünüldüğünde, hâkim ideoloji tarafından hem büyük bir tehlike olarak görülebilir ancak, Ziya Gökalp'ın de vurgu yaptığı noktada önemli bir kazanım olabilir. Keza, bir devlet sınırları içerisinde yaşayan farklı kültürel yapıların insanı değerlerin üst ve temel amaç doğrultusunda kendi değer yargıları ve kültürel yapıları ve dilleri çerçevesinde özgür bırakılması, demografik yönden hâkim yapının temellerinin sağlam kalmasına ve eğitimden beklenen çok görüşlülüğün, iyiye ve güzele gidişin kapılarını açar. Ki, kendi yurttaşlarına 'her

an' bir azınlık olduğunu hatırlatan yapısal ve hukuksal çerçeve ile kısmî asimilasyon, bireyleri daha tutucu ve kendi içinde yanlış yönelimlere giden bir yola sevk eder.

### Sonuç:

Çok kültürlü toplumların ortaya çıkışı, çok kültürlü eğitim ortamlarını da beraberinde getirmiştir. Küreselleşme ve göç gibi birinci dereceden faktörler, çok kültürlü toplumların eğitim stratejisi planlamasına yol açmıştır.

Çok kültürlü eğitimde en önemli sorunlar genellikle, *uyum süreci* esnasında yaşanmaktadır. Batılı ülkelere yerleşen ailelerin çocukları özellikle ilk günlerde 'yalnızlık' duygusuyla karşı karşıya kalmaktadır. Ayrıca, öğrencilerin kendi bilgisini uygulamaya koymadaki takip edeceği ölçütlere dair (ölçütsel) kurallara başvurabilir. Kaldı ki, pedagoji ve psikoloji alanlarında yapılan araştırmalar, öğrencilerin fiziksel ve ruhsal rahatlama (psikolojik destek) esnasında öğrenme potansiyelinin arttığını göstermiştir.

*Katılımcı* merkezli bir pedagoji prensibini benimseyen çok kültürlü eğitim, küçük/homojen gruplarla eğitim-öğretim yapmak ve kültürlerarası projeler yürüterek; çok kültürlülük ve çok dilliliğin doğurduğu problemlere çözüm getirmelidir. Eleştirel eğitim teorisi, eğitim-öğretim esnasında, etnik, cinsiyet, sınıf gibi ayrımlara başvurulması sosyal bilinç ve pedagojik otoritenin ilkelerine aykırı bulur. Bu noktada, başta ABD ve Kanada olmak üzere, İngiltere, Almanya gibi çok ulus ya da çok kültürlü ülkelerde okul öncesi sınıflarına yönelik "anti-ayrımcılık" eğitim programı uyguladığını (Güven, 2005) hatırlatmakta yarar vardır. Öte yandan, bireyleri ve kültürleri birer 'pazar' ya da 'tüketici' olarak düşünen küresel güçlerin *eğitime* çizmeye çalıştıkları 'faydacı' yaklaşımların çok kültürlü eğitim anlayışına ket vuracakları sorununu da çözümlenmek gerekir.

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# LEAN SERVICE AND APPLICATION OF MRI-TOMOGRAPHY IMAGING CENTER

Tijen Över Özçelik,  
Department of Industrial Engineering  
Sakarya University, Esentepe Campus, Serdivan,  
Turkey  
[tover@sakarya.edu.tr](mailto:tover@sakarya.edu.tr)

Didem Güleriyüz,  
[guleryuzdidem@hotmail.com](mailto:guleryuzdidem@hotmail.com)

**Abstract:** In this study, Magnetic Resonance (MRI) and Tomography Imaging Center of an Education and Research hospital was investigated from a system development point of view, and processes causing waste were identified. During analysis phase, it was found that waste-causing processes arise from waiting of patients due to deficiencies of the appointment system. Starting with the lean management philosophy and using tools and techniques of lean service notion, these processes were redesigned and waste was prevented by also taking the resistance and critical success factors encountered during lean application process into consideration. For this purpose, differences of incoming patients, types of operations, preparation periods and cycle times were analyzed and a new appointment model was proposed.

**Key Words:** Lean Management Systems, Lean Service, Lean Healthcare, MRI-Tomography Imaging Center

## Introduction

In the recent years, organizations attach as much importance to service and customer satisfaction as they attach to profitability, and they benefit from various techniques, technologies and points of view in order to meet expectations of dynamic demand, short operation/delivery period, high quality and low cost and to maintain their existence. Lean production and Lean Thinking in this regard are deemed as a nearly indispensable approach. Lean Thinking is a way designed to define the value, to line up the actions that create value in a manner that will give the best result, to implement these activities uninterruptedly and in an increasingly efficient fashion. In brief, Lean Thinking is lean, since it shows the way to derive more with increasingly lower efforts, less equipment, less time and less space, and thereby it converges more to the exact wishes of the customer. (Womack, Jones, 2003). Today, service-oriented sectors gain more significance and growing enterprises aim at profit maximization by eliminating waste. Lean Thinking essentially focuses on defining activities that do not create value in the services and production sectors and removing waste (Womack, 1990).

Lean service is use of basic principles of lean production in the services sector. Lean production philosophy that provided successful results in the manufacturing industry has started to be used in the service sectors in the recent years. Application of Lean Thinking is new and being adopted by health, logistics and enterprises that sell fast services at the first stage (Efe, 2011).

## Lean Management in the Hospitals

Existence of organizations, their survival and boosting of their market shares in today's competitive conditions is possible by responding to customer demands in the fastest and accurate way possible, above everything else. Hospitals, which carry out activities on humans that add value, cannot always respond to the demands of patients or cannot respond immediately and this gives rise to plenty of waiting time. Major reasons of these waiting times are bottlenecks and waste in the system. When one considers that people expecting service from hospitals are mostly patients, it is natural that they easily get dissatisfied as they do not have the endurance and time to wait. For these reasons, bottlenecks in the system should be quickly fixed, efficiency of so expensive resources should be increased and waste should be eliminated. Here, lean tools and techniques come to the help of hospitals, which are used in lean production but today receive interest in the services sectors as well. In our country, use of Lean Thinking philosophy in the service sectors (especially the health sector) is not so common, whereas in the world, especially in the United States, the years when applicability of Lean Thinking to the health sector was discussed are left behind and many hospitals implemented lean transformation successfully and obtained positive results. That is because, Lean Health can turn from a goal into

reality owing to the need to do “more work” with “less resources” in parallel to the economic change in the world and increased focus on raising safety and quality along with performance (Graban, 2008).

It may be useful to have a common terminology in identifying waste. 7 types of waste defined for the production sector can be used as a useful framework in identifying the waste in the hospitals. However, since hospitals involve processes that focus on humans, human potential is added as an eighth type of waste (Melton, 2005). There are eight types of waste defined for hospitals. These are:

- ✓ Defects
- ✓ Overproduction
- ✓ Unnecessary Movement of Materials
- ✓ Waiting
- ✓ Excessive Stock
- ✓ Unnecessary Movement of People
- ✓ Over processing
- ✓ Human Potential

## Materials and Method

Site of the study is the MRI and Tomography imaging center of an Education and Research Hospital. The number of patients is high, since the imaging center offers services in a state hospital, which is a full-fledged hospital. The center offers services 7/24 in three shifts of 8 hours. Full service flow of patients that come to the imaging center, from registration to the discharge, was analyzed. During analysis, problems were identified, and reasons of the problems were investigated by going down to the root causes. A system that would provide a solution to these problems was designed and application results were discussed.

### Identification of the problems

Process of identifying and resolving problems is tough job due to complexity, difficulty of choosing alternatives, ambiguity and the risk it involves. Due to these difficulties, best way to solve a complex problem is to use an effective decision-making process (Engin, 2005). At this stage, method of face to face meeting with the employees and patients was used. Work flow maps were studied, and upper management, employees and patients were met to identify the problems. But, the biggest problem seen was waiting of the patients. Patients had to wait a lot for the operation even if they come at the time of appointment, which caused dissatisfaction and problems.

Waiting time can in general be defined as the time during which no operation is done. It is easy to identify a lack of action as waste, but it is difficult to differentiate waiting times. Patients usually wait in the clinics due to bad work flow or bad programming. For patients, waiting time is the time they waited to reach the step that adds value in the patient tour. In a hospital, it is not only patients who wait, at the same time many materials wait during much of the time instead of being used in value-adding works. The reason for the waiting times is that work is done aggregately within the service and that the workflow does not comply with the first in-first out rule (Graban, 2008). In Table 1, appointments in a period of one month is investigated and average delays (average waiting time of the last patient) can be seen. Appointments given by the center during a one month time was investigated and waiting time of the last patient at the end of the day was calculated using these appointment lists.

**Table 1.** Monthly appointment delay periods

| Delay Period (Hours) | Number of days | Percentage (%) |
|----------------------|----------------|----------------|
| 1                    | 4              | 13             |
| 1-3                  | 8              | 27             |
| 3-5                  | 16             | 53             |
| > 5                  | 2              | 7              |

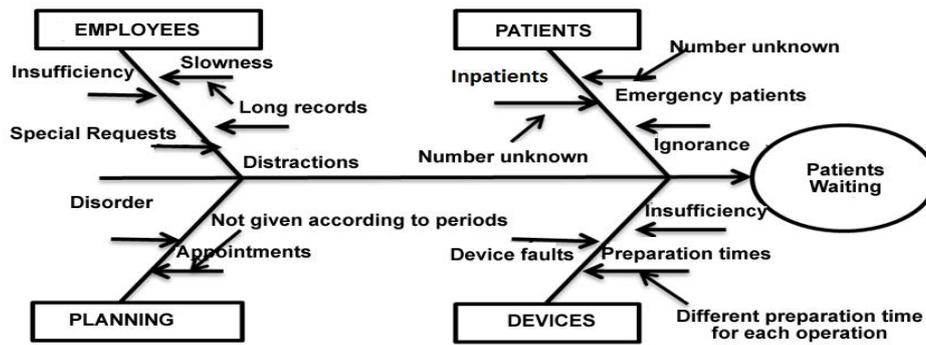
As seen in the table, last patient waits for 1 hour during 4 days, for 3 hours during 8 days, for 5 hours during 16 days and for more than 5 hours during 2 days. When average of these figures is taken, daily average waiting time is 188 minutes.

### Identifying the reasons for the problems

In order to identify the reasons for waiting problems of patients in the imaging center, Fish Bone Diagram (Cause-Effect Analysis) used in the decision-making and problem-solving stages of Lean Production applications was used.

### Fish bone diagram

A fish bone diagram shows the relationship between causes and effects. In general, it is used to reduce a problem to a few basic problems and focus on these potential basic problems. Fish bone diagram was first used in 1953 by Professor Kaoru Ishikawa in the quality applications in Japan (Şengül, 1997). In Figure 1, one can see the fish bone diagram prepared to find a solution to the question “Why do patients wait for a long time?” with the employees of the imaging center and to go down to root causes of this problem.



**Figure 1.** Fish Bone Diagram

According to the fishbone diagram created, reasons for waiting of patients are elongation of registration times, the fact that appointments are not given according to the time needed for imaging and according to the types of imaging, the fact that inpatients and emergency patients are not separated, insufficiency of number of staff, insufficiency of number of devices, the fact that patients are not sufficiently informed, special requests of the doctors, patients keeping technicians busy and lengthy preparation times. Elimination of these identified problems will contribute to lean transformation. But, trying to solve all of the problems will lead to failure to identify the root causes and allow repetition of these problems. For this reason, it should be determined solving which problems will contribute more to the lean transformation. Pareto analysis was conducted for this purpose.

### Pareto analysis

This approach laid out by Italian economist Pareto in 1897 and later implemented by M. C. Lorentz was originally developed to show the income distribution. It is J. M. Duran who adapted this to quality problems by making it a significant minority-insignificant majority principle and gave it the name “Pareto analysis” (Özcan, 2001). Pareto analysis data table based on total weights, cumulative weights, percentages and cumulative percentages according to the votes of the employees is shown in Table 2.

**Table 2.** Pareto analysis data table

| Problems   | Number of votes | Percentage | Cumulative Number of Votes | Cumulative percentage |
|--|-----------------|------------|----------------------------|-----------------------|
| Little time reserved for emergency patients/inpatients | 6               | 0.28571    | 6                          | 0.285714              |
| Imaging times of appointments                          | 5               | 0.2381     | 11                         | 0.52381               |
| Imaging types of appointments                          | 4               | 0.19048    | 15                         | 0.714286              |
| Lengthy preparation times                              | 2               | 0.09524    | 17                         | 0.809524              |
| Insufficiency of number of staff                       | 1               | 0.04762    | 18                         | 0.857143              |
| Insufficiency of number of devices                     | 1               | 0.04762    | 19                         | 0.904762              |
| Patients insufficiently informed                       | 1               | 0.04762    | 20                         | 0.952381              |
| Special requests of doctors                            | 1               | 0.04762    | 21                         | 1                     |

According to the pareto diagram, there are 4 problems that differentiate from others and constitute 80 % of all problems. Making improvements in these 4 problems will affect results of lean transformation more.

### Solution of Problems and Application

According to the pareto analysis, of the problems of allocating little time to emergency patients and inpatients, failure to give appointments according to imaging times and according to imaging types and length of preparation times, first three seem to arise from bad planning. Investigation was conducted to identify the root cause of the problem of lengthy preparation times, and at the end of measurements it was found that measurement times were not long but preparation operations were overly repeated. So the real problem is not the length of preparation period but repetition of preparation stages. If similarities can be identified in the preparation phase and similar works (imaging) can be done successively, waste will be minimized. Eventually, the reason behind the fact that preparation periods are lengthy in total is still the bad planning of the appointments. The solution that will eliminate all 4 identified problems is to redesign the appointment system.

Group Technology (GT) is a production philosophy based on grouping of products according to their similarities in product design and production, by making use of similarities among products. While implementing GT, similar parts are grouped in “part groups”. Each group will have similar design and production features. Thus, processing of each member of a group will be similar (Özçelik, 2011). Starting with the GT definition, preparations can be grouped based on similarities. Works (imaging) that have similar preparation phases will belong to the same group. There are 40 different MRI types that can be handled in the imaging center. Preparation of the device for imaging consists of changing the coil. 40 different types are imaged using 7 different coils. Therefore, grouping works that use the same coil together will remove the process of changing the coil and reduce the preparation time. There are 7 different imaging groups. It was aimed to redesign the appointment system based on these groups. In order to avoid repetition of preparation, appointments will follow one another in the same time range during the day for MRI types within the same group, which will eliminate the need to change the coil. Also, emergency patients will be reserved time within the day, which will reduce the time arising from emergency hospitals. Patients coming to the imaging center were observed for 30 days. And when data of 30 days was analyzed, following was found.

Imaging center provides services for 24 hours. 2478 patients came for MR imaging in 30 days. Imaging is performed for 82 patients daily on average. But, average of 100 patients are given appointments, and appointments of remaining patients are cancelled by phone. Distribution of 2478 by groups is shown in Table 3.

**Table 3.** Group distributions

| Groups                | Total patients | Percentage(%) |
|-----------------------|----------------|---------------|
| 1 <sup>st</sup> Group | 131            | 0,05          |
| 2 <sup>nd</sup> Group | 1119           | 0,45          |
| 3 <sup>rd</sup> Group | 384            | 0,15          |
| 4 <sup>th</sup> Group | 624            | 0,25          |
| 5 <sup>th</sup> Group | 189            | 0,08          |
| 6 <sup>th</sup> Group | 15             | 0,01          |
| 7 <sup>th</sup> Group | 16             | 0,01          |

After analyzing the number of incoming patients by group, in order to avoid waiting resulting from emergency patients, incoming emergency patients and the group of these emergency patients were investigated. During 30 days 148 emergency patients/inpatients came. 58 % of these emergency patients belong to 4<sup>th</sup> group, 24 % belong to 2<sup>nd</sup> group, 10 % belong to 5<sup>th</sup> group and 6 % belong to 3<sup>rd</sup> group. No emergency patient came for 1<sup>st</sup>, 6<sup>th</sup> and 7<sup>th</sup> groups. Distribution of emergency patients by group is as follows: emergency patients constitute 3.2% of 2<sup>nd</sup> group, 2.3 % of 3<sup>rd</sup> group, 13.7 % of 4<sup>th</sup> group and 7.9 % of 5<sup>th</sup> group. No emergency patient came for 1<sup>st</sup>, 6<sup>th</sup> and 7<sup>th</sup> groups. Average cycle time for each group was calculated. These periods are 17 minutes for 1<sup>st</sup> group, 14 minutes for 2<sup>nd</sup> group, 20 minutes for 3<sup>rd</sup> group, 11 minutes for 4<sup>th</sup> group, 19 minutes for 5<sup>th</sup> group, 15 minutes for 6<sup>th</sup> group and 25 minutes for 7<sup>th</sup> group. Daily time to be allocated by group, and number of patients on appointment and number of emergency patients calculated based on cycle times, according to the information at hand, are shown in Table 4.

**Table 4.** Number of patients on appointment and periods

| Groups                | Emergency patients | Number of patients to give appointments | Number of patients | Average service time (min) | Average preparation period (min) |
|-----------------------|--------------------|---|--------------------|----------------------------|----------------------------------|
| 1 <sup>st</sup> Group | 0                  | 4                                       | 4                  | 17                         | 2                                |
| 2 <sup>nd</sup> Group | 2                  | 43                                      | 45                 | 14                         | 1                                |
| 3 <sup>rd</sup> Group | 1                  | 9                                       | 10                 | 20                         | 2                                |
| 4 <sup>th</sup> Group | 5                  | 27                                      | 32                 | 11                         | 2                                |
| 5 <sup>th</sup> Group | 1                  | 5                                       | 6                  | 19                         | 1                                |
| 6 <sup>th</sup> Group | 0                  | 1                                       | 1                  | 15                         | 2                                |
| 7 <sup>th</sup> Group | 0                  | 1                                       | 1                  | 25                         | 1                                |

Since the preparation process will be performed once only, total time needed for groups:

Average set up time:  $T_{su}$

Average service Period :  $T_c$

Average Number of Appointments: RHS

Total time for  $i^{\text{th}}$  group:  $A_i$

$$A_i = T_{su} + (RHS_i \times T_c) \quad (1)$$

If total times needed for groups are calculated using the formula (1); 70 minutes is needed for 1<sup>st</sup> group, 603 minutes for 2<sup>nd</sup> group, 182 minutes for 3<sup>rd</sup> group, 299 minutes for 4<sup>th</sup> group, 96 minutes for 5<sup>th</sup> group, 17 minutes for 6<sup>th</sup> group and 26 minutes for 7<sup>th</sup> group. Total 1293 minutes should be programmed for appointments based on the number of people in the groups and remaining 147 minutes should be distributed within the day for emergency patients. This way, even if emergency patients come one after another, the patient who will wait most will wait for 147 minutes, which is a nearly impossible probability. Also, even in such case, average waiting time will be reduced from 188 minutes to 147 minutes, which means a reduction of 21.80 %.

In the current situation, number of patients who can be served daily is 82. By reducing the total preparation time, number of patients that can be served daily increased to 99, which is an increase of 20.73 %. This increase will considerably boost the profits. Even when no emergency patients come, 90 patients will be served, and this will still mean an increase of 9.95 %. But, it is almost impossible in a hospital, a dynamic system, that any process will remain unused.

Time ranges arranged by groups, when appointment schedule is arranged according to groups, is shown in Table 5.11, omitting the emergency patients. Highest number of patients comes for 2<sup>nd</sup> group. Giving the appointments for groups with the highest number of patients during daylight will allow easier communication with the doctors. For this reason, 24 hours is scheduled in the order of 2<sup>nd</sup> group, 4<sup>th</sup> group, 3<sup>rd</sup> group, 5<sup>th</sup> group, 1<sup>st</sup> group, 6<sup>th</sup> group and 7<sup>th</sup> group. If the period of 127 minutes allocated for emergency patients can be distributed according to patient numbers of groups, waste will be minimized. Appointment schedule that involve the emergency patient periods is shown in Table 5.

**Table 5.** Appointment time ranges

| Group     | Starting Time | Ending Time | Number of patients |
|-----------|---------------|-------------|--------------------|
| 1st Group | 08:00         | 19:01       | 43                 |
| 2nd Group | 19:01         | 00:31       | 27                 |
| 3rd Group | 00:31         | 03:52       | 9                  |
| 4th Group | 03:52         | 05:39       | 5                  |
| 5th Group | 05:39         | 07:15       | 4                  |
| 6th Group | 07:15         | 07:33       | 1                  |
| 7th Group | 07:33         | 08:00       | 1                  |

## Conclusions

Present situation and situation after the redesigned appointment system are compared in Table 6.

**Table 6.** Comparison Data

|                                | Current Situation | Future Situation | Comparison         |
|--------------------------------|-------------------|------------------|--------------------|
| Average Number of Patients     | 82                | 99               | 20.73 % increase   |
| Total Preparation Period (min) | 121               | 11               | 90.90 % decrease   |
| Waiting period (min)           | 188               | < 147            | > 21.80 % decrease |

With the new appointment system that is designed on the basis of reducing preparation times and waiting periods arising from emergency patients by dividing the works into groups, average number of imaging operations has increased by 20.73 %. An increase of 20.73 % will substantially boost the profits. Total preparation time has been reduced by 90.90 %. Reduction in the waiting periods will be 21.80 % at the lowest. With this new system, flow of patients improves, imaging times speed up and capacity is used in the best way. Also, cost, waste, waiting times and periods patients kept in the process are reduced, and it became possible to do more imaging and efficiency has improved. Movement of the technicians who kept repeating the same process was minimized, which boosted their motivation.

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# MECHANICAL PROPERTIES OF NAPIER GRASS FIBER REINFORCED EPOXY COMPOSITES

Kommula Venkata Parasuram

Faculty of Engineering and Built Environment, University of Johannesburg, Republic of South Africa  
& Mechanical Engineering Department, University of Botswana, Botswana  
Gaborone, Botswana  
[kommula@mopipi.ub.bw](mailto:kommula@mopipi.ub.bw)

K Obi Reddy

Department of Mechanical Engineering Technology, University of Johannesburg  
Johannesburg, Republic of South Africa  
[obisku@gmail.com](mailto:obisku@gmail.com)

Mukul Shukla

Department of Mechanical Engineering Technology, University of Johannesburg, Republic of South Africa  
& Department of Mechanical Engineering, Motilal Nehru National Institute of Technology, Allahabad, India  
[mshukla@uj.ac.za](mailto:mshukla@uj.ac.za); [mukulshukla@mnnit.ac.in](mailto:mukulshukla@mnnit.ac.in)

Tshilidzi Marwala

Faculty of Engineering and Built Environment  
University of Johannesburg  
Johannesburg, Republic of South Africa  
[tmarwala@uj.ac.za](mailto:tmarwala@uj.ac.za)

**Abstract:** Napier grass (*Pennisetum Purpureum*) fibre strands were extracted using mechanical retting process and these extracted fibre strands were treated with NaOH solution with various proportions (5, 10, and 15% w/v) to improve their surface morphology and enhance the bonding capacity with resins. Composite specimens were prepared using untreated and NaOH treated fibre strands as reinforcement and epoxy resin as a matrix material. The impact of alkali treatment on mechanical properties were evaluated. Quantitative results from this study will be useful for further and more accurate design of Napier grass fiber reinforced composite materials for various applications.

**Key words:** Composite, Alkali treatment, Napier grass

## Introduction

Over the last few decades, natural fibers have attracted attention as substitutes for synthetic fibers in composites production, largely due to increased emphasis on sustainability. Density of natural fibers is low and specific strength is high. Further, they are cheap, renewable, non-abrasive, and their specific properties are comparable with the commonly used glass fibers. Natural fiber composites exhibit excellent mechanical properties. Environment friendly character is very important for the acceptance of natural fibers in engineering markets, like automotive and construction. Presently automobile manufacturers like BMW and Mercedes are beginning to incorporate hemp fiber composites into their car components [1]. Natural fibers consists lignin and hemicelluloses, which will influence their adhesion to polymer matrix. The alkali treatment of the natural fiber removes lignin and hemicellulose from the surface [2]. Alkali treatment of the natural fiber chemically modifies the fiber surface and removes the impurity from it [3-4]. Napier grass (*Pennisetum Purpureum*) is a tall grass widely grown in the African continent. The structural, chemical, mechanical and thermal properties of these fibers are reported earlier [5 - 6]. In the present work Napier grass fiber strands were treated with up to 15% alkali concentration (w/v) and composites were prepared using untreated, 5, 10 and 15% alkali treated Napier grass fiber strands as reinforcement and epoxy resin as matrix material to study the influence of alkali treatment on the mechanical properties.

## Materials and Method

### Materials

Extracted Napier grass fiber strands, sodium hydroxide, Acetic acid, Araldite LY 556 and hardener HY 951.

### Fiber extraction

Napier grass fiber strands belonging to the Poaceae family were extracted from the stem using mechanical retting process. The separated fiber strands were washed thoroughly with distilled water and dried in the sun to ensure maximum moisture removal.

#### *Alkali treatment*

Some of these dried strands were cut into 20 mm length and treated with 5, 10 and 15% aqueous sodium hydroxide (NaOH) solutions at room temperature for 2 hours, maintaining a liquor ratio of 20:1 to remove the hemicellulose and other unwanted materials from the fiber strands.

#### *Composite preparation*

From the previous studies, it is evident that the epoxy laminates are dimensionally stable and free from internal stresses due to their low cure shrinkage [7, 8]. Epoxy (LY 556) of density  $1.15 \text{ g/cm}^3$  matrix and hardener (HY951) of density  $0.98 \text{ g/cm}^3$  were used to fabricate the composite. The weight ratio of 10:1.5 was used to mix epoxy and hardener respectively. In the present work, the composite laminates were prepared with weights of 10, 15, 20, 25 and 30% of untreated and alkali treated Napier grass fiber strands. Prepared epoxy resin poured in to fill up the glass mould after spreading the chopped Napier grass fibers randomly. These laminates were allowed to cure for 24 hours at room temperature. Finally, the laminates are subjected to post curing for 3 hours at  $100^\circ\text{C}$  in an oven. Two important factors such as alkali treatment and fiber loading (weight %) were considered as important factors in present work. Test specimens were prepared from these laminates after the curing process, as per the ASTM standards.

#### *Mechanical testing*

The standards used for tensile, flexural and impact test were ASTM-D 3039/D 3039M, ASTM-D 790-03 and ASTM-D 256-05, respectively. To achieve a statistically significant result for each condition, ten specimens were tested to evaluate the mechanical properties. The tensile and three-point bending (flexural) tests were conducted using ISTRON 3369 Universal Testing machine at a crosshead speed of 5 and 2mm/min respectively. M/s PSI Instruments make impact testing machine was used to conduct Izod impact test.

#### *Scanning Electron Microscopy*

Samples from each untreated and alkali treated specimens were cryogenically cooled and instantly subjected to brittle fracture. The fractured surfaces of these samples were coated with carbon and the micrographs of the fractured composites are recorded using X-Max (Oxford instruments) Scanning electron microscope operating with secondary electron imaging at 10kV.

## **Results and discussion**

The SEM micrographs of untreated, and alkali treated fiber strand reinforced epoxy composites are presented in Figs. 1 and 2. In Fig. 1(a), untreated Napier grass fibers appear to be free of any matrix materials adhering to them, thus indicating poor fiber matrix adhesion causing brittle failure and leaving debris on the fiber surface. In Fig. 1(b), 5% alkali treated composite shows some cavities absent and many polymer particles bonded chemically to the fiber surface. In Fig.2 (a), the fracture surface of 10% alkali treated fiber composites shows good mechanical interlocking between fiber and matrix. In Fig. 2(b) 15%, alkali treated Napier grass strands reinforced composite shows very few fibers on the fracture surface due to the fiber cover up by the matrix material. These micrographs show that the fiber matrix adhesion is improved with percentage of alkali treatment up to 10%.

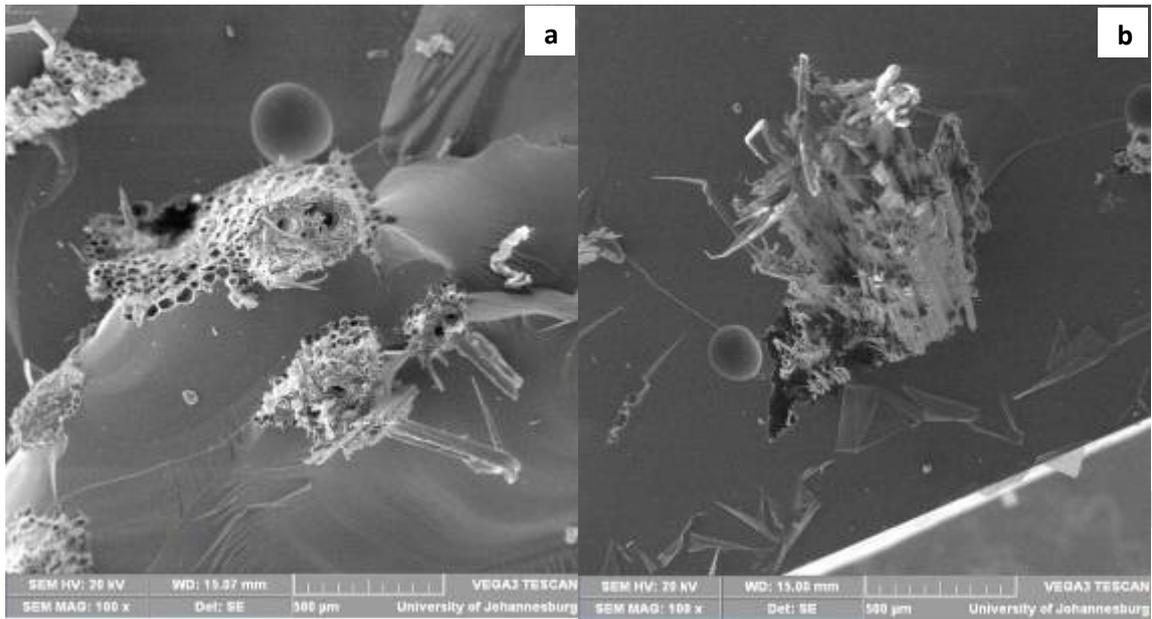


Figure 1: SEM micrograph of (a) untreated and (b) 5% alkali treated fiber reinforced epoxy composite

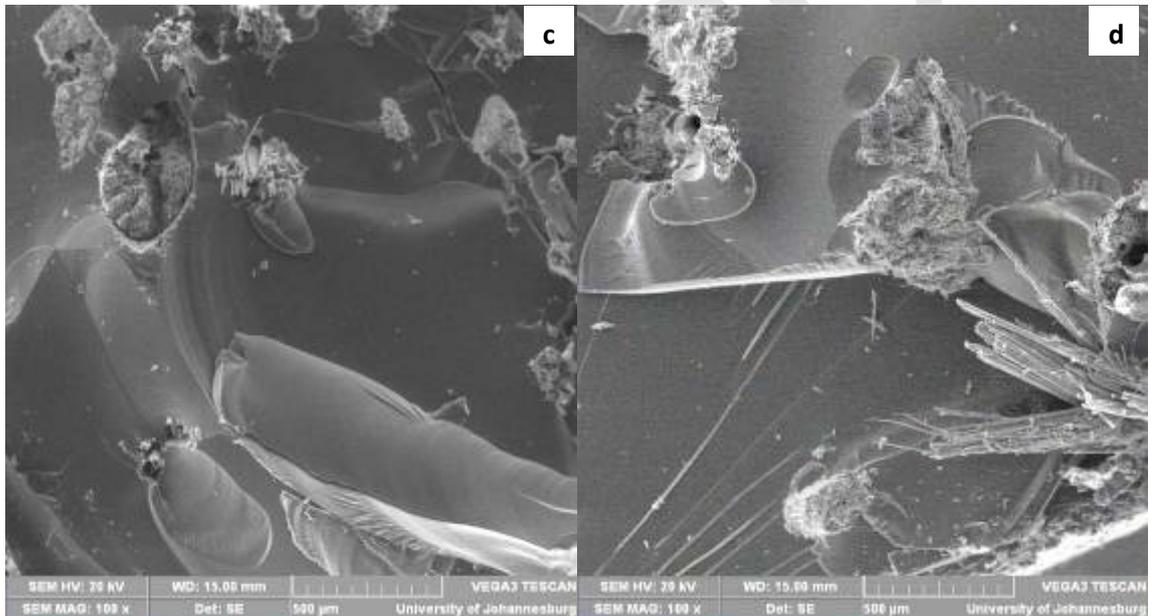


Figure 2: SEM micrograph of (a) 10% alkali and (b) 15% alkali treated fiber-reinforced epoxy composite

The effect of alkali treatment and fiber loading on tensile modulus of Napier grass-epoxy composites was determined and those were reported in Fig. 3. Surface modification of Napier grass fiber by alkali treatment improved the chemical bonding and helped to withstand high tensile load by the composites made out of them. From Fig. 3 it can be observed that the tensile modulus increases with an increase in fiber loading up to 20%. This is because of the reinforcing effect of the fibers, leading to a uniform stress distribution. However, tensile modulus was found to decrease for fiber loading above 20%, generally, for higher fiber loading, non-uniform stress transfer results due to fiber agglomeration in the matrix. The short length and random orientation of the fibers are might be two major factors, which are responsible for this behavior.

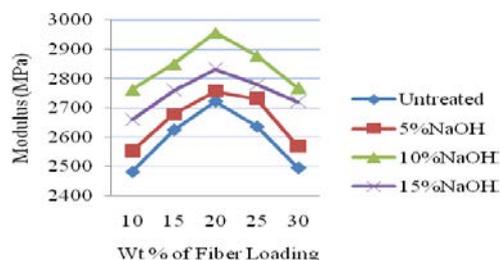


Figure 3: Tensile Modulus of Napier grass-epoxy composites

The percentage increase in tensile modulus (presented in parenthesis) over the matrix was found to be as follows: untreated (25%), 5% alkali treated (30%), 10% alkali treated (32%) and 15% alkali treated (28%). Thus, the tensile modulus is found to be maximum when the fibers are treated with 10% alkali. The highest tensile modulus was found to be 2957MPa for 20% fiber loading with 10% alkali treated fiber reinforced composites.

The flexural properties were also studied to assess the performance of these composites against bending loads. The flexural modulus of untreated, 5% alkali, 10% alkali, and 15% alkali treated fiber reinforced composites with fiber loading of 10, 15, 20, 25 and 30% are presented in Fig. 4. It can be concluded from the results that the trend of flexural modulus is similar to that of the tensile modulus. The % increase in flexural modulus (presented in parenthesis) over the matrix are as follows: untreated (20%), 5% alkali treated (24%), 10% alkali treated (27%) and 15% alkali treated (24%). Thus, the flexural modulus is also found to be maximum when the fibers are treated with 10% alkali. The highest flexural modulus is 3578 MPa for 20% fiber loading with 10% alkali treated fiber reinforced composites.

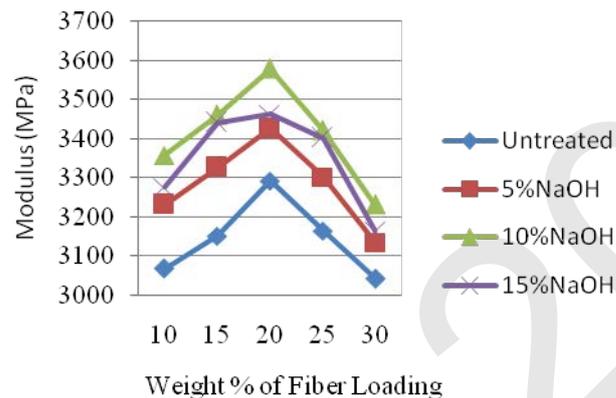


Figure 4: Flexural Modulus of Napier grass fiber-epoxy composites

The impact strength of untreated and alkali treated fiber-epoxy composites are presented in Fig. 5. The impact strength was improved up to 20% fiber loading, and started to decline later due to the interfacial bonding between the fibers and matrix.

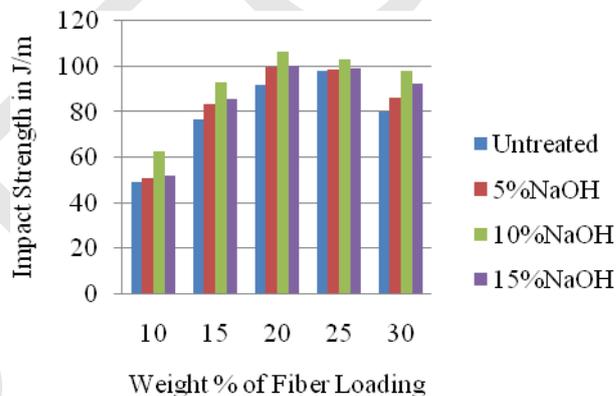


Figure 5: Impact strength of Napier grass-epoxy composites

The % increase in impact strength (presented in parenthesis) over the matrix are as follows: untreated (49%), 5% alkali treated (54%), 10% alkali treated (59%) and 15% alkali treated (55%). Thus, the impact strength is found to be maximum when the fibers are treated with 10% alkali and at 20% of fiber loading. From the above results, it is conclusively evident that the chemical modification of fiber strands by alkali treatment improved interfacial fiber-matrix bonding leading to an increase in mechanical properties of the composites.

## Conclusion

In the present work, mechanical properties of Napier grass fiber-epoxy composites were investigated. Alkali treatment had significant effect on the fiber structure and, as a result, on composite mechanical properties such as tensile modulus, flexural modulus and impact strength. The morphology of composites was studied using scanning

electron microscopy. The interfacial bonding between matrix and reinforcement was found to be improved by surface modification of fibers. From this study, it is evident that 10% alkali treated fibers at 20% loading give the best results for short length and random oriented Napier grass fiber-epoxy composites. The alkali treatment of the Napier grass fiber strands was found to refine its mechanical properties and this favors its application in the composite industry.

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# MESLEKİ TEKNİK EĞİTİM'DE PİYASA UYUMUNU SAĞLAYAN YÖNTEM MİDİR? İLETİŞİM MİDİR?

Mehmet Fatih DİNÇER

Sakarya Üniversitesi Çalışma Ekonomisi Anabilim Dalı Doktora Öğrencisi

mfatihdincer@gmail.com

Adnan BEDLEK

Sakarya Üniversitesi Çalışma Ekonomisi Anabilim Dalı Doktora Öğrencisi

adnanbedlek@tuik.gov.tr

## Özet

Özellikle son 35 yıldaki iletişim, ulaşım ve enformasyon teknolojilerinde meydana gelen gelişmeler ile önemli siyasal dönüm noktaları, önce finans piyasalarında daha sonra da reel sektörlerde görülmeye başlayan, zaman ve mekan kısıtlamalarını ortadan kaldıran yeni bir ekonomik dönem olan küresel rekabet dönemini getirmiştir. Bu keskin rekabette yer alabilmek, işletmelerin etkin ve verimli çalışabilmeleri ile mümkündür. Günümüzde işletmelerin etkin ve verimli çalışabilmeleri olmazsa olmaz bazı unsurlara bağlıdır. İşletmelerin verimli çalışabilmelerini engelleyen en önemli unsurlardan biri hiç şüphesiz kalifiye iş gücü eksikliğidir. Bu eksikliği gidermede iyi bir mesleki teknik eğitim sistemi ve etkin yöntemlere ihtiyaç duyulmaktadır. Bu çalışmada etkili bir mesleki teknik eğitim için, yöntem ve kaynak kullanımı ile mesleki teknik eğitimin tarafları yani öğrenci, öğretmen ve işveren kesimi arasındaki iletişim seviyesinin oynadığı rol ve bunun piyasaya uyumdaki etkileri orta öğretim bazında tartışılmaktadır. Tartışmada, Türk mesleki teknik eğitim sisteminin tarafları arasındaki iletişim seviyesinin, başarılı örneklere sahip diğer ülkelere göre daha düşük bir seviyede olduğu görülmektedir. Bu durumun mesleki teknik eğitimin performansı üzerinde olumsuz bir etkiye sahip olduğu düşünülmektedir.

Anahtar kelimeler: mesleki teknik eğitim, eğitim, piyasa, verimlilik

## Summary

Especially in the last 35 years Communication, transport and information technology developments and important political turning points , the first, then the real sectors and the financial markets began seeing a new economic era that eliminates the restrictions of time and space, which has the period of global competition. This keen to take part in the competition, businesses can work effectively and efficiently possible. Today, businesses can work effectively and efficiently depends on the sine qua non of some elements. the most important reason of inefficient performance at enterprises, is the lack of skilled labor. For the solution a good vocational education and training system and efficient methods are needed. In this study,using of resources and methods for efficient vocational education and training, "the role of communication between the partners of vocational education and training for vocational education and training compatible with the market" on the basis of secondary education will be discussed. Observed that between the comunication level of the Turkish vocational education and training parties lower than the succesful countries' comunication level. Thought that this stituation has negative effects on Turkish vocational education and training performance.

Key words: vocational education and training, education, market, productivity

## Giriş

Küresel rekabetin yapısında meydana gelen, zaman ve mekan unsurlarını taşımayan, sınırları kaldıran bir değişim büyükten küçüğe tüm işletmeleri etkilemektedir. Bu değişim firmaların dışarıda olup bitenleri umursamadan kendi kabukları ya da yerel iş alanlarında varlıklarını devam ettirme şanslarını ortadan kaldırmıştır. Sadece ulusal pazarlara bağlı kalsalar dahi, hem ulusal hem de uluslararası rakipleri karşısında ayakta kalabilmenin güçlüğünü fark eden işletmeler, yerel piyasalardan global piyasalara doğru bir yönelim göstermişlerdir. Böylece işletmeler her türlü faaliyetlerini ve yatırımlarını dünya rekabeti açısından düşünüp değerlendirmek durumunda kalmışlardır. Bu rekabette var olmanın en önemli şartlarından biri işletmelerin iyi yetişmiş kalifiye insan gücüne sahip olmasıdır.

Makro anlamda güçlü bir ekonomi için yüksek istihdam düşük işsizlik seviyesinin gerekliliği açısından baktığımızda, mevcut işsizlik sorununun çalışma çağındaki nüfusun kalifiye işgücü açığını karşılayamayacak şekilde vasıfsız işgücünden oluşması yatmaktadır. Mevcut işgücünün eksik ve verimsiz çalışması da ayrıca bir gizli işsizlik kaynağı olarak ortadır. Üretimin en önemli girdisi olan insan kaynağı ile günümüzün vazgeçilmezi olan bilgisayarlara aynı perspektiften bakılabilmektedir. Buna göre bilgisayarların sürekli gelişen ve değişen teknoloji ile hackerların ve kötü amaçlı yazılımların etkileri karşısında işlerliğini kaybetmemesi ve yüksek performans için sürekli hem donanımsal hem yazılımsal olarak sürekli güncellendiğini görürüz. Basit anlamda bilgisayarımızdaki antivirüs programını bile hemen her gün güncellemekteyiz. Bu durumda insan kaynağı da sürekli değişen ve gelişen teknoloji, üretim bilgisi ve rekabet açısından güncellenmelidir. Aksi halde işgücünün mevcut vasıflarının da bir önemi kalmayacaktır. İşletmelerin rekabet edebilir verimlilik düzeylerinde çalışması, iş piyasasında işletmeler için sıradan olmayan, sağladığı katkı nedeniyle önem taşıyan güçlü bir işçi sınıfı oluşabilmesi için kalifiye işgücü açığının karşılanması gerektiği de açıktır. Bu açığı karşılamak da güçlü ve güncel bir mesleki teknik eğitim sistemine ve etkili yöntemlere ihtiyaç duyulmaktadır. Ancak mesleki teknik eğitimin piyasa ihtiyaçlarını ne kadar etkin karşıladığının göstergesi sanayici ihtiyaçlarını olabildiğince iyi karşılayan mezunlar ve sanayicinin onlardan duyduğu memnuniyettir. Böyle bir yapının oluşumunda mesleki teknik eğitim modelleri, bunları başarılı uygulayan ülkeler ve bu ülkelerde okul-sanayi iletişimi ile ilgili bilgilere göz atmak ve bunları ülkemizdeki durumla karşılaştırmak faydalı olacaktır.

## Mesleki Teknik Eğitim Modelleri

Şahinkesen'e göre çağımızda mesleki ve teknik eğitim sistemi, çeşitli ülkelerde demografik faktör, endüstri yapısı, hizmetler sektörü, devletin yönetim şekli, finansman olanakları, gelenekler, tarihi evrimi gibi çok değişime bağlı olarak çeşitli şekillerde yürütülmektedir. Bu çeşitliliği çıraklık eğitime dayalı sistemler, okula dayalı sistemler, hem okula hem işyerine dayalı sistem(ikili sistem) şeklinde sınıflandırmak mümkündür.(Şahinkesen,1992: 691-692)

Daha fazla kabul gördüğü düşünülen bir diğer sınıflandırmaya göre dünyada uygulanan eğitim sistemlerinde, hükümetlerin meslekî ve teknik eğitimdeki rolü bakımından, makro düzeyde üç temel yaklaşım vardır: piyasa modeli, okul (bürokratik) modeli, işbirliği modeli. Piyasa modelinde meslekî ve teknik eğitim işletmeler ve özel eğitim kurumlarınca sağlanır, hükümetin rolü çok azdır. Bürokratik modelde hükümet planlama, yönetim ve denetim bakımından meslekî ve teknik eğitimin tek sorumlusudur. İşbirliği modelinde hükümet, meslekî ve teknik eğitimi özel sektör ile işbirliği yaparak gerçekleştirir. Bu sisteme hükümetçe desteklenen ve denetlenen piyasa modeli de denebilir.(Baloğlu,1990:147) Bu bilgileri tablo haline getirerek şu şekilde ifade edebiliriz:

| <b>Mesleki Teknik Eğitim Modelleri</b>                |  |                |
|---|--|----------------|
|   | İşletme ve Özel Eğitim Kurumlarının Rolü | Hükümetin rolü |
| Piyasa Modeli (iş yeri ağırlıklı)                     | Çok                                      | Az             |
| Bürokratik Model (okul ağırlıklı)                     | Az                                       | Çok            |
| İşbirliği Modeli<br>(hükümet denetimli piyasa modeli) | Eşit Paylaşım                            | Eşit Paylaşım  |

## **Bazı Ülkelerde Mesleki Teknik Eğitim**

### **Almanya’da Mesleki Teknik Eğitim**

“Dualist(ikili) Sistem” olarak adlandırılan Alman meslekî eğitim sistemi esas olarak teorik eğitim ile uygulamalı eğitim programlarının bütünleştirildiği bir temele oturtulmuştur. Avrupa Topluluğu içinde en gelişmiş meslekî eğitim sistemlerinden birine sahip olan Alman sistemini güçlü kılan unsur, eğitim ile istihdam arasında geliştirilmiş olan sıkı uyumdur.(Aykaç,2002:54)

İkili sistem olarak tanınan mesleki eğitim sistemi lise çağı öğrencilerinin yaklaşık %53 gibi büyük bir öğrenci dilimini kapsar. İkili sistemde kendi eğitimini tamamladıktan sonra, katılımcıların çoğunluğu daha sonra bir usta ya da işçi olarak istihdam edilebilir. Bunlardan belirli koşullar altında nitelikli ve yüksek ortalamalı olanlarına yüksek öğrenime devam etmeleri için izin verilir.( SCHNEDIER ve Diğerleri,2007:22)

İşletme içi eğitimle, bir meslek okulunda haftada 1-2 gün süreli teorik eğitimin birlikte yürütüldüğü Dualist Sistem daha sonra sürdürülecek olan mesleğe yönelik deneyim sağlamak ve bu tür eğitimden geçen gençler açısından istihdam imkânları artmaktadır. Meslekî eğitimin çok yaygın olduğu Almanya’da genel diplomaların ve meslek diplomalarının birinin diğerinden daha üstün olduğunun söylenmesi söz konusu değildir.( Aykaç,2002:54)

İkili sistemin en güçlü yanlarından biri yüksek katılımın derecesi ve işverenler ve diğer sosyal ortaklar adına sistemin sahiplenilmesidir. Ulusal ve eyalet bazında belediye ve şirketlerden oluşan karmaşık bir ağ tarafından kontrol ve dengesi sağlanan işverenlerin kısa vadeli ihtiyaçları için hedeflerde deforme olamadan daha geniş ve uzun vadeli eğitim ve ekonomik hedeflere dönük bir sistem söz konusudur. (Hoeckel ve Schwartz ,2010:14) Zaten Almanya’nın mesleki teknik eğitim konusunda öne çıkmasında bu sahiplenme ve prosedürlerin disiplinli şekilde yerine getirilmesi birincil önem taşımaktadır.

### **İsveç’de Mesleki Teknik Eğitim**

İsveç’de Ortaöğretim İkinci Devresinde Öğrenci ve veliler yöneltme sonucu 9' uncu sınıfta bölüm seçmekte özgürdürler. Öğrenciler dokuzuncu sınıftaki bölümlerine göre orta öğretim ikinci devre okullarına (gymnase, fackskola) devam eder. Gymnase' nin farklı programları öğrencilerin belirli sayıda ortak dersler almalarına ve bölüm seçmelerine olanak verir. Fackskola, gymnase ve mesleki eğitim arasında geçiş olanakları okul yöneltmesini zorunlu kılmaktadır. Ortaöğretimin ikinci devrede yöneltme, ekonominin gereksinimleri, öğrencilerin istekleri ve ülkenin kaynakları göz önünde bulundurularak yapılır. Buna göre genellikle, 3/1 ' i gymnase' lere 3/1' i meslek okullarına (e' coles professionnelles) 3/1' i de uzmanlaşmış meslek okullarına (e' coles professionnelles specialiees) yönetilirler.(Ada ve Üstün,2008:156)

İsveç'te meslekî eğitime önemli bir kaynak aktarılmaktadır. İsveç eğitim sisteminde sürekli yenilikler yapılmaktadır. İş konumundaki eğitim özeldir. Ama çoğu firma devletten bu amaçla büyük miktarlarda finansman desteği almaktadır. Bunu meslekî eğitimde ve bunların ölçülerini geliştirmekte kullanmaktadır. (WLF) çalışma yaşamı fonu, meslekî eğitim finansmanını destekleyecek bu desteğin başarılı olup olmadığını değerlendirecek firmalar bulmaktadır. İş piyasası meslek eğitimini desteklemektedir. Ayrıca meslekî okullarda yetiştirdikleri öğrenciler bu piyasanın ihtiyaçlarını düşünerek hazırlanmaktadır. (Aykaç,2002:52)

### **Finlandiya'da Mesleki Teknik Eğitim**

Finlandiya Eğitim sisteminde de İsveç eğitim sistemindeki gibi dokuz yıllık zorunlu eğitim söz konusudur. Zorunlu eğitimin sekizinci sınıfından itibaren meslek seçimi konusunda danışmanlık yapılır. Öğrencinin güçlü ve zayıf yanları yapılan testler ve kişisel görüşmelerle ortaya çıkarılır. Mesleklerinde pratik yapacakları bir işyeri bulmada öğrencilere yardımcı olunur. Dokuzuncu sınıfta genel veya meslek lisesine başvuruda gerekli evrakların hazırlanmasında öğrencilere yardım edilir. (Dursun,2010:39)

Mesleki Ortaöğretim ikinci devre eğitim ve öğretimi gören öğrenciler de üniversite giriş sınavına girebilmektedirler. Mesleki eğitim ve öğretim yedi farklı eğitim alanını, 112 farklı çalışma programını içeren 52 mesleki yeterliliği kapsamaktadır. Çalışmaların kapsamı üç yıldır (120 kredi).(MEB,2005:4)

Her mesleki yeterlilik en az 20 kredilik kısmı şirketlerde uygulama olmak üzere, dil, bilim gibi temel ve seçmeli konuları içermektedir. Çalışmalar öğrenci danışmanlığını ve bir final projesini de içeren zorunlu ve seçmeli bir dizi çalışmadan oluşmaktadır. Öğrenci becerileri ve yeterlikleri her çalışma modülünün tamamlanmasının ardından değerlendirilmektedir. Yeterlilik sertifikası bireysel çalışma planına dâhil edilmiş olan tüm çalışmaların tamamlanmasının ardından verilmektedir.(Ekinci ve Öter,2010:17-18) Okul merkezli Temel Mesleki Teknik Eğitiminin başlıca finansörü devlettir. Bu sistem yerel vergiler yoluyla oluşan belediye finansıyla desteklenmektedir. Devlet ayrıca kredi verme yoluyla eğitime katılan kişileri de desteklemektedir. Temel Mesleki Teknik Eğitime katılanlar özel bankalarca tahsis edilen kredilerden de faydalanmaktadır.(Çetin,2002:37)

Meslek eğitimi için bir "Okul Programı Kurulu" oluşturulmuştur. Bu kurulun üyeleri, okul ve firma temsilcilerinden oluşur. Bu kurul işyerinde gerçekleştirilecek meslek eğitiminin akışı ve hedefleri için planlar yapar. Tüm öğrenciler bireysel ders planına uygun olarak üç yıllık meslek eğitimi sonunda yeterlilik belgesi yani meslek diploması alırlar. Bunun yanı sıra lise bitirme sınavına da girebilirler. (Dursun,2010:40) Burada bahsedilen Okul programı kurulu ülkemizdeki uygulamada yer alan il istihdam ve mesleki eğitim kurullarının daha mikro ve tam yerinden izleme ve öneri getirme imkanı getiren çok daha etkili bir yapıdır.

### **Türkiye'de Mesleki Teknik Eğitim**

Türkiye'de Mesleki Teknik Eğitim 4 yıllık meslek liseleri, teknik lise, endüstri meslek liseleri, kız meslek liseleri ve bunların Anadolu lisesi versiyonlarından oluşmaktadır. Bu kurumlarda son sınıfta haftada üç gün işyeri staj uygulaması ile öğrencilerin pratik yapmaları amaçlanmıştır. Yani genel anlamda sistem okul ağırlıklıdır. Ülkemizde mesleki teknik eğitime güncel standartlar kazandırma ve iyileştirme sağlanması amacıyla son yıllarda uygulanan Mesleki Eğitim Ve Öğretim Sisteminin Güçlendirilmesi Projesi MEGEP ile birlikte belirlenen yeni yaklaşım kapsamında Türkiye'de

yapılan çalışmalardan iş piyasası ihtiyaç analizi ve Meslek standartlarının gözden geçirilmesi oldukça önemlidir. iş piyasası ihtiyaç analizi bağlamında Arza göre değil, arz- talep dengesini esas alan iş piyasasının istediği yeterliklere göre donatılmış, yerel, bölgesel ve ulusal düzeyde iş gücü ihtiyaçlarını karşılayan bir iş piyasası analizi yapılmıştır. Analiz sonuçları programa yansıtılmıştır. Meslek standartlarının gözden geçirilmesi bağlamında ise Meslek Standartları Kurulu (MSK) tarafından hazırlanan 250 meslek standardı Millî Eğitim Bakanlığı, sosyal ortak temsilcileri, ulusal ve uluslararası uzmanlar ile birlikte yeniden gözden geçirilmiştir. 120'ye yakın meslek standardı revize edilmiş veya yenileri geliştirilmiştir. Ulusal ve uluslar arası uzmanlarca uluslararası meslek standardı formatı oluşturulmuştur. (Altın,2007:135)

MEGEP kapsamında geliştirilen eğitim standartlarına bağlı olarak oluşturulan çerçeve programlar doğrultusunda modüler yapıda eğitim öğretim programları hazırlanmıştır. Öğretim programlarına bağlı olarak öğretmen kılavuzu hazırlanmıştır. 42 geniş alanda 197 dal programı Talim ve Terbiye Kurulunca onaylanarak 2005-2006 eğitim öğretim yılında tüm Türkiye'de uygulanmaya konmuştur.( Altın,2007:135-136) Modüler müfredat mesleki standart ve kademelere dayalı, katılımcının alacağı ana dersler, genel dersler ve teknik dersleri gösteren bir ders yapısında; süresi, modül sayısı ve kredi miktarları belli olan müfredatı içeren ve bu müfredatı yeterliliğe dayalı sonuçlara götürebilmesi için uygun öğretim materyalleri ile desteklenmesidir. Belirlenen mesleki standartlara dayalı geliştirilecek modüler programlar, ilgili sektör, genel müdürlükler ve Talim ve Terbiye Kurulu Başkanlığı ile işbirliği içerisinde yapılmıştır.( Altın,2007:139)

Proje kapsamında okul sanayi ilişkileri güçlendirilmeye çalışılmışsa da bu konuda esas görev eski adı ile il mesleki teknik eğitim komisyonları, yeni adı ile il istihdam ve mesleki teknik eğitim kurulları, okul sanayi ilişkilerini canlı tutma ve ihtiyaçları milli eğitim bakanlığına aktarma konusunda yetkili organlardır. Kurul; valinin başkanlığında, belediye başkanı, büyükşehir belediyesi bulunan illerde büyükşehir belediye başkanı veya genel sekreteri ya da genel sekreter yardımcısı, il özel idaresi genel sekreteri, il millî eğitim müdürü, il sanayi ve ticaret müdürü, il ticaret ve sanayi odası başkanı veya başkanları, işçi konfederasyonlarından birer temsilci, işveren konfederasyonlarından birer temsilci, Sakatlar Konfederasyonundan bir temsilci, il esnaf ve sanatkârlar odaları birliği başkanı, ilde bulunan yüksek öğretim kurumlarının çalışma ekonomisi ve endüstri ilişkileri bölümü veya mesleki teknik eğitim bölümlerinden valinin belirleyeceği bir öğretim üyesinden oluşur. Kurulun görevleri arasında bulunan en önemli maddeler şunlardır:(Resmi Gazete,2008)

- a) İlin istihdam ve mesleki eğitim politikasını oluşturmak,
- b) İlin muhtelif sektör ve branştaki işgücü ve mesleki eğitim ihtiyacını belirlemek üzere işgücü piyasası analizleri yapmak-yaptırmak, il düzeyinde işgücü piyasası bilgi sistemi ile izleme – değerlendirme sistemini oluşturup uygulamak, bu amaçla gerektiğinde ilgili alan uzmanlarından komisyonlar oluşturmak, bunların görev tanımları çerçevesinde hazırladıkları raporları değerlendirmek, yayınlamak ve gerektiğinde ilgili Bakanlık, kamu kurum ve kuruluşlarına sunmak,
- c) Millî Eğitim Bakanlığınca gönderilen mesleki ve teknik eğitim çerçeve programlarının işgücü piyasası araştırma sonuçlarına göre ilin ihtiyaçları doğrultusunda düzenlenmesi için görüş bildirmek,
- ç) Mesleki ve teknik eğitim uygulamalarında ortaya çıkan uyumsuzlukların çözümüne yardımcı olmak,
- d) Mesleki eğitim, işgücü ve istihdam konularında kurum ve kuruluşlardan gelecek görüş ve önerileri incelemek, değerlendirmek ve sonuçlandırmak,

- e) İl düzeyinde istihdamı koruyucu, geliştirici ve işsizliği önleyici tedbirleri belirlemek ve gereği için ilgili kurum ve kuruluşlara bildirmek,
- f) İşgücü piyasası araştırma sonuçları da dikkate alınarak İl Millî Eğitim Müdürlüğü ve Kurum tarafından hazırlanan işgücü yetiştirme faaliyetlerine ilişkin planları onaylamak ve bunların uygulama sonuçlarını izlemek,
- g) Mesleki ve teknik eğitimin geliştirilmesine ilişkin tam gün tam yıl eğitim uygulaması ile ilgili görüş bildirmek,
- ğ) İşgücü ihtiyaç analizleri sonuçlarını da dikkate alarak, ilde bulunan tüm mesleki ve teknik eğitim veren okul veya kurumların bünyesinde yer alacak alan ve dalların belirlenmesi, kısa, orta ve uzun vadede ilin mesleki ve teknik eğitim okul yatırımlarının planlanması ile beraber eğitimi yapılacak alan ve dal ihtiyaçlarını belirleyerek, Millî Eğitim Bakanlığına görüş sunmak,

Kurul; her yıl Ocak, Nisan, Temmuz ve Ekim aylarında toplanır. Ayrıca, başkanın çağrısı üzerine olağanüstü de toplanabilir. Kurul, üye sayısının salt çoğunluğu ile toplanır. (resmi gazete,2008)

## Sonuç

Genel anlamda alanda başarılı bulunan ülkelerin mesleki eğitim sistemleri incelendiğinde, uygulanan sistemin okul ya da işletme ağırlıklı model olması başarıyı getiren temel faktör olarak göze çarpmamaktadır. Okul ağırlıklı sistem yüksek altyapı ve eğitim materyali maliyetine, işyeri ağırlıklı sistem ise düşük maliyete sahiptir. Ancak her iki modelden de yukarıda anlatıldığı gibi başarılı örnekler çıkması, maliyetlerin başarıda birincil önemde olmadığını göstermektedir. Başarılı sistemlerin ortak özelliği özel sektör ya da sanayi ile güçlü iletişim ve işbirliği olarak karşımıza çıkmaktadır.

Bu işbirliği Almanya'da ulusal ve eyalet bazında belediye ve şirketlerden oluşan bir ağ tarafından sağlanmaktadır. Bu ağ uzun vadeli ekonomik hedefleri gerçekleştirmek için taviz vermeyen, sabırlı ve sahiplenmeci bir yapıdır. Aynı şekilde İsveç örneğinde mesleki teknik eğitim öğrencisi ve mezunlarını istihdam için devlet tarafından özel sektöre sunulan kredi ve teşvik gibi imkanlar bu bağın güçlü bir iletişime sahip olmasına yardımcı olmaktadır. Bu iletişimin en güçlü olduğu örnek Finlandiya'dır. Finlandiya'da her okulda bulunan okul ve özel sektör temsilcilerinden oluşan okul programı kurulu mesleki teknik eğitimde işbirliği ve çözümleri sağlamada sektörel ve bölgesel boyuttan çok daha mikro bir düzeye indirgeyen adeta butik çözüm merkezleri boyutundadır.

Ülkemizde ise her ne kadar eğitim standartlarının modernleştirilmesi için pilot uygulamalarla özel sektör ve devlet arasında işbirliği sağlanmaya çalışılmış ise de bu durum genele yansıtılamamıştır. Okul-sanayi işbirliğini ve iletişimini güçlendirme ile görevli il istihdam ve mesleki teknik eğitim kurulları ülke çapında aktif çıktı sağlayamamaktadır. Bu durumun altında yatan nedenlere baktığımızda; kurul toplantılarına katılma zorunluluğu olmasına karşın, katılmama durumunda herhangi bir yaptırımın olmaması, gönüllü hareket etme bilinci ve toplumsal fayda sağlama refleksinin zayıf olması gibi durumlardan dolayı özel sektör aktif katkıdan uzaklaşmaktadır. Ayrıca bu durum bu tür kuruluşların uygun alt yapı olsa da etkili iletişimi sağlamaktan uzak kalmalarına neden olmaktadır. Tüm bu sayılanlar ışığında başarılı yani piyasa uyumunu sağlamış bir mesleki teknik eğitim yapısı için, model, yöntem ve imkanlardan çok, güçlü okul-sanayici iletişiminin daha etkili bir rol oynadığı açıkça görülmektedir. Ülkemiz göz önüne alındığında bu iletişimi kuvvetlendirme ve bu konudaki bilinci artırma yönünde atılacak adımların mesleki teknik eğitimde piyasa uyumuna daha fazla katkı sağlayacağı söylenebilir. Bu iletişimi sağlamada sorumluluk öğrenci, öğretmen ve işveren boyutunda

toplumun çok daha yaygın bir kesimine ait olsa da bu konudaki iyileşme ve bilinçlenmeler bahsettiğimiz il istihdam ve mesleki teknik eğitim kurulları gibi temsil ve yönetim gücü olan noktalardan başlamak zorundadır.

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# MICROSTRUCTURE AND INTERFACE ANALYSIS OF Ni<sub>3</sub>Al INTERMETALLIC ALLOY COATING ON AISI 304 STEEL BY PTA PROCESS

<sup>1</sup>Ilyas Somunkiran, <sup>1</sup>Soner Buytoz, <sup>2</sup>Bülent Kurt

<sup>1</sup>Firat University, Faculty of Technology, Department of Metallurgy and Materials Engineering, 23119 Elazığ/ Turkey

<sup>2</sup>Nevşehir University, Faculty of Engineering, Department of Materials Engineering, Nevşehir/Turkey

\*Corresponding author: Soner Buytoz (sbuytoz@gmail.com)

**Abstract** In this study, an austenitic stainless steel was coated with Ni<sub>3</sub>Al intermetallic alloy. Deposition layers formed from AISI 304 stainless steel by plasma transfer arc (PTA) process at 110, 120 and 130 A currents values and argon gas was used for both plasma and protective. Analyses of microhardness, SEM, EDX and X-ray were carried out in order to examine surface and interface characteristics of the coating layers. It was found that the primer Ni<sub>3</sub>Al phase and secondary NiAl phase existed in the Ni<sub>3</sub>Al alloy coating obtained by PTA process at 110 A current. From the results, it was seen that increased current values caused to the cracks in the coating layer and also affected the coating layer and interface microstructure.

**Keywords:** PTA coating, Ni<sub>3</sub>Al, Microstructure

## Introduction

The demands on the lifetime and surface performance of the materials are continuously increasing. Thus, different surface coating techniques have been used to improve surface properties of materials. Surface properties and quality depend strongly upon the selected alloys and deposition processes [1-5]. The use of plasma transferred arc technique for deposition of high-performance coatings has been attempted by many researchers [6-9]. Fabricating high, wear-resistant coatings on their surfaces is an efficient approach to improve the surface properties of metallic material without affecting seriously the properties of the substrate materials. [10-12]. Plasma transferred arc (PTA) process can be defined as a gas-shielded arc welding process where the coalescence of metals is achieved via the heat transferred by an arc that is created between a tungsten electrode and a submaterial. The arc is constricted by a copper alloy nozzle orifice to form a highly collimated arc column. The plasma is formed through the ionization of a portion of the plasma (orifice) gas [13].

Ni<sub>3</sub>Al has excellent corrosion and oxidation resistance in a wide range of temperatures owing to formation of highly stable alumina oxide layer on the surface. Also, Ni<sub>3</sub>Al keeps its phase stability up to high temperatures close to its melting point [14]. Austenitic stainless steel is a widely used engineering alloy in liquid-handling systems and hydraulic machinery because of its excellent corrosion resistance, good processibility, and relatively low cost. However, they exhibit high toughness and good oxidation resistance only up to the temperatures of nearly 600 °C [15,16].

In this paper, PTA weld-surfacing process was adopted to produce composite coating on AISI 304 stainless steel substrate using Ni<sub>3</sub>Al intermetallic alloy. Microstructural characteristics of the coating layer and the interface of Ni<sub>3</sub>Al intermetallic alloy and stainless steel were characterized using scanning electron microscopy (SEM), X-ray analysis (EDS), X-ray diffraction (XRD) and energy dispersive analysis and microhardness measurements.

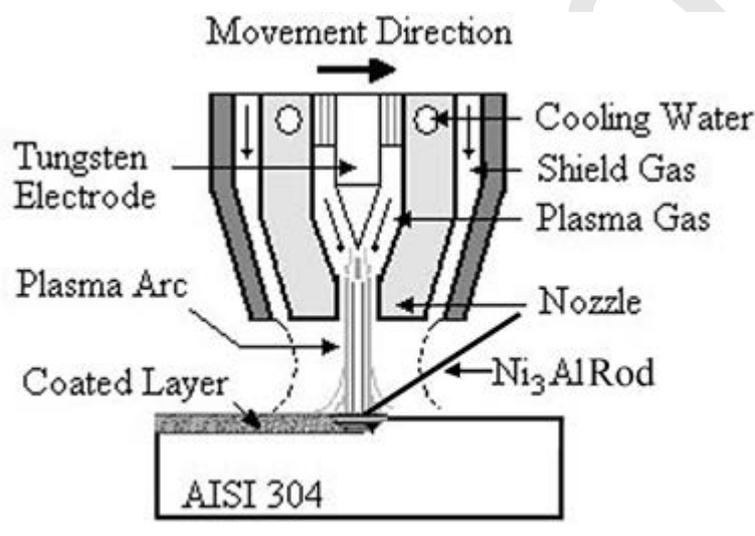
## Experimental procedure

In this study, Ni<sub>3</sub>Al intermetallic alloy rod of 2 mm diameter and the AISI 304 stainless steel flat bar of 10 mm thick were used as coating and substrate material respectively. AISI 304 Stainless steel specimens were cut to the

dimensions  $80 \times 25 \times 10 \text{ mm}^3$ , polished with 220-grit SiC abrasive paper and rinsed with ethyl alcohol prior to coating. Table 1 shows the chemical compositions of the materials. The operating principle of PTA process is schematically shown in Fig. 1. Surface coating procedure was realized that different three current values were used. Parameters of PTA weld-surfacing process are given in Table 2.

**Table 1.** Chemical compositions of the coating and substrate materials

| Alloy              | Composition (%) |       |      |       |      |       |       |        |       |      |
|--------------------|-----------------|-------|------|-------|------|-------|-------|--------|-------|------|
|                    | C               | Cr    | Ni   | Mo    | Si   | Mn    | P     | S      | Al    | Fe   |
| Ni <sub>3</sub> Al | 0.007           | 0.046 | Bal  | 0.002 | 0.03 | 0.024 | 0.002 | 0.0004 | 11.12 | 0.45 |
| AISI 304           | 0.02            | 17.3  | 11.0 | 2.2   | 0.78 | 1.8   | 0.02  | 0.015  | -     | Bal. |



**Figure 1.** Schematic appearance of PTA coating method.

When the plasma arc transferred the surface of the specimen, the coating material was melted simultaneously and melted coating layer occurred on the substrate material surface. Thus, a novel coating layer, which is metallurgically bonded to substrate and has rapidly solidified microstructure, was fabricated.

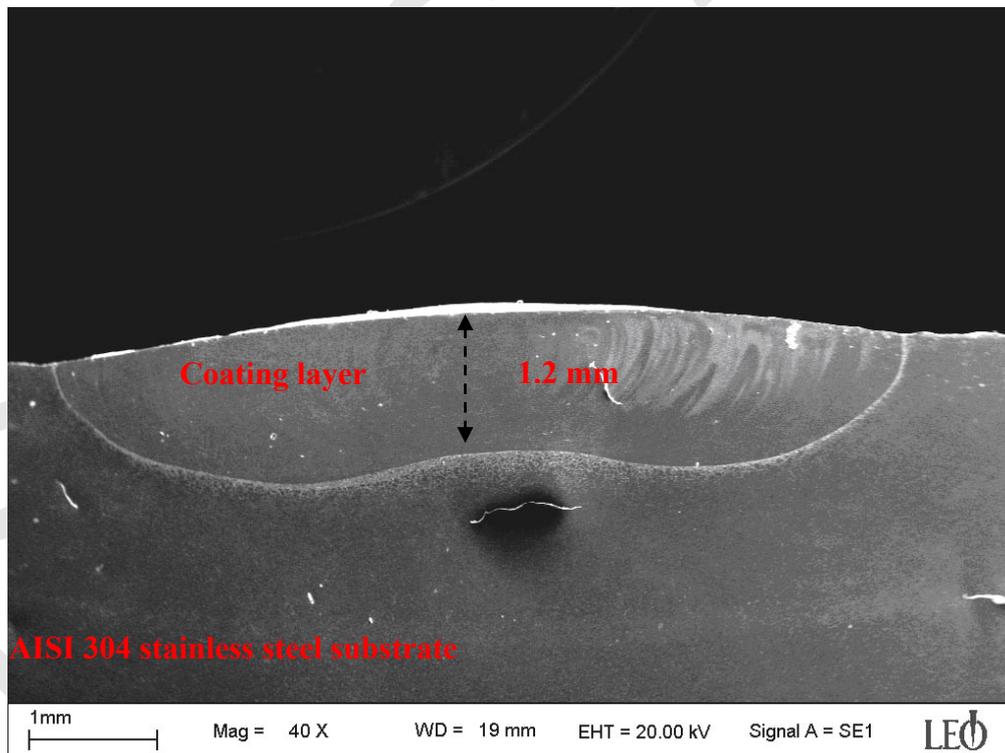
**Table 2.** PTA weld-surfacing process experimental parameters

|                             |                 |
|-----------------------------|-----------------|
| Arc current (A)             | 110 - 120 - 130 |
| Shield gas flow (Ar, l/min) | 25              |
| Plasma gas flow (Ar, l/min) | 0,2             |
| Diameter of electrode (mm)  | 4,7             |
| Travel speed (mm/s)         | 2,2             |
| Torch gap (mm)              | 3               |

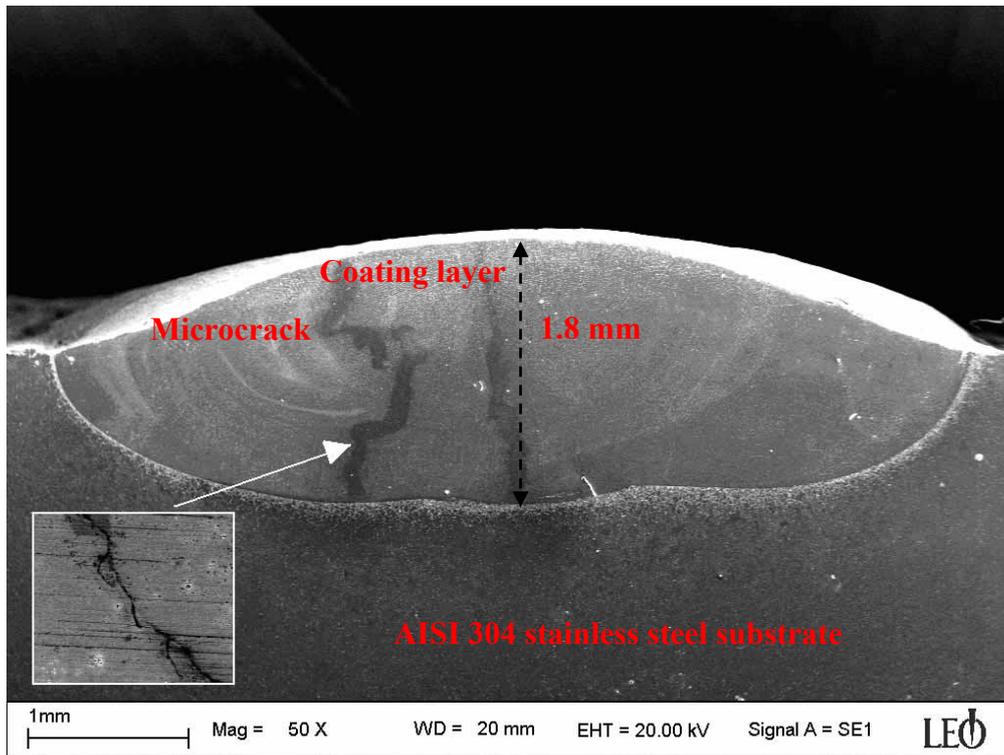
Metallographic examination of the coating layer and, the interface of coating layer and substrate material involved preparing transverse sections followed by grinding and polishing to 3  $\mu\text{m}$  diamond paste. For microstructural examination, the specimens were etched electrolytically in a solution of 50 ml  $\text{HNO}_3$  and 50 ml pure water. The microstructures of the specimens were investigated by scanning electron microscopy (SEM), the energy dispersive X-ray (EDX) and XRD analysis. Microhardness measurements were carried out by a Leica microhardness tester under a load of 50 g.

## Results and Discussions

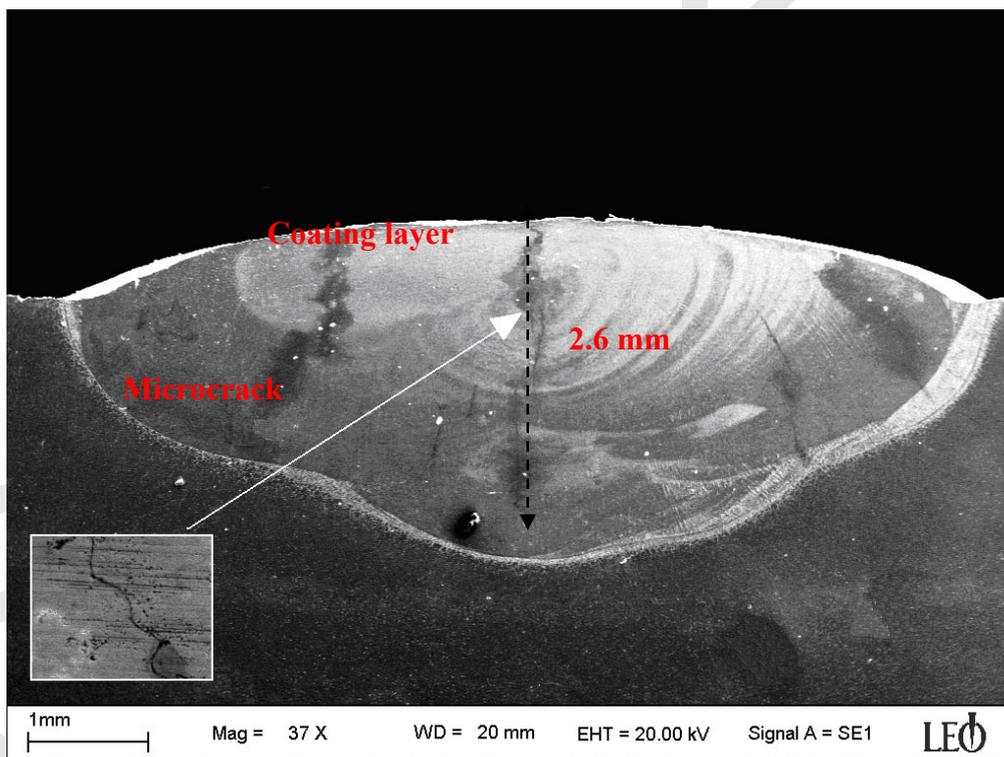
Fig. 2 shows the typical surface microstructure of the alloyed layers with three different currents values. It can be seen that the width of effective coating layers is 1.2, 1.8 and 2.6 mm at 110, 120 and 130 A respectively. Increasing current values were caused to higher mix ratio between alloyed layer and substrate material. No cracks or pores were seen both in the alloyed layer and interface at the 110 A current (It is clearly seen in Figure 2 a). But, the microcracks caused at the coated layers with increasing arc current value. It is clearly seen in Fig. 2 (b) and Fig. 2(c). This can be attributed to a combination of factors, including high thermal residual stresses under rapid solidification and high temperature non-equilibrium phases generated [17]. Since polycrystalline  $\text{Ni}_3\text{Al}$  is brittle because of the brittleness of the grain boundaries. In addition low thermal conductivity of stainless steel is thought to be another reason for the cracks, which it limit heat transfer from the intermetallic and consequent thermal stresses loaded.



(a)



(b)

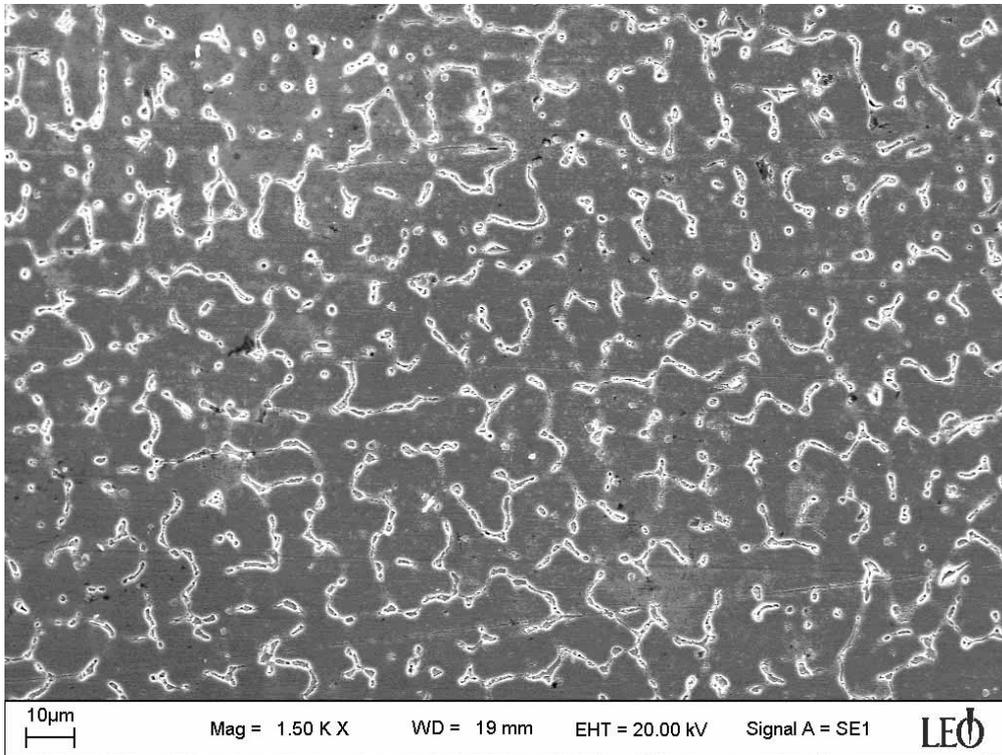


(c)

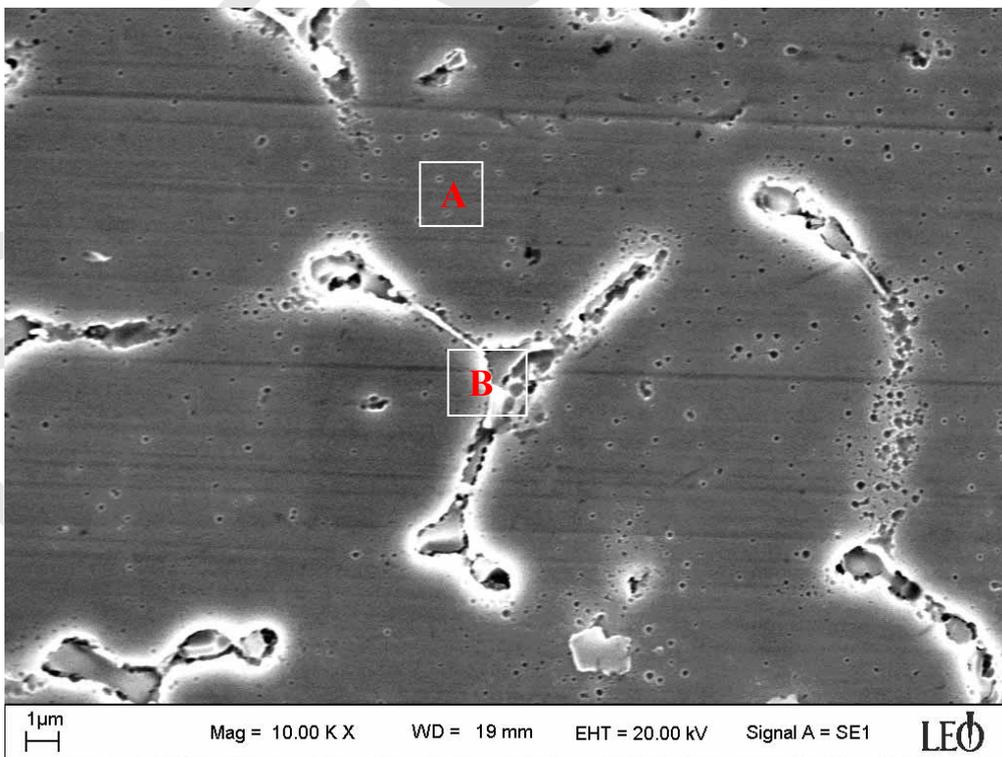
**Figure 2.** SEM micrographs of coating layer depths at the 110 A (a), 120 A (b) and 130 A (c) currents.

Figure 3 shows SEM image of the etched cross-section of the  $\text{Ni}_3\text{Al}$  intermetallic alloy deposited by the PTA process at 110 A current value. From the Figure 3 (a), two different phase are seen as matrix and precipitate phases. This situation clearly is shown at the magnified micrograph in the Fig. 3 (b). The EDX results taken from A and B points in Fig. 3 (b) are shown in Figure 3 (c) and (d). The composition of alloyed layer main material consists of 84.4 % Ni, 14.6

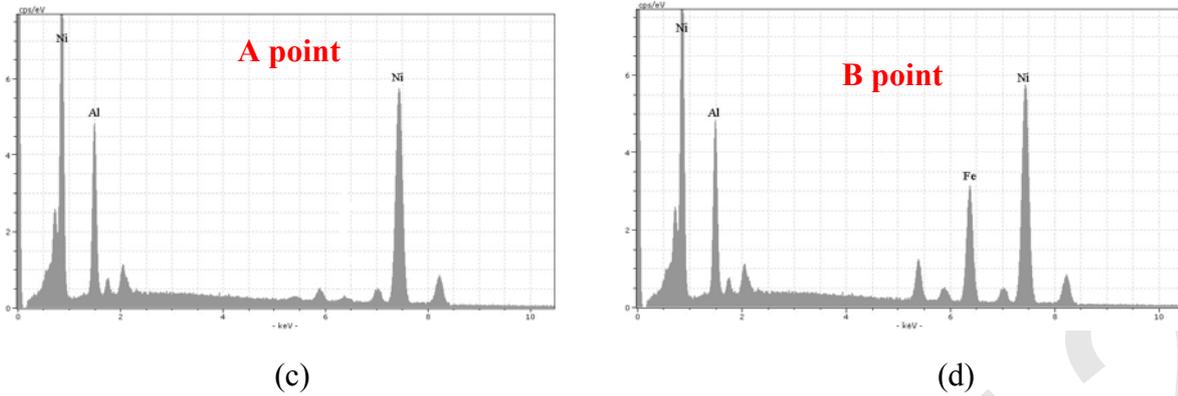
% Al and 0.55 % Fe. From the Ni-Al binary phase diagram, thus compositions were determined as Ni<sub>3</sub>Al phase for A point and NiAl phase for B point. The precipitate phase composition into the coating layer was determined as 70.2 % Ni, 24.4 %Al and 4.8 % Fe from the EDX result. The NiAl phase with small volume fraction is distributed non-uniformly in the Ni<sub>3</sub>Al matrix. This phase was also caused to relatively smaller grain size.



(a)

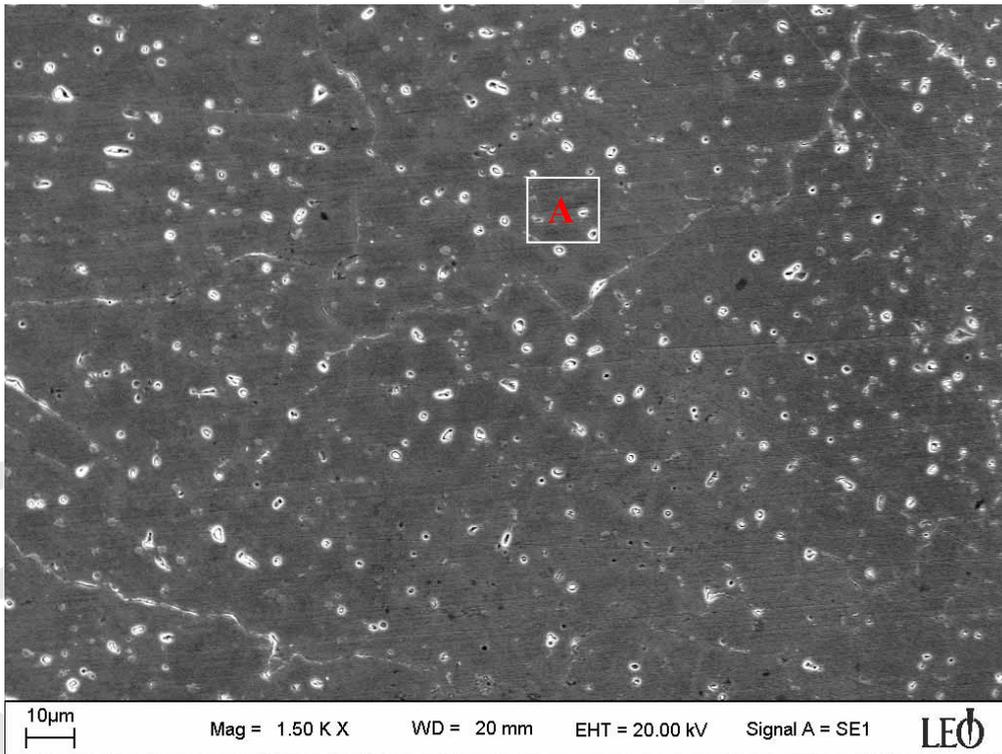


(b)

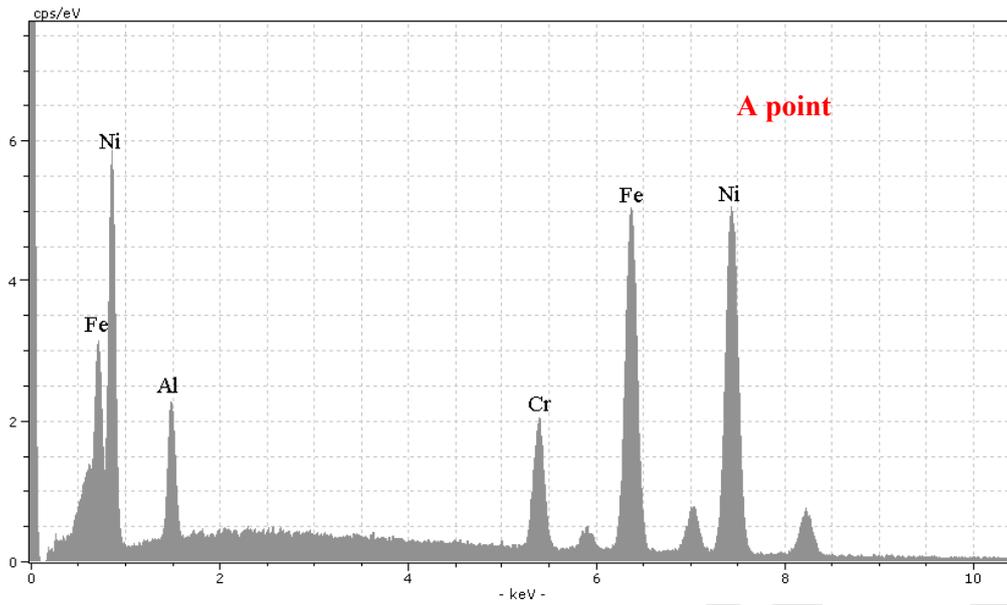


**Figure 3.** SEM micrograph of coating layer at the 110 A.

Fig. 4(a) shows the microstructure of the alloyed layer using 120 A current. When the employed arc current reaches 120 A, precipitated phases are dispersed into the coating layer matrix and its contents are decreased. This situation can be clarified by increasing heat input and mixed alloying elements from the AISI 304 stainless steel. The matrix phase for 120 A current consist of 55.4 % Ti, 29.5 % Fe, 7.5 % Cr and 7.6 % Al from EDX analysis taken in this field (Fig. 4 (b)). This composition was determined to be  $\gamma$  phase by Fe-Cr-Ni ternary phase diagram. This result showed that in the high currents as 120 A,  $Ni_3Al$  intermetallic alloy not formed.



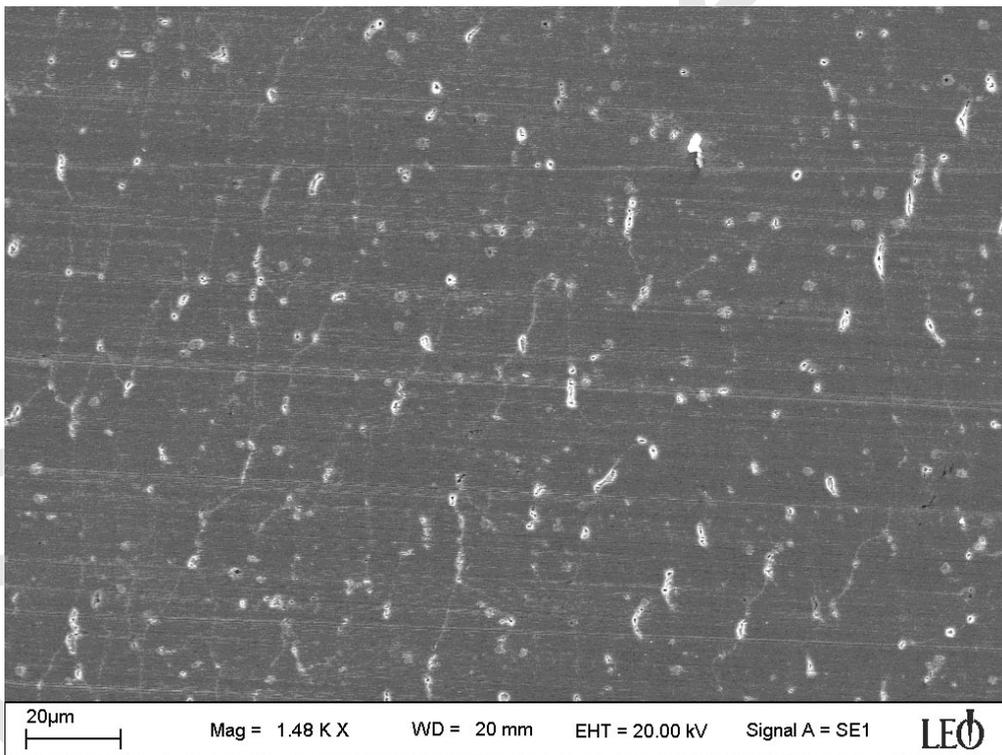
(a)



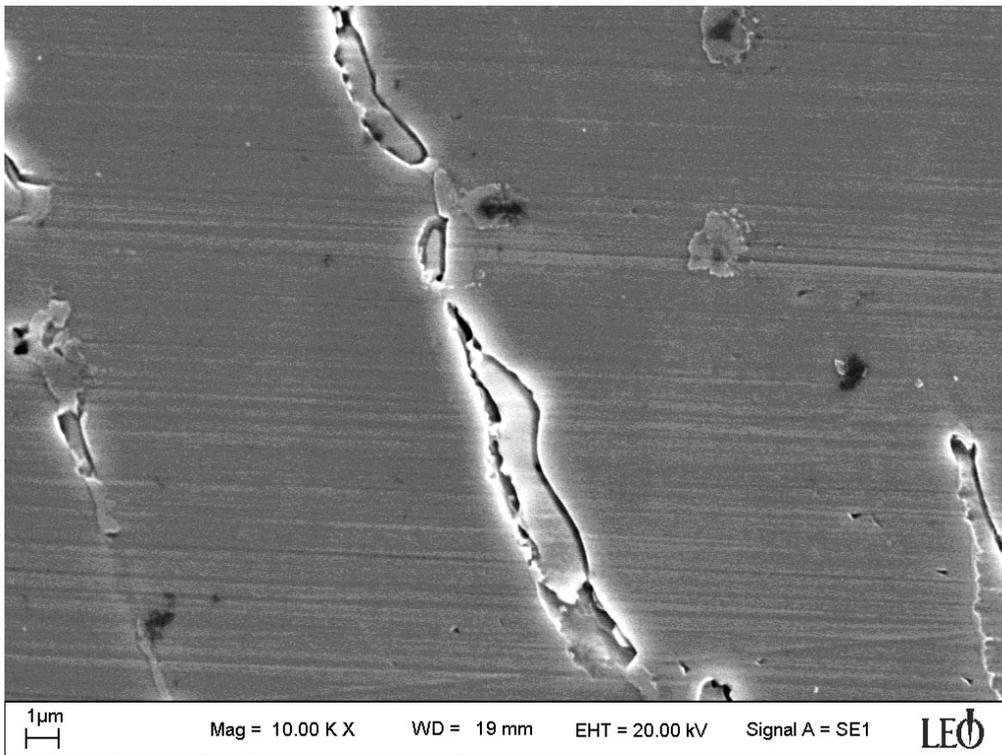
(b)

Figure 4. SEM micrograph of coating layer at the 120 A.

Fig. 5(a) and (b) shows the microstructure of alloyed layer for 120 A. The interface micrographs of the alloyed layer and substrate material are seen in Fig. 6.



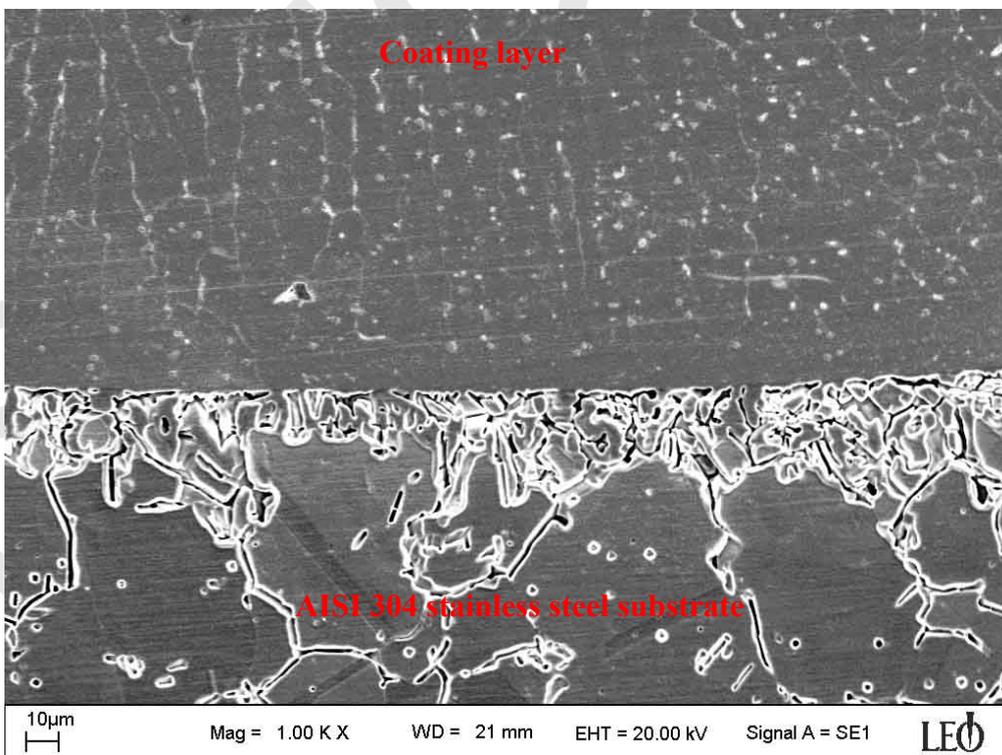
(a)



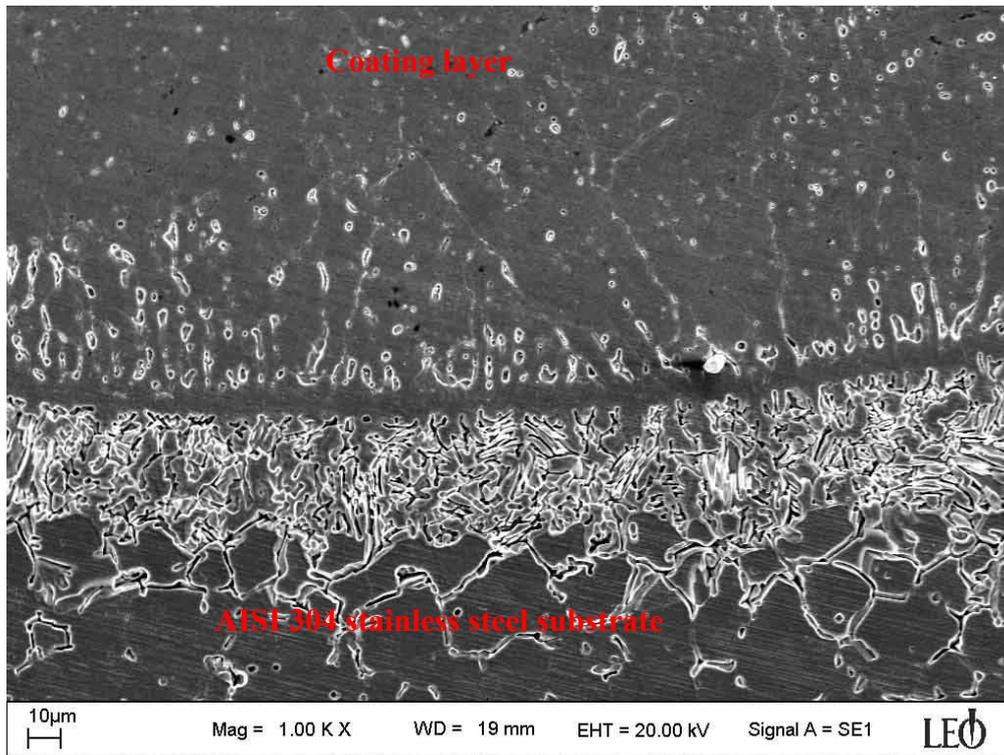
(b)

**Figure 5.** SEM micrograph of coating layer at the 130 A.

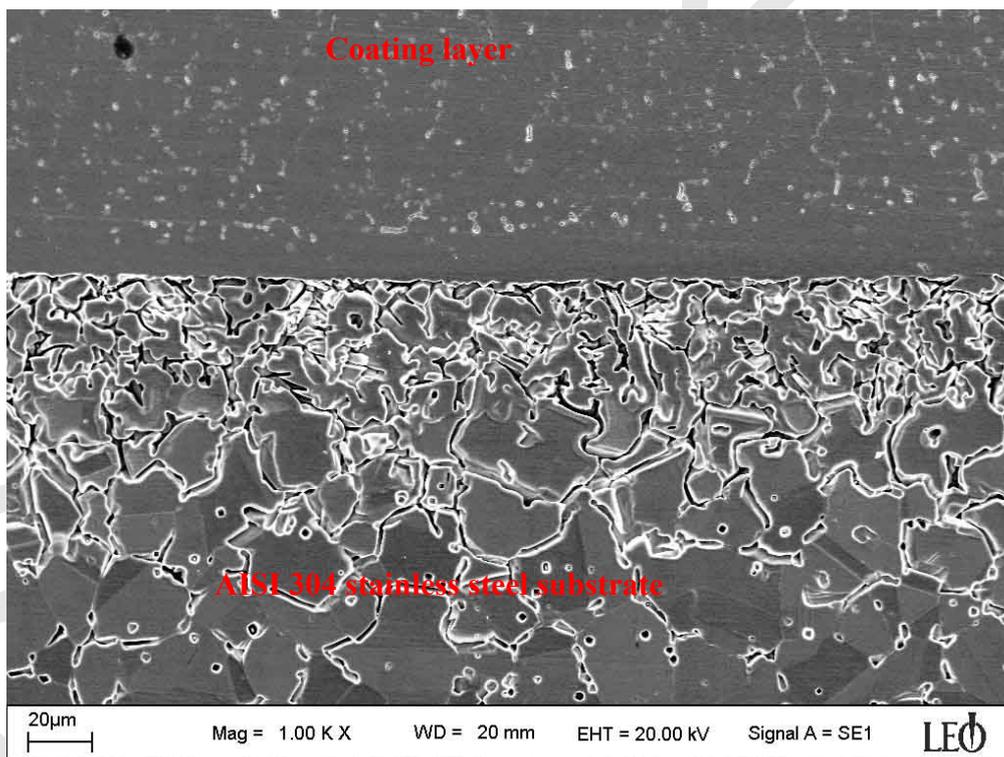
The width of the interface zone, which formed with rapid solidification, was 5  $\mu\text{m}$  for 120 A and 10  $\mu\text{m}$  for the currents of 130 A (Fig. 6(b) and Fig. 6(c)). The width of heat affected zones (HAZ) was approximately 40  $\mu\text{m}$ , 60  $\mu\text{m}$  and 90  $\mu\text{m}$  for 110, 120 and 130 A respectively.



(a)



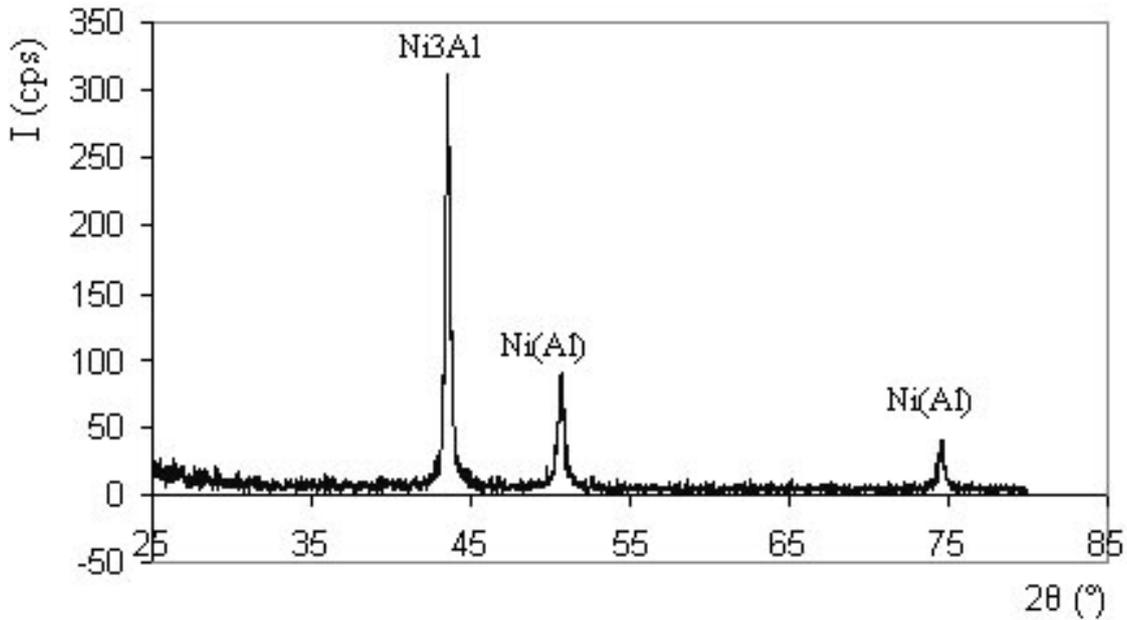
(b)



(c)

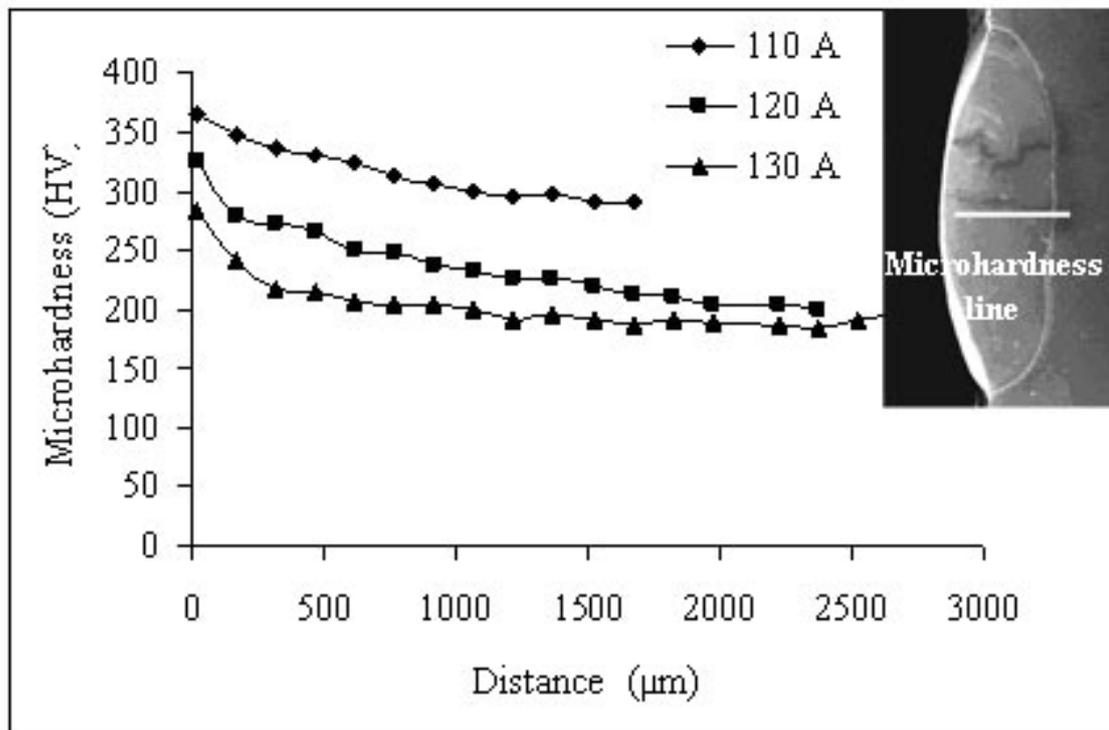
**Figure 6.** SEM micrograph of coating layer and substrate material interface at at the 110 A (a), 120 A (b) and 130 A (c) currents.

The XRD pattern of the  $\text{Ni}_3\text{Al}$  coating layer at the 110 A is shown in Fig. 7. The desired product  $\text{Ni}_3\text{Al}$  is the predominant phase in the alloyed layer. In addition,  $\text{NiAl}$  phase was formed in the coating layer as second phase. This result also supported the microstructural results.



**Figure 7.** X-ray profile of the  $\text{Ni}_3\text{Al}$  coating layer for 110 A.

The microhardness test results taken from the coating layer surface towards substrate material are shown in Fig.8.



**Figure 8.** Microhardness distribution from the coating layer surface to the substrate material.

From the figure it is clearly shown that increased welding currents reduce the coating layer hardness. This result can be explained with increased heat input according to increased welding currents. Increased heat input caused to higher mixture ratio between coating and substrate materials. Therefore, increased Fe and Cr addition reduced the

hardness of coating layer. From the coating layer microstructure and EDX result in Fig. 4 it is clearly shown that higher heat input caused to  $\gamma$ -phase formation in the coating layer.

## Conclusions

$Ni_3Al$  intermetallic alloy was coated on an austenitic stainless steel surface by plasma transfer arc (PTA) process. The following results were obtained.

- 1- The coating layer thickness of 1.2, 1.8 and 2.6 mm at 110, 120 and 130 A currents, respectively were obtained.
- 2- Microcracks in the coating layer occurred at the 120 and 130 A current values. This can be high thermal residual stresses under rapid solidification and high temperature non-equilibrium phases generated.
- 3- In the increased currents,  $Ni_3Al$  intermetallic alloy not formed.
- 4- The microhardness of coating layers decreased with the increased current values.

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# MODELING INTERNET ROUTING PROTOCOLS AND SCALABILITY EVALUATION

Fatih Çelik, Ahmet Zengin, Barış Taçyıldız, Hüseyin Ekiz, Ayhan Kiraz  
Technology Faculty  
Sakarya University  
Turkey  
azengin@sakarya.edu.tr

**Abstract:** Paper presents a discrete event simulation (DEVS) based comparative performance analysis between OSPF and RIP together with BGP protocol by using DEVS-Suite. Several network models are designed and configured respectively with OSPF, RIP and combination of BGP, in order to evaluate OSPF and RIPs scalability performance. Evaluations of proposed routing protocols are performed based on the metrics such as execution time, convergence time, turnaround time, throughput and efficiency across increasing size and complexity through the simulated network models. The evaluation results show that OSPF routing protocol provides a better scalability performance than RIP routing protocol for Internet applications.

Keywords: DEVS, DEVS-Suite, OSPF, RIP, BGP, Internet.

## Introduction

In this paper, we developed DEVS-based protocol models for RIP, OSPF and BGP for addressing the main challenges in scalability of these protocols in the Internet. During the experiments, DEVS-based discrete event simulation software, known as DEVS-Suite Kim, Sarjoughian and Elamvazhuthi (2009), has been successfully manipulated as domain-neutral simulation software. Apart from that, it offers easy graphical and trackable interface, additionally by providing an extensive library of components for designing simulation model more reliably and efficiently. Developed DEVS-Suite OSPF and RIP frameworks provide visualization, advanced tracking capability, reusability and component-based model design. Subsequently, the research investigates how well the OSPF and RIP protocols respond to various Internet performance metrics, such as execution time, efficiency, convergence, end to end delay and throughput. Such analysis is important since it facilitates in determining the most suitable and robust Internet protocols in a proposal to optimizing the traffic goals in the Internet. The research also examines and compares the routing performance of protocols under a variety of network conditions and scales. A number of important system parameters such as network size, number of nodes per AS, number of links per nodes and topology model are taken into consideration. The changes of such parameters are made to realize different realistic Internet scenarios as well as to evaluate the extent of their impact on network and routing protocols performance such as scalability.

## DEVS Formalism

Discrete event system specification (DEVS) formalism is a novel approach for modeling dynamic systems and is developed by Zeigler Zeigler, Praehofer and Kim (2000). In DEVS, time passes only when a new event occurs. This approach is well suited for formally describing concurrent processing and the event-driven nature of arbitrary configuration of networked components. This modeling approach supports system theoretic, formalized, hierarchical and modular model construction, distributed execution, and therefore characterizing complex, large-scale systems with atomic and coupled models. Following properties are main reasons to make use of DEVS formalism in our network modeling effort:

- 1-An event-based efficient approach: DEVS approach is developed as an extension of the Moore machine formalism (Zeigler, 1990). DEVS formalism is a kind of finite state automaton approach in which states and outputs are created by the current state and the inputs. As contrary to other finite state approaches, DEVS has brought new concepts to simulation community such as state lifespan and a hierarchical concept. These innovations have rendered possible to create very efficient simulation software.
- 2-Strong couplings among components: In the DEVS component connection architecture, a basic entity is a component called atomic model. Each atomic model owns one or more communication ports. By the way, two atomic models are connected by “wiring” their ports together. DEVS formalism relies on network models to facilitate entity or message movement and decision making.
- 3-Modular and hierarchical design: DEVS autonomous component architecture yields to design highly modular and hierarchical system. This scheme provides a manageable system across increasing size and complexity. In

particular, for large-scale network applications, this property is needed to design scalable methods. In DEVS implementations, models, their simulators and experimental frames are all distinct entities and their software representations are also modular.

4-Object-orientation: Object-oriented design is today's most popular programming paradigm. Object-orientation yields to simpler, concrete, robust, flexible and modular software implementations. DEVS exploits these properties to create a successful and manageable simulation application.

5-Easy to abstract: DEVS provides abstraction and simplification mechanisms as wide as to modeling objectives. When modeling ultimately complex and dynamic systems, simplification mechanisms become important for the sake of building scalable systems.

6-Automated parallel/real-time execution: DEVS can manage parallelism (Chow, 1996). It has a specific function for parallel-occurred events which orders events according to some criteria. DEVS also supports for real-time execution. DEVS-based simulators can perform single host, distributed and real-time execution.

7-Interoperation and reuse: DEVS simulators can run over various middle-wares such as MPI, HLA and CORBA Sarjoughian and Zeigler 2000. In a typical DEVS design, a variety of model components can be reused. This may reduce development times and provide to focus on higher levels. Model repositories and experimental frames can be created, maintained and they are ready to reuse.

Developed DEVS network models can be executed using DEVS-Suite simulation engine (Sarjoughian, 2010). As an extension of DEVSJAVA, DEVS-Suite is an object oriented realization of parallel DEVS and its associated simulators. The main components of the simulation package are simview, DEVS tracking Environment, and timeview Kim, Sarjoughian and Elamvazhuthi (2009).

## Routing Protocols for Internet

Routing protocols in the network systems can be split into two main categories: link state routing and distance vector routing (Steenstrup, 1995). Currently, in particular for Internet, link state protocols are used for intranet while distance vector protocols are used for inter-gateway interactions (Tanenbaum, 1996).

Routing Information Protocol (RIP) is widely deployed routing protocol for Internet which is based on distance vector routing algorithm (Hendrik, 1988). Having an open framework and easy to deploy architecture, RIP are become popular in today's network devices, however it does not meet requirements of current large-scale network systems (Steenstrup, 1995).

Open Shortest Path First protocol (OSPF) as one of the famous link state routing protocol is an open standard routing protocol and a particularly efficient interior gateway (IGP) routing protocol that is faster than routing information protocol (RIP) which is one of the most known kinds of the distance vector protocols family (Force, 2009). It uses the Dijkstra algorithm when estimating the shortest paths (Dijkstra, 1959).

Border Gateway Protocol (BGP) is an inter-Autonomous System (AS) routing protocol which provides to exchange network reachability information with other Autonomous Systems (Steenstrup, 1995). This exchanged information contains the list of Autonomous Systems that BGP packet traverses. Using this information, a graph of AS connectivity is constructed by which routing decisions can be made according to distance vector algorithm.

## Network Model

In order to evaluate the performance of the routing protocols, a network model is developed on top of the DEVS-Suite Simulation Viewer. Developed simulator has a hierarchical and modular design inherited from underlying DEVS modeling formalism. Being an object-oriented implementation of the DEVS formalism, DEVS-Suite has a high level user interface that is built as of Java Kim, Sarjoughian and Elamvazhuthi (2009). Hierarchical structure of the developed simulator is divided into three levels. These are network application level, node level and event process level.

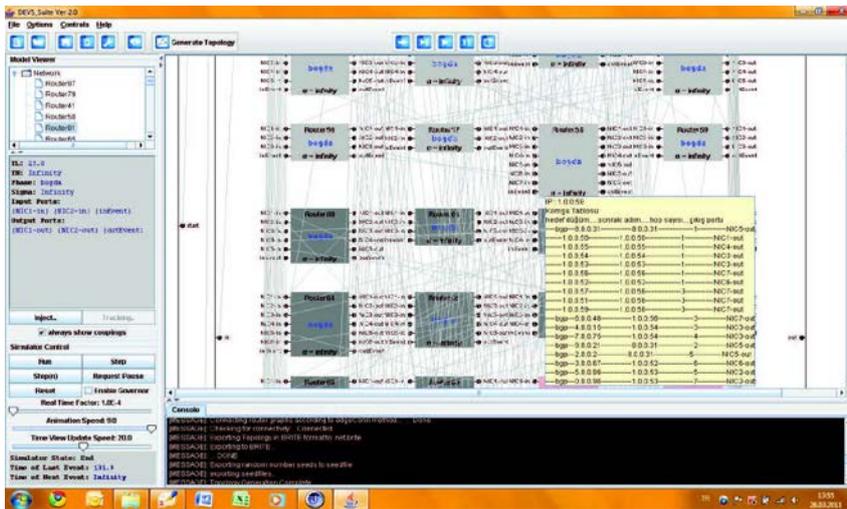


Figure 1: RIP-DEVS network model in DEVS-Suite simulation viewer

The network models are generalized to model a wide range of network technologies in a single model. First of all, devices belonging to the first layer of seven-segment OSI layers are modeled. These hardware devices are links, queues, network interface cards (NIC) and the nodes. DEVS formalism and its associated tools are selected for modeling such a distributed system since DEVS enables the modeler to specify systems in system theoretic manner and yields hierarchical and modular developments, facilitating to model distributed systems with intelligent components and overcome the complexity. DEVS definitions of the network model can be found in (Zengin, 2010) and Zengin and Sarjoughian (2010).

Node level is an internal infrastructure of the network level autonomous system. Since a typical networked system can only be characterized as nodes and links, it is started to develop network model by specifying these basic components using parallel DEVS atomic model. Thanks to DEVS component structure flexibility, a node can be routers, workstations, satellite and so on.

Process level are used to specify the attribute of the node model by using DEVS model specifications and source code Java which is inside the node models. Figure 2 depicts a node's state chart in which states are only changed via internal and external transitions. As seen in the figure, a node's OSPF behavior is abstracted to ten states to mimic OSPF behavior. For example, when a node is in "idle" state if it receives a packet and its queue is full, then state changes to "congested".

## Formalization of the RIP-DEVS model

Besides OSPF model definition, RIP protocol is also analyzed and modeled using Discrete Event System Specification and implemented in DEVS-Suite Simulation Viewer. First of all, as in the OSPF case above, whole RIP logic is split into the sub-functions and procedures. Following are phases through which complete RIP behavior can be implemented:

- 1-Route Request Phase: In this phase, routers periodically advertise their distance to the destination to their neighbors similarly to hello protocol in the OSPF case. After initialization process, a typical RIP router uses Request message to get neighbor's routing information. On receiving Request, RIP router floods Response messages periodically.
- 2- Routing Table Update Phase: Every RIP router maintains a routing table to route the data packets. In our routing table implementation, there is only one routing entry for each destination. This information includes the shortest path to the destination, next router along the path to the destination and the cost value. On receiving an advertisement message, the router estimates whether received routes can be used or not. If received routes contain new information or routes, then the router updates its routing table.
- 3-Flooding Phase: Whenever a router updates its routing table, it goes through the advertising neighbor with this newly obtained information.
- 4-Message Forwarding Phase: When a new route is established, a router can route or forward a message containing this new information to its neighbors.

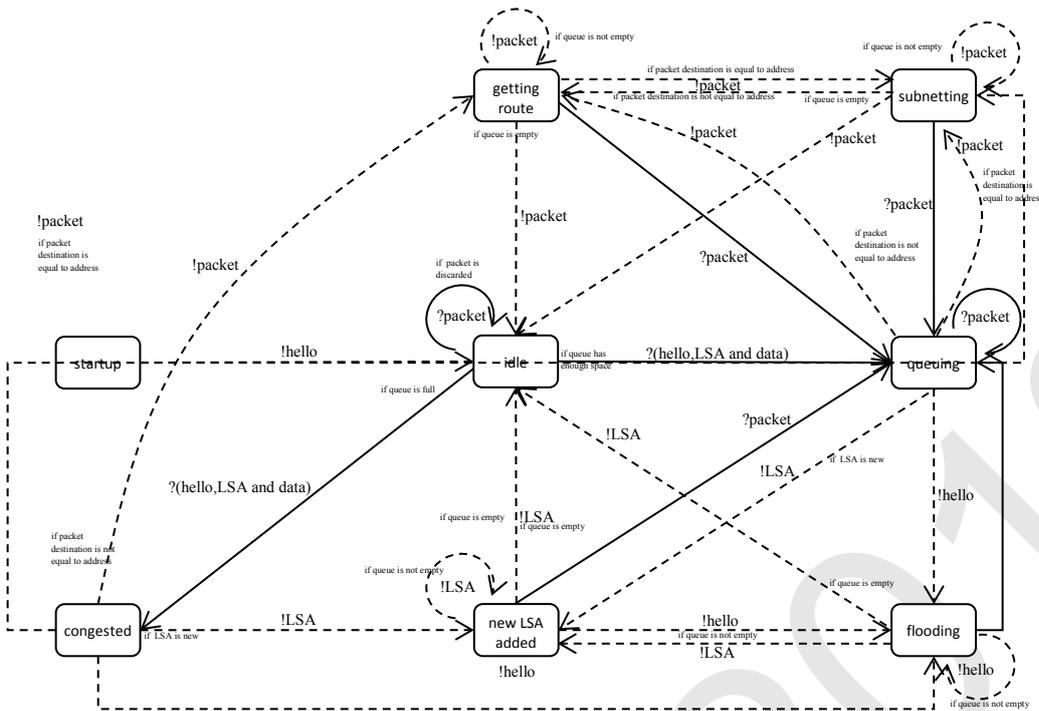


Figure 2: Finite state diagram of a node running OSPF protocol.

## Simulation Experiments

In this paper, a network simulator on the DEVS-Suite Simulation Viewer has been developed and used as a protocol evaluation framework. DEVS-Suite is a simulator built on top of discrete event systems specification (DEVS) formalism and it simulates the system behavior by modeling each event in the system and processes it through user defined processes Kim, Sarjoughian and Elamvazhuthi (2009). In order to investigate performance of the simulator in large-scale models and the Internet, a series of simulation experiments are done using RIP and OSPF as well as the BGP models as described in previous sections. Experiments are conducted in Core2Duo machine running at 2.1GHz with 4 GBRAM and Ubuntu 9.1064bit operating system. Large-scale DEVS coupled models up to thousands nodes are generated using integrated BRITE topology generator and then measured and reported the simulator outcomes. In the following table and graphs, these results are given in detail to show developed models and simulator's performance. Over ten thousands nodes, Java Virtual machine is reported out of memory error for OSPF-DEVS simulator, while over approximately nine thousands nodes, RIP-DEVS model reports the same message. Consequently, experiments were done within these scales.

**Table 1:** Comparison of OSPF and RIP protocols scalability characteristics

| Number of nodes | Number of AS | Number of nodes per AS | Logical convergence time (steps) |     | Efficiency (%) |      | Average throughput (Kbps) |      | Average turnaround time (sec) |       | Simulation logical time (steps) |      |
|-----------------|--------------|------------------------|----------------------------------|-----|----------------|------|---------------------------|------|-------------------------------|-------|---------------------------------|------|
|                 |              |                        | OSPF                             | RIP | OSPF           | RIP  | OSPF                      | RIP  | OSPF                          | RIP   | OSPF                            | RIP  |
| 10              | 1            | 10                     | 46                               | 50  | 100,000        | 100  | 4,40                      | 4,39 | 5,076                         | 5,213 | 1051                            | 1007 |
| 20              | 1            | 20                     | 109                              | 98  | 100,000        | 100  | 4,39                      | 4,36 | 6,317                         | 7,346 | 1116                            | 1012 |
| 30              | 1            | 30                     | 191                              | 128 | 100,000        | 100  | 4,39                      | 4,38 | 6,818                         | 7,652 | 1199                            | 1008 |
| 50              | 1            | 50                     | 392                              | 183 | 99,978         | 93,5 | 4,28                      | 4,08 | 7,64                          | 9,024 | 1401                            | 1012 |
| 50              | 5            | 10                     | 104                              | 131 | 100,000        | 100  | 4,36                      | 4,35 | 10,231                        | 10,16 | 1118                            | 1015 |
| 70              | 1            | 70                     | 647                              | 213 | 99,919         | 98,4 | 4,01                      | 4,30 | 8,23                          | 10,5  | 1599                            | 1010 |
| 100             | 1            | 100                    | 747                              | 228 | 99,924         | 96,7 | 4,05                      | 4,20 | 8,62                          | 11,35 | 1755                            | 1016 |
| 100             | 5            | 20                     | 207                              | 130 | 99,999         | 92,9 | 4,34                      | 4,03 | 12,88                         | 13,11 | 1225                            | 1017 |
| 100             | 10           | 10                     | 132                              | 131 | 100,000        | 100  | 4,36                      | 4,34 | 12,347                        | 13,29 | 1146                            | 1018 |
| 150             | 5            | 30                     | 355                              | 167 | 99,899         | 99,1 | 3,90                      | 4,28 | 13,69                         | 17,15 | 1374                            | 1023 |
| 200             | 10           | 20                     | 259                              | 171 | 99,995         | 97,7 | 4,30                      | 4,19 | 15,17                         | 17,14 | 1281                            | 1030 |
| 250             | 5            | 50                     | 517                              | 235 | 99,965         | 92,2 | 4,19                      | 3,94 | 15,19                         | 18,41 | 1535                            | 1033 |
| 300             | 10           | 30                     | 450                              | 244 | 99,947         | 93,9 | 4,05                      | 4,05 | 18,2                          | 19,56 | 1484                            | 1024 |

|       |     |     |      |      |         |      |      |      |        |       |      |      |
|-------|-----|-----|------|------|---------|------|------|------|--------|-------|------|------|
| 350   | 5   | 70  | 739  | 268  | 99,968  | 97,6 | 4,13 | 4,17 | 18,99  | 20,67 | 1774 | 1033 |
| 500   | 5   | 100 | 1304 | 477  | 99,829  | 94,5 | 3,57 | 4,06 | 18,63  | 22,7  | 2330 | 1028 |
| 500   | 10  | 50  | 706  | 285  | 99,85   | 91   | 3,65 | 3,88 | 21,9   | 22,84 | 1735 | 1036 |
| 500   | 50  | 10  | 654  | 273  | 100,000 | 97,3 | 4,27 | 4,19 | 21,091 | 21,95 | 1688 | 1026 |
| 700   | 10  | 70  | 1061 | 320  | 99,889  | 93,9 | 3,82 | 4,03 | 23,86  | 24,12 | 2103 | 1028 |
| 1000  | 10  | 100 | 1385 | 469  | 99,855  | 87   | 3,65 | 3,69 | 24,11  | 25,52 | 2419 | 1041 |
| 1000  | 50  | 20  | 935  | 412  | 99,968  | 92,2 | 4,13 | 3,94 | 26,17  | 24,87 | 1971 | 1034 |
| 1000  | 100 | 10  | 246  | 134  | 100,000 | 29,6 | 4,11 | 1,27 | 45,243 | 27,59 | 1321 | 1027 |
| 1000  | 100 | 10  | 1154 | 321  | 99,991  | 96,9 | 4,24 | 4,15 | 23,95  | 23,82 | 2186 | 1031 |
| 1500  | 50  | 30  | 1092 | 505  | 99,879  | 75,9 | 3,71 | 3,23 | 31,78  | 28,96 | 2140 | 1037 |
| 2000  | 100 | 20  | 1638 | 810  | 99,943  | 83,8 | 4,00 | 3,58 | 30,095 | 27,92 | 2680 | 1033 |
| 2500  | 50  | 50  | 238  | 780  | 99,817  | 69,6 | 3,44 | 2,96 | 39,46  | 31,84 | 1289 | 1038 |
| 3000  | 100 | 30  | 2184 | 901  | 99,86   | 69,2 | 3,63 | 2,96 | 34,807 | 30,07 | 3230 | 1034 |
| 3500  | 50  | 70  | 245  | 743  | 99,869  | 45,9 | 3,67 | 2,28 | 35,24  | 31,04 | 2707 | 1047 |
| 5000  | 50  | 100 | 2496 | 1024 | 99,678  | 51   | 2,86 | 2,08 | 37,06  | 32,67 | 3544 | 1041 |
| 5000  | 100 | 50  | 2445 | 786  | 100,000 | 50,5 | 3,74 | 2,12 | 95,431 | 32,1  | 1523 | 1053 |
| 7000  | 100 | 70  | 407  | 281  | 99,9    | 6,5  | 3,51 | 0,29 | 90,47  | 25,26 | 1542 | 1001 |
| 8000  | 100 | 80  | -    | 944  | -       | 68,8 | -    | 1,34 | -      | 32,88 | -    | 1030 |
| 9000  | 100 | 90  | -    | 1060 | -       | 63,2 | -    | 1,57 | -      | 33,11 | -    | 1035 |
| 10000 | 100 | 100 | 3321 | -    | 99,547  | -    | 2,3  | -    | 39,906 | -     | 4372 | -    |

## Conclusion and Future Work

The comparative analysis has been done in the same network configurations with different protocols for real time applications. Performance has been measured on the basis of some parameters that aimed to figure out the effects of scalability on routing protocols. Network scalability can be enhanced by reducing network convergence time and decreasing overhead of the routers. In our paper, implementation of RIP shows that network convergence time is much faster than OSPF networks because RIP network learns the topology information and updates faster than OSPF. However, RIP's efficiency is significantly low in larger networks. In the context of efficiency, we found that efficiency in the RIP network is less than OSPF. In comparison, the simulation results have shown that the throughput in the OSPF network is higher than RIP networks. The simulation results have shown that end to end delay of RIP network is relatively less than OSPF networks. As a result, data packets in RIP network reach faster to the destination. Another performance metrics for routing protocol evaluation is packet delay variation, which measures the differences between the delays of packets. The performance of packet delay variation for RIP is better than OSPF for large-scale networks. In small networks, these values are almost same.

Consequently, in this work, the comparative performance among RIP and OSPF routing protocols for large-scale applications has been analyzed. By comparing these protocols performances, we have come across that the implementation of OSPF routing protocols in the network performs better than RIP (i.e., OSPF can scale up to 10000 nodes, while RIP is about 9000). In future, a research work can be done on the explicit features of both OSPF and RIP in a parallel and distributed environment.

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## MODELLING PORT HANDLING CAPACITY USING FUZZY LOGIC APPROACH: THE CASE OF MERSIN PORT

Asst.Prof.Dr. Rifat TUR  
Akdeniz University  
Faculty of Engineering  
Antalya/TURKEY  
rifattur@akdeniz.edu.tr

Prof. Dr. Can E BALAS  
Gazi University  
Faculty of Engineering  
Ankara/TURKEY  
canbalas@gazi.edu.tr

**Abstract:** The aim of this study was modelling of formed operating capacity of Mersin Port depending on annual handling quantity. Being of model variables complex and inappreciable required that the system should be examined by fuzzy logic approach. When compared traditional approaches, fuzzy logic is the approach which impressively explains relationship between input and output variables. Fuzzy logic approach is based on definition of relationship between variables with formed fuzzy rule base by fuzzification of numeric values belonging to input and output variables and obtaining a crisp value by defuzzification of output value generated in the system. For this study, while input variables were annual loading and unloading quantities, output variable was capacity usage ratio of the port. Model is proposing a fuzzy relation between annual handling amount of port and formed port capacity, and describing variation of port capacity as proportional. Furthermore, the model maximizes effectiveness of port operating by planning of annual target handling amount for port considering formed capacity.

**Keywords:** Fuzzy logic, port handling, Mersin port.

### Introduction

Regarding its geographic location, maritime should be the leading sector for Turkey in order to improve foreign trade, integrate with world economy and achieve other economic aims. World trade fleet is about 800 million of dead weight tons (DWT) and trade capacity of the fleet exceeds 300 billion dollars. However, when related data compared for Turkish maritime, the ratio is a negligible value, such as 1.5 %.

Ports are generally infrastructural facilities which are large scale and require great budgets. Effective utilization of port capacity is very important when primary target is recovery of financial resources spent at construction and operation stages as soon as possible. Rapid recovery is possible by effective utilization of capacity. It can be seen at the literature that simulation models are developed, oriented for rising of formed port capacity (White et al., 1994; Thiers and Janssens, 1998; Wang et al., 2004). Bruzzone and Signorile (1998) have examined planning of port operations, which are directly related with capacity, by genetic algorithms and simulation techniques in their study. Knatz (2006) have mentioned redevelopment process in case of being port capacity more or less than planned and developed plans applicable for Long Beach and Los Angeles Ports. Dekker et al. (2003) have shown a different approach and investigated financing sources for increasing capacity and their direct and indirect effects on society. Wang et al. (2004) have developed a different approach by analyzing of maritime and port operations using risk analysis and decision-support system. Studies are generally focused on directly increasing of capacity.

The developed fuzzy model have a prototype model characteristic due to emphasizing effective usage of formed capacity rather than increasing of port capacity. Furthermore, the model provides great advantages to achieve plannings and investments for targeted-operating capacity.

### Mersin Port

The Mersin Port of is located at the east of Mediterranean region, 36°46'20'' north latitudes and 36 ° 39'00'' east longitudes . After the economical decisions on 24 January 1980, the Mersin Port of got the feature of an ideal transit port between the world and Middle East as a result of improving of railway and highway lines. The Mersin Free Trade Zone, which holds a place inside of the Mersin Port, has the property of being a distribution center for expensive import products.

### Technical Properties and Capacity of The Mersin Port

The port is being surrounded by breakwaters, made up two different forms, to protect it from south and west winds. The distance between both breakwaters' ends is 275 meters forming inlet and outlet gate. The breakwater at the west side is build up by rubble mound and has the length of 1 539 meters. The concrete breakwater at the east side has

the length of 2 933 meters. Besides, a submerged breakwater is available. There are 589 000 square meters open and 35 032 square meters closed storage areas (Table 1). Container terminal is formed on an area of 251 350 square meters and its daily handling capacity is 8 474 TEU (Twenty-foot Equivalent Unit) as full and empty. Annual container storage capacity is 203 376 TEU.

**Table 1:** Characteristics of the Mersin Port.

| Property                                       | Capacity (in a year) |
|--|----------------------|
| Ship acceptance capacity                       | 3 273 ship           |
| Container loading/unloading capacity           | 4 427 000 tons       |
| Different commodity loading/unloading capacity | 2 304 700 tons       |
| Bulk solid loading/unloading                   | 350 600 tons         |
| Storage capacity in closed area                | 562 992 tons         |
| Storage capacity in open area                  | 8 109 024 tons       |

## Overview of Fuzzy Logic

Zadeh (1965) has firstly suggested fuzzy logic concept and base lines of fuzzy logic are formed through developing this concept by many scientists (Patyra and Mlynek, 1996). The first fuzzy logic application has started with performing of fuzzy control of a steam engine by Mamdani in 1974. Especially, America and Japan have been achieved different fuzzy logic applications in many commercial and industrial areas (Kosko, 1996). After suggesting of fuzzy-set based fuzzy logic concept, diverse books have been gained to the literature, explaining the concepts of this area and different applications (Klir et al., 1995; Jang et al., 1996; Sugeno and Kank; 1988). Depending on the particular structure of the consequent proposition, three main types of fuzzy models are distinguished as:

1. Linguistic fuzzy model (Zadeh, 1973; Mamdani, 1977) (Mamdani type)
2. Fuzzy relation model (Pedryez, 1984; Yi and Chung, 1993)
3. Takagi-Sugeno (TS) fuzzy model (Takagi and Sugeno, 1985) (Sugeno type)

One of the great advantages of fuzzy logic in respect of statistical methods is that it does not need too many retroactive data. It doesn't affected from extreme-high or extreme-low values in a small data set and can use logical-linguistic terms. It is a fitting approach due to those reasons.

Forming of a fuzzy logic model consists of 4 steps:

1. Fuzzification: Fuzzy subsets and numerical intervals are described belonging to input and output variables and linguistic terms related with study are assigned to fuzzy subsets.
2. Rule definition: Logical rule network is formed between input and output variables. Rule base are generally formed with IF and THEN logical terms
3. Aggregation: The rules are mathematically evaluated and the results of all of the rules combined in a process called aggregation.
4. Defuzzification: The result of each rule is digitized by defuzzification mechanism regarding membership degree of input variables.

## Prototype Fuzzy Logic Model

It was accepted in the model that the most effective input parameters were loading and unloading variables. Data interval of model consisted of performed loading and unloading amounts between 1963 and 2005 years. Data were firstly evaluated in monthly time interval, but more agreeable results were obtained from annual time interval. As seen in Table 2, standard deviation of data composing input variables are high especially for unloading variable. This situation, complicating analysis by time series (ARMA-ARIMA models) decreases the reliability of developing model.

**Table 2:** The statistical parameters of input and output data.

| Data                  | Average   | Std. Dev. | Skewness | Max.       | Min.      |
|-----------------------|-----------|-----------|----------|------------|-----------|
| Loading (tons/year)   | 3 801 362 | 1 521 747 | 0,221892 | 6 622 193  | 1 376 750 |
| Unloading (tons/year) | 5 638 882 | 2 075 793 | 0,434463 | 11 186 650 | 1 866 542 |

The number, the form and over the full range of possible value of membership functions are usually formed by expert opinion and experience, statistical range and base logical grouping. The maximum and minimum values of variables in the model were obtained from digitizing of data between 1963 and 2005 years, taken form Turkish State Railways and Mersin Chamber of Shipping. Forming of membership functions were achieved by means of statistical scattering and expert opinion. Trapezoid shaped membership function was firstly tried, but gauss shaped membership function was determined as the best suitable type for model. The order of fuzzy linguistic term was very low, low,

medium, high and very high for input variables (loading and unloading amounts), while very bad, bad, medium, good and very good for output variables (capacity), consecutively.

Rule base of model was composed by loading and unloading data belonging to 1963 towards 2005 years and expert knowledge and experience. Complete rule base consisted of 125 rules. But only meaningful rules were determined to avoid too many rules complicating the model. Meanwhile, all rules had the degree of support of 1.0. So, all of the rules in the model contributed to the solution equally. Some part of the rule base, formed for model, was shown in Table 3.

**Table 3:** Partial rule base of the model.

| Number of the rule | If        |           | Degree of support | Then      |
|--------------------|-----------|-----------|-------------------|-----------|
|                    | Loading   | Unloading |                   | Capacity  |
| 1                  | Very low  | Very low  | 1.0               | Very bad  |
| 2                  | Very low  | Low       | 1.0               | Bad       |
| 3                  | Low       | Low       | 1.0               | Bad       |
| 4                  | Low       | Medium    | 1.0               | Medium    |
| 5                  | Medium    | Medium    | 1.0               | Medium    |
| 6                  | Medium    | High      | 1.0               | Good      |
| 7                  | High      | Low       | 1.0               | Medium    |
| 8                  | High      | High      | 1.0               | Good      |
| 9                  | Very high | Low       | 1.0               | Good      |
| 10                 | Very high | Very high | 1.0               | Very high |

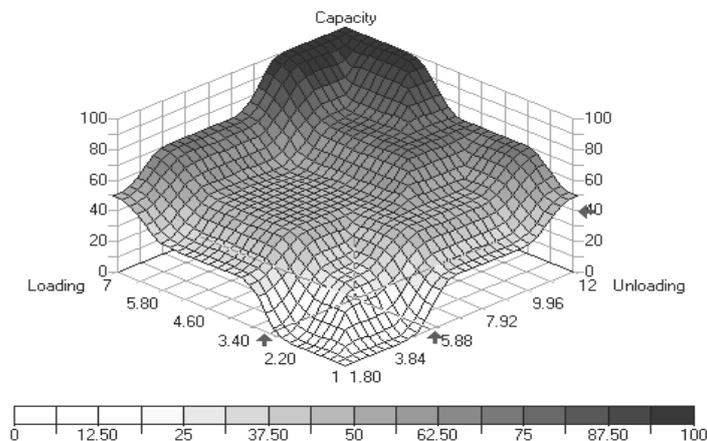
In this study, annual capacity of the port was consequently determined by individually analyzing of loading and unloading data. For instance, loading and unloading values belonging to 1981 year was analyzed by the model. The values of handled commodity amount of the port in 1981 year were given in Table 4.

**Table 4:** Summary of the data sets used in the sample.

| Sample data (year) | Data      | Amount (tons/year) |
|--------------------|-----------|--------------------|
| 1981               | Loading   | 1 767 317          |
|                    | Unloading | 5 361 081          |

CoA defuzzification mechanism was used in the developed fuzzy model. It was determined that 25 percentage of formed port capacity, regarding handling amount, was used in 1981 year. Data have triggered some rules of previously formed rule base related with their numerical values. Taking into consideration of data in sample, triggered rules in rule base and their degrees of support were given in Figure 4. Performed rules under their degree of support were defuzzicated and capacity usage ratio was found as 25% (crisp value).

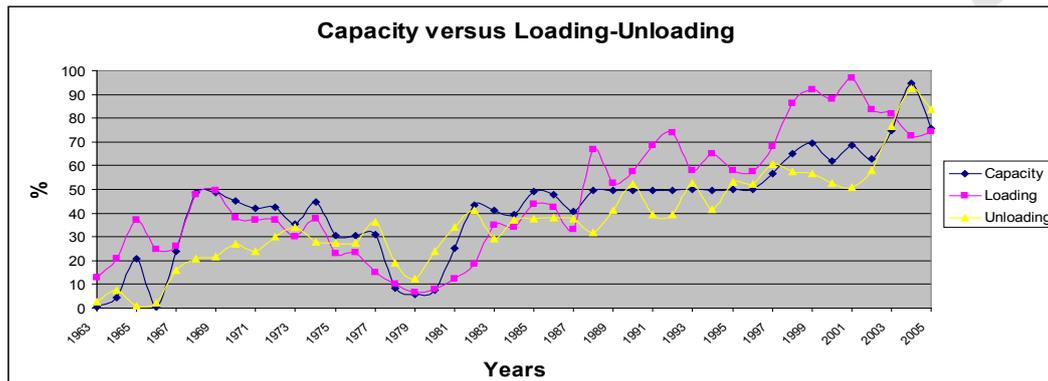
Three-dimensioned view of the model regarding rule base defined for fuzzy model could be seen in Figure 5. Capacity usage ratio determined by fuzzy model, regarding loading and unloading values belonging to selected sample data set, could be also seen.



**Figure 1:** 3D system analysis for fuzzy model

## Results and Discussion

In fuzzy model, a data set of Mersin Port for 43 years was analyzed. As a result of analysis, it was determined that port capacity had a rising trend for both input parameters (Figure 2). Formed port capacity had dramatically fallen between 1975 and 1979 years. Moreover, port operations had closed to stop. The reason of that rapid fall was that Turkey had operated Cyprus Peace Operation in 1975 year and the operation showed secular and negative effect. Similarly, the port had showed a fall trend between 1990 and 1996 years. Despite the fact that loading capacity was about 65%, port had been operated at 50% of its formed capacity. That stationary period in port capacity resulted from Gulf Crisis in 1990 and Gulf War between Iraq and 28 allied counties, in leadership of United States of America, in 1990-1991 years. Despite the fact that Turkey was not a member of allied forces, secular effects of war and consecutively laid embargoes had negatively affected economy and maritime trade of Turkey. The negative effects of the war lightened in following 5 years and, rising port investments and revision operations provided perfectly usage of formed capacity.



**Figure 2:** Formed Capacity Usage for 43 years in The Mersin Port

## Conclusion

In this study, a fuzzy model, which determines usage ratio of formed capacity of a port regarding its annual handling amount, has been developed. The fuzzy model has been applied to the handled commodity amount of the Mersin Port between 1963 and 2005 years and, formed capacity of the port was calculated in those years. The model has been developed on the basis that it would be revised when formed capacity would increase and would be adapted to any port operation. Furthermore, the model could determine the required handling amount, necessary for reaching to its planned capacity, in two ways: loading and unloading.

Only evaluating of rising loading and unloading amounts from year to year without formed capacity couldn't mean that port has been used effectively. It is a necessity that a port should be operated with a model which also considers the formed capacity. From this aspect, effective usage of formed capacity of the Mersin Port hasn't been achieved in past due to economical crisis and wars. The developed fuzzy model has great importance owing to the fact that it provides effective capacity usage by forming a true and trusted relation between formed capacity and annual handling amount in port operations.

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## MOVING VEHICLE TRACKING IN VIDEO SEQUENCES

*Aydogan Akcay*

Electrical Engineering Department  
Yildiz Technical University  
aydoganakcay@gmail.com

*Abdullah Bal*

Electronics&Communications Engineering  
Department , Yildiz Technical University  
bal@yildiz.edu.tr

**ABSTRACT** Visual Tracking Decomposition (VTD) is an object tracking technique that includes principle components of observation and motion models. In this paper we have utilized 4 observation models (hue, saturation, and intensity) and 2 motion models (smooth and abrupt movements) for moving vehicle tracking in video sequences. Before initialized VTD algorithm, Gaussian Mixture Model (GMM) is employed for background extraction. The proposed tracking algorithm has been tested for challenging scenarios such as scale variation, different moving objects on the scene, obstacle by the other objects, and more than one moving vehicles in the frame. In the following Figures, results of the tracking algorithm are demonstrated for different cases:

1- Vehicle blocked by tree - VTD method



GMM and VTD method



2 – Size changes on vehicle



3 – Camera noise



**Keywords:** Vehicle Tracking, Gaussian Mixture Model, Visual Tracking Decomposition.

# MUHASEBE EĞİTİMİNİN ÖĞRENCİNİN KARIYER SEÇİMİNDEKİ ETKİSİ: AKSARAY ÜNİVERSİTESİ İİBF ÖRNEĞİ

**Yrd.Doç.Dr. Haluk DUMAN**

Aksaray Üniversitesi İktisadi ve İdari Bilimler Fakültesi İşletme Bölümü

**Ar.Gör. Haşim BAĞCI**

Aksaray Üniversitesi İktisadi ve İdari Bilimler Fakültesi İşletme Bölümü

**ÖZET:** Muhasebe disiplini içerisinde hukuk, vergi, istatistik, bilgi işlem gibi birçok disiplin yer almaktadır. Muhasebe bilgi sistemi şirketin faaliyetlerini belirlenen hedefler doğrultusunda kıyaslama yapma, geleceğe ilişkin karar alma sürecinde ve rakiplerle rekabetin boyutunu tespit etme konusunda bilgi sunmaktadır. Şirketlerde muhasebe departmanının bu fonksiyonları yerine getirebilmesi için muhasebe çalışanlarının; muhasebe ve onu etkileyen disiplinler konusunda iyi bir eğitim alması gerekmektedir. Muhasebe bilgi sistemi tarafından üretilen bilginin kalitesi; muhasebe eğitiminin kalitesi ve mesleki kalite standartlarının artırılması ile mümkün olacaktır.

Muhasebe eğitimi birçok faktörün etkisi altındadır. Bu faktörler: ekonomik gelişmeler, teknolojik gelişmeler, yönetim faktörü, öğretim elemanı (öğretici) faktörü, öğrenci faktörüdür.

Ekonomik gelişmeler muhasebe dünyasına yön vermekte, teknolojik gelişmeler muhasebe işlemlerinin yerine getirilmesinde iş yükünü azaltmakta ve işlemleri hızlı ve doğru yapabilmek için imkan sunmaktadır. Teorik eğitim, teknoloji sayesinde pratiğe kolayca aktarılabilir. Bu durum muhasebede öğrenmeyi kalıcı hale getirmekte ve iş hayatına yönelik alt yapının oluşmasını sağlamaktadır.

Öğretim üyesinin başarısı teori ve uygulamayı birleştirebilme yeteneği ve pedagojik formasyonu ile konusunu entegre edebilmesine bağlıdır. Ayrıca öğrencilerin hayatı sürekli öğrenme odaklı olarak algılamaları ve mesleki eğitimde araştırma tabanlı eğitim anlayışına sahip olmaları gerekmektedir.

Muhasebe eğitiminin kalitesinin sonuçları; öğrencinin muhasebe bilgi seviyesi ve bu bilginin iş hayatında uygun iş bulma ve işte başarılı olma süreci sonunda ortaya çıkacaktır. Bu durum da öğrencinin teorik muhasebe eğitimi boyunca elde ettiği bilgileri iş hayatına aktarabilme ve kendini iyi ifade edebilme yeteneği ile ilişkilidir.

Çalışmanın amacı öğrencilerin kariyer seçimini etkileyen faktörler ile muhasebe eğitiminin öğrencilerin kariyer seçiminde ne düzeyde etkili olduğu ölçülmeye çalışılacaktır.

Çalışma Aksaray Üniversitesi İktisadi ve İdari Bilimler Fakültesi öğrencileri üzerinde anket yöntemi ile veriler analiz edilecektir.

*Anahtar kelimeler: Muhasebe Eğitimi, Kariyer Seçimi*

## The effect of accountancy education on students' career preferences: the example of business administration faculty at Aksaray University

**Abstract:** There are many disciplines such as law, tax, statistics and information processing within the discipline of accountancy. Accountancy information system represents information to make a comparison with the determined aims and company's activities; to make decisions concerning the future and to determine the level of competition with rivalries. In order accountancy departments within the companies to accomplish these functions, accountancy workers should have a good education on accountancy and other disciplines that affect it. The quality of the information produced by accountancy information system depends on the quality of accountancy education and vocational quality standards.

Accountancy education is affected by many factors, namely economic and technologic developments, management, instructor (teacher) and student.

Economic developments direct the world of accountancy; technologic developments decrease the workload and enable more quick and correct operations. The theoretical education can be transferred to the practice easily thanks to technology. This situation makes learning of accountancy more permanent and enables the infrastructure related to the business life.

The success of the instructor depends on his/her ability to combine the theory and the practice and to integrate the pedagogical formation with his/her subject. Besides, they should always perceive the life learning centered and have the understanding of research based education in vocational education.

The results of the accountancy education quality will come out with students' level of accountancy knowledge and in the process of their finding an appropriate job and being successful in it thanks to that knowledge. And this situation is related to students' ability to transfer the knowledge that they get through the theoretical accountancy education and ability to express themselves.

The aim of the study is to find out the factors that affect students' career preferences and how much accountancy education affects students' career preferences.

In the study, the data collected from students studying at Business Administration Faculty at Aksaray University via survey will be analyzed.

*Keywords: Accounting Education, Choosing Career*

## 1. Giriş

Küreselleşme olgusuna bağlı olarak; teknolojik gelişmeler, değişen müşteri istek ve ihtiyaçları, endüstri yapısı ve ürün yaşam süresindeki değişimler, ekonomik krizler, rekabette ayakta kalabilmeyi sağlayan rekabetçi avantajların uzun süre korunamaması, finansal raporlamada ortaya çıkan yenilikler, düzenleyici kurumların artan düzenlemeleri gibi faktörler işletmelerin sürekli değişen bir çevrede faaliyetlerini sürdürmelerine neden olmaktadır (Albrect ve Jack, 2000). Değişen çevre ise işletmelerin faaliyetlerini sürdürebilmek için ihtiyaç duydukları bilgilerin çeşitliliğini arttırmakta ve geçerlilik süresini kısaltmaktadır ( Uzay, 2004).

Muhasebe meslek mensubu; bünyesinde yer aldığı işletmeyi, rakiplerini ve çevrenin durumunu, faaliyet gösteren diğer işletmelerin yer aldığı çevreyi ve bu çevrenin şartlarını global bir bakış açısıyla irdelemelidir. Globalleşme, bilginin sayılara dönüşümü, düzenleyici ve denetleyici kurumların da içinde bulunduğu işletme paydaşlarının sayısının hızla artması meslek mensubundan beklentileri şekillendirmektedir. Meslek mensupları; sadece bünyesinde yer aldıkları işletmeler ve devlet için değil kamu için finansal ve finansal olmayan bilgiler üretebilmeli ve ilgililere sunabilmelidir. Bu beklentiler daha fazla hesap sorumluluğunu ve bu da sonuç olarak tüm toplumlarda nitelikli muhasebe meslek mensuplarına olan talebi arttırmaktadır ( International Accounting Education Standarts 1-8, 2008).

## 2. Muhasebe Eğitimi

Muhasebe eğitimi; günümüzde ticari işletmelerin finansal ve finansal olmayan işlemlerine ait belgelerin toplanması, kaydedilmesi, sınıflandırılması, özetlenmesi ve ilgililere rapor halinde sunulmasını, üretim maliyetlerinin belirlenmesi ve geleceğin planlanmasını sağlayacak teorik ve pratik eğitim vermeyi gerektirmektedir. Başka bir ifade ile muhasebe eğitimi ve mesleği işletme faaliyetlerinin işletme çevresinde meydana gelen değişimleri muhasebe bilgi sistemine eksiksiz, doğru, zamanında, karşılaştırılabilir ve tutarlı olarak kaydedilmesini gerektirmektedir. Gelişmeler ışığında muhasebe eğitimi ve mesleği ekonomik, teknolojik, hukuk vb. değişim ve gelişmelere uyum sağlamaktadır.

Muhasebe eğitimi sayesinde öğrenciler; ekonomik ve sosyal olayların işletme ve üzerindeki etkilerini sürekli göz önünde bulundurmalarını, geçmiş performansın değerlendirilmesi, geleceğe ilişkin planlarının yapılmasında yardımcı olacak bilgi birikimini kazanır. Muhasebe mesleği ve eğitimi bu boyutları ile sürekli öğrenme tabanlı, rekabet boyutu ile hızlı düşünme ve hareket edebilme, yasal boyutu ile işlemlerin hukuki boyutlarının göz önünde bulundurulmasını gerektirmektedir. Bu durum aynı zamanda stres ve zaman yöntemini de içermektedir.

Muhasebe işlemleri; muhasebenin temel kavramları, genel kabul görmüş muhasebe ilke ve standartları ve mali tablo düzenleme ilkeleri vb. muhasebe mevzuatının yanında meslek kanunları, vergi kanunları, ticaret, sermaye piyasası kanunu ve teknolojik gelişmelerden etkilenmektedir. Bu durumda muhasebe eğitiminde multidisipliner bir eğitim anlayışının benimsenmesini zorunlu kılmaktadır. Aksi takdirde etkin ve verimli bir muhasebe eğitiminden söz etmek mümkün olmayacaktır.

### 2.1 Muhasebe Eğitiminin Tarihçesi

Günümüzde özellikle uluslararası standartlara sahip bir muhasebe eğitimi çerçevesi mevcut değildir. Ülkelerin muhasebe sistemlerini oluşturan bireylerin sahip olduğu muhasebe eğitim düzeyi ve kalitesi bir ülkeden diğerine göre farklılık göstermektedir. Gelişmekte olan birçok ülkedeki mevcut muhasebe sistemi ile muhasebe eğitim sistemi, bu ülkelerin yakın ekonomik ve siyasal ilişkide bulunduğu veya geçmişte sömürgesi olduğu gelişmiş ülkelerdeki sistemlerden önemli ölçüde etkilenmiştir. Gelişmekte olan bir ülke olan Türkiye’de de muhasebe eğitimi doğrudan herhangi bir ülkeden transfer edilmemiş olmakla beraber; Cumhuriyet’in ilanına kadar Fransa ekolü, Cumhuriyet’in ilanından 1940’lara kadar Alman ekolü ve 1940’lardan bugünlere kadar ve halen Amerika’dan etkilendiği görülmektedir (Çürük, 2001).

Türkiye’de ilk muhasebe eğitimi 1868 yılında kurulmuş olan “Mekteb-i Mülkiyeyi Şahane” okulunda başlamıştır. En geniş muhasebe eğitimi ise 1883 yılında kurulan “Hamidiye Yüksek Ticaret Mektebi”nde verilmiştir (Özdoğan, 1978). Cumhuriyet döneminde ilk aşamada üniversitelerde muhasebe eğitimi veren kürsüler oluşturulmuş, 1960’lı yılların başlarından itibaren de bu eğitimi veren okulların sayısı hızla artmıştır (Beyazıtli, 2000).

### 2.2 Muhasebe Eğitiminin Etkinliği ve Yeterliliği

Dünyada yüksek öğretim kurumlarında verilen muhasebe programlarını akredite eden bağımsız bir kurum olan Amerikan İşletme Fakülteleri Birliği Akreditasyon Konseyi (Accreditation Council of the American Assembly of Collegiate Schools of Business, AACSB), yüksek öğretim kurumlarında bireylerin kazandıkları bilgi ve beceriler olarak

ifade edilebilecek çıktının üretildiği eğitim sisteminin temel olarak; öğrenciler, öğretim elemanları, finansal kaynaklar, eğitim programları ve fiziki altyapı tarafından etkilendiğini belirlemiş ve akreditasyon standartlarını bu kriterlere göre oluşturmuştur (Çelik & Gürdal, 1999).

Eğitimin etkinliği ile ilgili yapılan çalışmalarda bakış açılarının birbirinden farklılık gösterdiği görülmektedir. Çalışmalarda kullanılan girdiler; eğitim harcamalarından, öğrencilerin sosyo-ekonomik bilgilerine, öğretim elemanı maaşlarından, sınıf büyüklüklerine kadar geniş bir yelpazede yer alırken çıktılar da aynı şekilde büyük farklılık göstermiştir. Çalışmalarda kullanılan değişkenler ve kullanılan yöntemlerin de aynı şekilde farklılık gösterdiği görülmektedir. Çalışmalarda kullanılan yaklaşımlar: üniversite, bölüm ve bireysel olarak öğrenciler bazında gruplandırılabilir (Bayazıtlı & Çelik, 2004).

Muhasebe eğitimi ile ilgili literatüre bakıldığında Adler (1999)'in, muhasebe eğitiminin geliştirilmesine yönelik önerilerde bulunduğu görülmektedir. Bu çalışmada etkin öğretme ve öğrenmeye yönelik eğitim konularındaki ihtiyaçlara önem verilmesi gerektiği belirtilmiştir. Eğitimcilerin, toplumun gelişmesine katkı sağlayabilecek, gerekli uyum sağlayabilme yeteneğine sahip ve “nasıl öğrenilmesi gerektiğini öğrenmiş” mezunlar yetiştirmesi gerektiğini vurgulayan Kelly ve diğerleri (1999), müfredat üzerinde bütünsel bir yaklaşım ortaya koymuşlardır.

Wijewardena ve Cooray (1995), yaptıkları çalışmada ülkelerin muhasebe eğitimi karşılaştırmış; Avustralya’da finansal muhasebe eğitimi üzerine ağırlık verilirken, Japonya’daki eğitimde yönetim muhasebesine ağırlık verildiği sonucuna ulaşmıştır.

Stolowy ve Tenenhaus (1998)’e göre uluslararası muhasebe eğitimine ilişkin farklı yaklaşımlar incelenerek, Avrupa ülkeleri çerçevesinde değerlendirilmiştir. Ülkeler arasındaki farklılıkların ve çok uluslu şirketlerin muhasebe boyutlarının dikkate alınarak muhasebe eğitiminde kullanılmasının etkili olacağı yönünde sonuçlara ulaşılmıştır.

Beattie ve diğerleri (1993)’e göre finansal muhasebe eğitiminin geliştirilmesi amacıyla yapılan bazı çalışmalarda ise sağlanan görsel bilgilerin metinsel bilgilerden eğitimsel faydaları bakımından daha hızlı sonuç verdiği ortaya çıkmıştır.

### 3. Kariyer Kavramı

Kariyer; bireyin iş yaşantısındaki aktivite, sorumluluk, tutum ve davranışların gelişimi olarak tanımlanan bir kavramdır. İnsan çalışma yaşamına başladığı günden itibaren belirli bazı gereksinimlerini karşılamak için işinde ilerlemek ve hiyerarşik yapıda yükselmek ister. Fizyolojik, güvenlik, sosyal açıdan doyum, toplum içinde saygı görme gereksinimi ve son olarak bireyin kendi isteklerini gerçekleştirmek istemesi kariyer yapma olgusunun en temel nedenleridir (Taşçı, 2004). Kariyer; kişinin iş yaşamı boyunca edindiği işe ilişkin deneyim ve etkinliklerle ilgili olarak algıladığı tutum ve davranışlar dizisi, bir insanın çalışabileceği seneler boyunca herhangi bir iş alanında devamlı olarak ilerlemesi, deneyim ve yetenek kazanmasıdır (Demirtaş ve Güneş, 2002). Günümüz modern yönetim anlayışında işletmelerin insan kaynaklarından yararlanabilmeleri için kariyer geliştirme programlarına yer vermeleri, gerek organizasyonel etkinlik, gerekse çalışanın iş tatmininin sağlanması açısından oldukça büyük önem taşımaktadır. Kariyer geliştirme sisteminin iki alt basamağı bulunmaktadır: kariyer planlama ve kariyer yönetimi.

#### 3.1 Kariyer Planlama

Kariyer planlama: çalışanların değerleri ve ihtiyaçları ile iş deneyimleri ve fırsatları arasında en uygun ilişkiyi kurmayı amaçlayan bir sorun çözme ve karar alma sürecidir. Çalışanların daha mutlu ve verimli olmalarını sağlar. Geleceğini tahmin edebilen, kendisini neyin beklediğini bilen, amacını ona göre belirleyen, yüksek motivasyona sahip, kendini işine adanmış çalışanlar üretir (Barutcugil, 2007). Kariyer planlaması birtakım süreçlerden oluşmaktadır. Bunlar (Özel, 2007):

- Kişinin bilgi, beceri, ilgi, değer yargısı, güçlü ve güçsüz yönlerinin değerlendirilmesi,
- Kariyer planlarında yer alan bireysel amaçlar ile örgütsel amaçlar arasında çatışmanın minimize edilmesi,
- Organizasyon içi-dışı kariyer olanaklarının tanımlanması,
- Kısa, orta ve uzun dönemli hedefler saptaması,
- Kariyer planlarının hazırlanması,
- Planların uygulanması süreçlerini içerir.

Belirli süreçlerden oluşan kariyer planlaması yapıldıktan sonra bireyin kariyerine nasıl yön vereceği belirlenmelidir. Bunun için en önemli kavram kariyer yönetimidir.

#### 3.2 Kariyer Yönetimi

Kariyer yönetimi, bireyin kariyer planları doğrultusunda belirlenen süreçleri uygulamaya koymasındadır. Burada amaç kariyer hedeflerini gerçekleştirmeyi sağlayacak faktörleri ve zamanı başarılı olarak yönetmektir. Kariyer yönetimi ile ilgili literatürde birçok tanım yer almaktadır.

Barutcugil (2007)’e göre kişinin kendisi ve çevresi ile ilgili farkındalığı artırarak kariyer amaçlarını belirlemesini, geribildirim almasını ve kariyerindeki ilerlemeyi ele alan bir süreçtir.

Donald ve arkadaşları (1993)’na göre; bireysel ve örgütsel amaçları uyumlaştırma yoluyla planlanan ve gerçekleştirilen faaliyetlerdir.

Aytaç (1997)'a göre; personelin bireysel kariyer plânlarını örgütün desteklemesi ve uyumlaştırılmasını içermektedir. Kariyer yönetimi gerek personelin meslek hayatının plânlaması gerekse bu plânların eyleme geçirilmesidir.

Walker ve Gutterdidge (1990)'a göre; örgütlerin çalışanların yeteneklerini, ilgi alanlarını ve çıkarlarını analiz etmelerine yardımcı olması ve kariyer geliştirme faaliyetlerinin planlanmasıdır.

Kariyer yönetiminin belli başlı birtakım amaçları vardır. Bu amaçlar (Armstrong, 1991):

- Yönetimin başarısını artırmak için organizasyon ihtiyaçlarını tespit etmek,
- Kavrama gücü olan bireylere, herhangi bir sorumluluk düzeyinde eğitim vermek,
- Bireylerin yetenek ve isteklerini örgüt ile uyumlu olarak görev ve sorumluluklarını yerine getirmesini sağlamak suretiyle başarılı bir kariyer imkanı sunmaktır.

Amaçları belirlenen bir kariyer yönetimi; bir ihtiyacın belirlenmesi ve kariyer araştırması ile başlar. Bu aşamada kişi, kendisi ve çevresi ile ilgili bilgilerin farkında olmaya çalışmaktadır. Kendisinin farkında olma: kişisel değerleri, inançları, ihtiyaçları, amaçları, istekleri ve yetenekleri hakkında objektif değerlendirme yapabilmeyi ifade ederken; çevresinin farkında olma ise: kişinin ilgilendiği işin gereklerini ve var olan iş fırsatlarını tanıması anlamına gelir (Barutcuğil, 2007).

Kariyer yönetimi ile bir çalışan mevcut bulunduğu konumun farkında olur, kendisi için bir sonraki adımda ne olduğunu bilir, iş geleceğini öngörür ve gelişme seyrine uygun hazırlıkları yapabilir kısacası kendisini geleceğe hazırlama fırsatını yakalar.

Sonuç olarak kariyer gelişiminde iki kavram çok önemlidir. Öncelikle çalışan kişinin kariyer planlaması yapılır, ardından örgüt bünyesinde bu konuda yapacağı çalışmalar ile kariyer yönetimini gerçekleştirmiş olur.

#### **4. Kariyer Seçimi - Muhasebe Eğitimi İlişkisi**

Muhasebe eğitimi ile genel anlamda mesleki kariyer seçiminde öncelikle 'hayat boyu öğrenme' felsefesinin benimsenmesi öğretilmektedir. Çünkü muhasebe; geçmişin bilgi birikimi ve tecrübesini gelişen ve değişen iş ve çevre koşullarına uyum sağlayarak, işletmeleri geleceğe taşımaya sağlayacak bilgi sistemidir. Sistemin sağlıklı işlemesi ise tam, doğru, tutarlı, karşılaştırılabilir ve ihtiyaca uygun bilgi üretimi ile söz konusu olacaktır.

Muhasebe eğitiminin başarısı çok disiplinli bir eğitimi gerektirmektedir. Örneğin; etkin ve verimli bir muhasebe eğitimi için matematik, istatistik, üretim yönetimi, sayısal yöntemler vb. derslerin yanında hukuk ve vergi bilgisi, bilişim teknolojilerine hakim olma, ekonomik ve siyasi gelişmeleri yerel, ulusal ve global olarak takip edebilme yeteneği gerektirmektedir. Bu durum öğrencinin mesleki kariyerini planlamasında; bugün ve gelecekte yapabileceği işlere ilişkin analitik düşünme, çok yönlü analiz edebilme, mesleki olarak güçlü ve zayıf yönlerini öngörümleyebilme, iş hayatında başarılı olabilmek için yapması ve yapmaması gereken işlemleri planlaması ve uygulaması konusunda gerekli melekeleri kazandırmaktadır.

Muhasebe eğitimi ile öğrencilere hukuk eğitimi ile birlikte mesleki etik kodlar da öğretilmektedir. Bu sayede öğrencinin kariyer seçiminde gerek rekabet içinde olduğu bireylerle olan ilişkilerinde gerekse çalıştığı organizasyon bünyesinde sadece kendisinin ve çalıştığı organizasyonun menfaatini değil tüm toplumun menfaatini gözetecek iş ve işlemler yapması temin edilir.

Muhasebe eğitiminde; organizasyonların belirli dönemlerde yaptığı planlar ile aldıkları kararlara bağlı olarak yapılan faaliyetlerin mali sonuçları ortaya konur, hedeflerin gerçekleştirilmesi için çaba sarf edilir.

Öğrencinin kariyer seçiminde belirlediği hedefler ile mesleki hayatı boyunca belirli periyotlar halinde kendisini kontrol etmesi; mevcut durumunu ve gelecekte olması muhtemel konumunu gözden geçirmesi gerekir. Mevcut durumuna göre yeniden kariyer planlaması yapması gerekir.

Sonuç olarak; muhasebe eğitimi öğrencinin kariyer seçimi ve planlamasında mevcut koşulları yönetebilme, geleceği öngörümleme, kariyerinin başarılı yönetimi ve yeteneklerini ortaya koyması konusunda planlama, analiz etme, uygulama, kontrol ve yorumlama konularında destek olmaktadır.

#### **5. Muhasebe Eğitiminin Öğrencinin Kariyer Seçimindeki Etkisinin İncelenmesi**

##### **5.1 Araştırmanın Amacı**

İktisadi İdari Bilimler Fakültesi'nde okuyan öğrencilerin geleceğe ilişkin kariyer planlarının oluşturulmasında muhasebe eğitiminin etkisini ölçmeye yöneliktir.

##### **5.2 Araştırmanın Örneklemi ve Kısıtlar**

Araştırmanın örneklemi; Aksaray Üniversitesi İktisadi İdari Bilimler Fakültesi (İİBF) öğrencileridir. Araştırma örneklemi 478 öğrenciden oluşmaktadır. Araştırmaya 260 öğrenci katılmıştır.

Araştırmanın kısıtları:

- Muhasebe eğitimi yoğunluklu olarak İİBF’de gösterildiği için seçilmiştir.
- İktisadi İdari Bilimler Fakültesi bünyesinde ise işletme, iktisat ve kamu yönetimi bulunmaktadır. Kamu yönetiminde yeterli muhasebe eğitimi söz konusu olmadığı için örneklem dışında tutulmuştur. İktisat bölümünün 3. ve 4. sınıf öğrencileri olmadığı için örneklem dışında tutulmuştur.
- İşletme ve iktisat bölümü öğrencileri içerisinde muhasebe eğitiminin büyük bir kısmını almış 3. ve 4. sınıf öğrencileri örnekleme katılmıştır.

## 5.3 Uygulama

### 5.3.1 Tanıtıcı Bilgiler

Araştırma Aksaray Üniversitesi İİBF işletme bölümü 3. ve 4. Sınıf öğrencileri üzerinde yapılmıştır. Araştırmaya 260 öğrenci katılmış olup, 109 kişi (%42) bay ve 151 kişi (%58) ise bayandır. Araştırmaya katılanlardan 234 kişinin (%90) yaş ortalaması 20-23 arasındadır.

**Tablo 5.3.1.1:** Tanıtıcı Bilgiler

| Tanıtıcı Bilgiler     | Frekans | Yüzde | Geçerli Yüzde | Kümülatif Yüzde |
|-----------------------|---------|-------|---------------|-----------------|
| <b>1-Cinsiyetiniz</b> |         |       |               |                 |
| 1a. Bay               | 109     | 41,9  | 41,9          | 41,9            |
| 1b. Bayan             | 151     | 58,1  | 58,1          | 100,0           |
| <b>2- Yaşınız</b>     |         |       |               |                 |
| 2a. 20-23             | 234     | 90,0  | 90,7          | 90,7            |
| 2b. 24-27             | 24      | 9,2   | 9,3           | 100,0           |
| <b>3- Sınıf</b>       |         |       |               |                 |
| 3a- 3. sınıf          | 137     | 52,7  | 56,8          | 56,8            |
| 3b- 4. sınıf          | 104     | 40,0  | 43,2          | 100,0           |

### 5.3.2 Güvenilirlik Analizi

**Tablo 5.3.2.1:** Güvenilirlik Analizi

| Cronbach's Alpha | N of Items |
|------------------|------------|
| ,923             | 59         |

Yapılan araştırmada, missing değerlerine sahip sorular göz ardı edilerek güvenilirlik hesaplanmıştır. Bulunan Cronbach's Alpha katsayısına göre araştırmanın güvenilirliği % 92,3'tür.

### 5.3.3. Hipotez Testleri

Yapılan araştırmada, muhasebe eğitiminin kariyer üzerindeki etkisini ölçmek için 15 soru Compute Variable seçeneği ile birleştirilerek yeni bir veri sütunu elde edilmiş ve testler bu veriler ışığında gerçekleştirilmiştir.

Muhasebe eğitiminin kariyer seçimine etkisini; muhasebe alanında kariyer yapmayı düşünenlerle, düşünmeyenler açısından değerlendirmek için bağımsız örneklem T testi yapılmış ve aşağıdaki sonuçlara ulaşılmıştır:

**Tablo 5.3.3.1:** Grup İstatistikleri

|                       | Muhasebe alanında kariyer yapmayı düşünüyor musunuz? | N   | Mean   | Std. Deviation | Std. Error Mean |
|-----------------------|--|-----|--------|----------------|-----------------|
| muhasebe_egitimi_etki | Evet   | 124 | 2,2091 | ,69224         | ,06216          |
|                       | Hayır  | 126 | 2,5313 | ,85968         | ,07659          |

124 kişi muhasebe alanında kariyer yapmayı düşünmekte iken 126 kişi ise bu alanda kariyer yapmayı düşünmemektedir.

$H_0$ : Muhasebe eğitiminin öğrencilerin kariyerleri üzerine etkilerinin ortalaması; muhasebe alanında kariyer yapmayı düşünen ve düşünmeyenler arasında farklılık göstermez.

$H_1$ : Muhasebe eğitiminin öğrencilerin kariyerleri üzerine etkilerinin ortalaması, muhasebe alanında kariyer yapmayı düşünen ve düşünmeyenler arasında farklılık gösterir.

**Tablo 5.3.3.2:** Independent Samples Test (Bağımsız Örneklem T Testi)

|                       |                             | Levene's Test for Equality of Variances |      | t-test for Equality of Means |         |                 |                 |                       |   |         |
|-----------------------|-----------------------------|---|------|------------------------------|---------|-----------------|-----------------|-----------------------|---|---------|
|                       |                             | F                                       | Sig. | t                            | df      | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |         |
|                       |                             |   |      |                              |         |                 |                 |                       | Lower                                     | Upper   |
| muhasebe_egitimi_etki | Equal variances assumed     | 6,349                                   | ,012 | -3,260                       | 248     | ,001            | -,32214         | ,09881                | -,51676                                   | -,12753 |
|                       | Equal variances not assumed |   |      | -3,266                       | 238,680 | ,001            | -,32214         | ,09864                | -,51646                                   | -,12782 |

-3,260 t değerine karşılık gelen Sig değeri  $0,001 \leq 0,05$  olduğundan  $H_0$  hipotezi red,  $H_1$  hipotezi kabul edilir. Yani tablo 5.3.3.2'ye göre muhasebede kariyer yapmayı düşünenler muhasebe eğitiminin kariyer planlamadaki etkisini daha önemli görmektedir.

Muhasebe eğitiminin kariyer üzerindeki etkisinin, muhasebe alanında kariyer yapmayı düşünenler için ne anlam taşıdığını test etmek amacıyla Paired Sample T testi yapılmış ve aşağıdaki sonuçlara ulaşılmıştır:

**Tablo 5.3.3.3:** Paired Samples Statistics

|        |                           | Mean   | N   | Std. Deviation | Std. Error Mean |
|--------|---------------------------|--------|-----|----------------|-----------------|
| Pair 1 | muhasebe_egitimi_etki     | 2,3002 | 217 | ,77775         | ,05280          |
|        | Kazanç potansiyeli        | 2,6175 | 217 | 1,36635        | ,09275          |
| Pair 2 | muhasebe_egitimi_etki     | 2,2951 | 214 | ,78064         | ,05336          |
|        | Ailenin etkisi            | 3,318  | 214 | 1,2341         | ,0844           |
| Pair 3 | muhasebe_egitimi_etki     | 2,2998 | 213 | ,77565         | ,05315          |
|        | Sosyal statü              | 2,7981 | 213 | 1,25953        | ,08630          |
| Pair 4 | muhasebe_egitimi_etki     | 2,3078 | 216 | ,78238         | ,05323          |
|        | Mesleki doyum             | 2,5833 | 216 | 1,28769        | ,08762          |
| Pair 5 | muhasebe_egitimi_etki     | 2,3083 | 219 | ,78109         | ,05278          |
|        | İlgi ve yetenek           | 2,4566 | 219 | 1,28566        | ,08688          |
| Pair 6 | muhasebe_egitimi_etki     | 2,2730 | 211 | ,76819         | ,05288          |
|        | Öğretici etkisi           | 2,7820 | 211 | 1,30926        | ,09013          |
| Pair 7 | muhasebe_egitimi_etki     | 2,2830 | 205 | ,78578         | ,05488          |
|        | İş tecrübesi              | 2,5951 | 205 | 1,26296        | ,08821          |
| Pair 8 | muhasebe_egitimi_etki     | 2,2834 | 206 | ,78397         | ,05462          |
|        | Kolay iş bulabilme imkanı | 2,6165 | 206 | 1,35557        | ,09445          |

$H_0$ : Muhasebe eğitiminin öğrencilerin kariyerleri üzerine etkilerinin ortalaması; muhasebe alanında kariyer yapmayı düşünen ve düşünmeyenler arasında farklılık göstermez.

$H_1$ : Muhasebe eğitiminin öğrencilerin kariyerleri üzerine etkilerinin ortalaması, muhasebe alanında kariyer yapmayı düşünen ve düşünmeyenler arasında farklılık gösterir.

**Tablo 5.3.3.4: Paired Samples Test**

|   | Paired Differences |                |                 |   |         | t       | df  | Sig. (2-tailed) |
|---|--------------------|----------------|-----------------|---|---------|---------|-----|-----------------|
|   | Mean               | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference |         |         |     |                 |
|   |                    |                |                 | Lower                                     | Upper   |         |     |                 |
| Pair 1: muhasebe_egitimi_etki - Kazanç potansiyeli        | -,31734            | 1,36380        | ,09258          | -,49982                                   | -,13487 | -3,428  | 216 | ,001            |
| Pair 2: muhasebe_egitimi_etki - Ailenin etkisi            | -1,02262           | 1,29936        | ,08882          | -1,19770                                  | -,84753 | -11,513 | 213 | ,000            |
| Pair 3: muhasebe_egitimi_etki - Sosyal statü              | -,49831            | 1,18384        | ,08112          | -,65820                                   | -,33841 | -6,143  | 212 | ,000            |
| Pair 4: muhasebe_egitimi_etki - Mesleki doyum             | -,27551            | 1,20066        | ,08169          | -,43654                                   | -,11449 | -3,372  | 215 | ,001            |
| Pair 5: muhasebe_egitimi_etki - İlgı ve yetenek           | -,14831            | 1,33768        | ,09039          | -,32646                                   | ,02984  | -1,641  | 218 | ,102            |
| Pair 6: muhasebe_egitimi_etki - Öğretici etkisi           | -,50897            | 1,27840        | ,08801          | -,68246                                   | -,33547 | -5,783  | 210 | ,000            |
| Pair 7: muhasebe_egitimi_etki - İş tecrübesi              | -,31211            | 1,22535        | ,08558          | -,48085                                   | -,14337 | -3,647  | 204 | ,000            |
| Pair 8: muhasebe_egitimi_etki - Kolay iş bulabilme imkanı | -,33309            | 1,35143        | ,09416          | -,51873                                   | -,14744 | -3,537  | 205 | ,000            |

Tablo 5.3.3.4'e göre -1,641 t değerine karşılık gelen Sig değeri  $0,102 \geq 0,05$  olduğundan  $H_1$  red,  $H_0$  kabul edilir. Yani muhasebe eğitiminin kariyer planlama üzerinde etkili olduğunu düşünenlerin ortalaması ile muhasebe alanında kariyer yapma nedeni ilgi ve yetenek olanların ortalamaları arasında fark yoktur. Muhasebe alanında kariyer yapmayı düşünenlerin kariyer planlarında muhasebeye olan ilgi ve yeteneklerinin önemli faktör olduğu görülmektedir. Bu durum öğrencilerin kariyer planlarında etkili olan kazanç, aile, sosyal statü, mesleki doyum, öğretici ve iş tecrübesinin önemli faktör olmadığı görülmektedir. Sonuç olarak öğrencilerin ilgi ve yeteneklerine göre kariyer planlamaları onlar için mesleki başarı, istenilen kazanç vb. amaçlara ulaşmada gerekli çalışma ve sabrı göstermelerini sağlayacaktır.

**Tablo 5.3.3.5: Muhasebe Eğitimi - Kariyer**

| Muhasebe Eğitimi Kariyer İlişkisi   | Frekans |    | Yüzde |      | Geçerli Yüzde |      | Kümülatif Yüzde |       |
|---|---------|----|-------|------|---------------|------|-----------------|-------|
|   | 1       | 2  | 1     | 2    | 1             | 2    | 1               | 2     |
| 1- Geçmişin gözden geçirilmesi ve analizini yapabilme                                       | 197     | 48 | 75,8  | 18,5 | 80,4          | 19,6 | 162             | 192,2 |
| 2- Geleceğin planlanması  | 200     | 41 | 76,9  | 15,7 | 82,7          | 16,9 | 171,11          | 94,6  |
| 3-Analitik düşünme yeteneği   | 208     | 36 | 80    | 13,8 | 85,2          | 14,7 | 164,3           | 195,1 |
| 4-Bir ekonomik ve sosyal olayı tüm yönleri ile inceleme ve çözüm üretme                     | 211     | 27 | 81,2  | 10,4 | 88,6          | 11,3 | 166,4           | 197,1 |
| 5-Sosyal ve ekonomik olayların etkilerini finansal ve finansal olmayan yönleri ile inceleme | 212     | 30 | 81,6  | 11,5 | 87,5          | 12,4 | 158,7           | 194,6 |
| 6-Mali tabloları analiz yapabilme yeteneği  | 209     | 40 | 80,4  | 15,4 | 83,9          | 16   | 163             | 194,8 |
| 7-Sürekli öğrenme anlayışı  | 196     | 46 | 75,4  | 17,7 | 81            | 19   | 160,4           | 196,3 |
| 8-Stres ve baskı altında çalışabilme ve yönetebilme   | 177     | 61 | 68,1  | 23,5 | 74,4          | 25,3 | 138,7           | 193,3 |
| 9-Dürüst ve sosyal sorumluluk sahibi olma   | 200     | 37 | 76,5  | 14,2 | 84,4          | 15,6 | 175,5           | 195,8 |
| 10-Çalışmalarında ve davranışlarında tutarlı olma   | 208     | 32 | 80    | 12,3 | 86,7          | 13,4 | 182,1           | 197,9 |
| 11-Bir işin yapılmasında en ince detaya kadar araştırma ve bilgileri ortaya çıkarma         | 206     | 37 | 79,2  | 14,2 | 84,8          | 15,2 | 171,7           | 194,7 |
| 12-Risk ve sorumluluk alma  | 214     | 31 | 82,3  | 11,9 | 87,3          | 12,7 | 173,8           | 197,1 |
| 13-Bütün iş ve işlemlerde tarafsız olma   | 204     | 39 | 78,4  | 15   | 83,9          | 16   | 177,8           | 195,1 |

|   |     |    |      |      |      |      |       |       |
|---|-----|----|------|------|------|------|-------|-------|
| 14-Mesleğin gerektirdiği etik(ahlaki) kodlara göre hareket etme                                     | 213 | 30 | 81,9 | 11,6 | 87,6 | 12,4 | 191,8 | 194,2 |
| 15-Sürekli denetim ve kıyaslama ile planlanan işi doğru zamanda, doğru yerde etkin ve verimli yapma | 222 | 26 | 85,3 | 10   | 89,5 | 10,4 | 192,7 | 195,6 |

1:Son Derece Önemli, Çok Önemli, Önemli

2:Pek Önemli Değil, Hiç Önemli Değil

Tablo 5.3.3.5'e göre öğrencilerin mesleki kariyerlerinde muhasebe eğitiminin etkileri:

- Öğrenciler mesleğin icrasında yapacakları işlemleri; belli kişi veya zümrenin menfaatine değil tüm toplumu dikkate alan dürüst ve sosyal sorumluluk sahibi, bütün iş ve işlemlerde tarafsız olma, mesleğin gerektirdiği etik değerlere göre hareket etme,
- Öğrenciler mesleki kariyerinde ilerleme için; stres ve baskı altında çalışabilme ve yönetebilme, üstlerin ve astarların güvenmesi için çalışma ve davranışlarında tutarlı olma, yetki ve sorumluluk devri için ihtiyaç duyulan zamanda risk ve sorumluluk alma,
- Bir işin başarılabilmesi için; geçmişin gözden geçirilmesi ve analizi, işin istenilen zaman, yer ve kalite vb. özelliklerde yapılabilmesi için araştırma ve bilgileri ortaya çıkarma ve sürekli denetim ve kıyaslama ile faaliyetlerin etkinliğini ve verimliliğini artırıcı işlemler yapma,
- Geleceğe ilişkin karar verme sürecinde analitik düşünme yeteneği, geleceğin planlanması ve en önemlisi çevredeki değişimleri takip edebilme ve yönetebilme açısından hayata sürekli öğrenme anlayışı ile bakabilme,
- Mali işlemlere ilişkin; tüm ekonomik ve sosyal yönleri ile inceleme, finansal ve finansal olmayan yönlerini ortaya koyma, mali bilgilerin özetlendiği finansal tabloları analiz edebilme ve çözüm önerileri üretebilme yeteneğini elde etmiştir.

### 5.3.4.Kariyer Yönetimi

**Tablo 5.3.4.1: Kariyer Yönetimi**

|   | Frekans |     | Yüzde |      | Geçerli Yüzde |      | Kümülatif Yüzde |       |
|---|---------|-----|-------|------|---------------|------|-----------------|-------|
|   | 1       | 2   | 1     | 2    | 1             | 2    | 1               | 2     |
| <b>Kariyer seçiminde etkili olan faktörler</b>        |         |     |       |      |               |      |                 |       |
| 1- Aile   | 179     | 73  | 68,8  | 28,1 | 71            | 29   | 139,3           | 188,5 |
| 2- Maddi imkansızlık                                  | 95      | 153 | 36,6  | 58,8 | 38,3          | 61,7 | 61,2            | 168,5 |
| 3-Çevre faktörü                                       | 124     | 124 | 47,7  | 47,7 | 50            | 50   | 78,7            | 179,4 |
| 4-Kişisel yetenekler                                  | 191     | 57  | 73,5  | 21,9 | 76,9          | 23   | 130,6           | 190,3 |
| 5-Eğitim ve sınav sistemi                             | 209     | 39  | 80,4  | 15   | 84,4          | 15,7 | 169,4           | 194   |
| <b>Mesleki kariyerindeki beklentiler</b>              |         |     |       |      |               |      |                 |       |
| 1-Para kazanmak                                       | 244     | 12  | 93,8  | 4,6  | 95,3          | 4,7  | 211,7           | 198   |
| 2-Saygınlık   | 241     | 13  | 92,7  | 5    | 94,9          | 5,2  | 226             | 197,6 |
| 3-Mesleki tatmin                                      | 226     | 25  | 86,9  | 9,6  | 90,1          | 10   | 193,6           | 197,2 |
| 4-Mutluluk  | 234     | 22  | 90    | 8,5  | 91            | 8,5  | 223,7           | 196,9 |
| 5-Şöhret  | 102     | 138 | 39,2  | 53,1 | 42,5          | 57,5 | 72,5            | 175,8 |
| <b>Çalışma hayatında aranan koşullar</b>              |         |     |       |      |               |      |                 |       |
| 1-Yüksek maaş   | 240     | 16  | 92,3  | 6,1  | 93,8          | 6,3  | 195,4           | 198,4 |
| 2-İyi bir kariyer yapabilme imkanı                    | 249     | 9   | 95,8  | 3,5  | 96,5          | 3,5  | 231,8           | 197,3 |
| 3-Huzurlu bir çalışma ortamı                          | 243     | 12  | 93,4  | 4,6  | 95,3          | 4,8  | 245,9           | 197,6 |
| 4-Adil ve performansa dayalı yönetim ve ücret sistemi | 234     | 19  | 90    | 7,3  | 92,5          | 7,5  | 226,9           | 196,8 |
| 5-Çalışma saatlerinde esneklik                        | 206     | 36  | 79,2  | 13,8 | 85,1          | 14,9 | 162             | 194,6 |

1:Son Derece Önemli, Çok Önemli, Önemli

2:Pek Önemli Değil, Hiç Önemli Değil

Tablo 5.3.4.1'e göre öğrencilerin kariyerleri ile ilgili olarak:

- Kariyer seçiminde aile ve kişisel yeteneklerin çok büyük etkisinin olduğu buna karşılık olumsuz faktör olarak eğitim ve sınav sisteminin etkili olduğu görülmektedir. Kariyer seçiminde maddi imkanlar ile çevrenin önemli bir etkisinin olmadığı görülmektedir.
- Mesleki kariyerlerinden beklentilerinde para kazanma, saygınlık, mesleki tatmin ve mutluluk önemli faktör olarak tespit edilmiştir. Öğrencilerin mesleki başarılarına bağlı olarak şöhret elde etme konusunu önemli görmemektedirler.
- Çalışma hayatında iyi bir maaş, uygun ve adil bir çalışma şartlarını çok önemli bulduklarını belirtmişlerdir.

## 5.4. Sonuç ve Değerlendirme

Muhasebe mesleğinin gelişmesi, toplumda hak ettiği yere sahip olması şüphesiz mesleği icra edenlerin kişisel yeteneklerine ve bu kişilerin eğitimine sıkı sıkıya bağlıdır. Muhasebe derslerinde verilen bilgiler ve bu bilgilerin elde edilme süreci, piyasayla büyük bir paralellik göstermektedir. Bundan dolayı muhasebe eğitiminin kalitesi; öğrenci, öğretici, uygulayıcı ve söz konusu eğitimi alan öğrencileri istihdam edecek işletmeler açısından son derece önemlidir.

Kariyer, bir kişinin tüm çalışma yaşamını kapsamaktadır. Bireyin kariyerine ilişkin kararlar yalnızca birey, örgüt ve her ikisi tarafından alınabilmektedir. Kariyer planlaması, kişinin yaşamı boyunca yer alacağı işle ilgili görevi ve pozisyonların, hedeflerin, geleceğinin planlanmasıdır. Temelde kişisel bir süreçtir. Kariyer gelişimi, kişinin kendi kariyer planlarına ulaşabilecek ve başarı sağlayacak bir gelişimi anlatmaktadır. Kişisel bir kariyer planının uygulanması için gerekli programları ve faaliyetleri içerir. Kariyer geliştirme, örgütün, çalışanlarının kariyer yönünü ve ilerlemesini etkileyen etmenlerden haberdar olmasını sağlayan, bilgilerinin ve kapasitelerinin artırılmasını amaçlayan resmi faaliyetleridir.

Kariyer yönetimi ise, öz bir ifade ile kişinin kendi kariyer planlarına ulaşabilmesi için örgüt tarafından desteklenmesi anlamını taşımaktadır. Kariyer yönetiminin amacı, örgütsel sistem içinde işgörenlerin kariyer hareketlerinin bireysel ve örgütsel amaçları karşılayacak şekilde planlanmasını, geliştirilmesini ve yönetilmesini içerir. Böylece kariyer yönetimi; kariyer planlaması ve kariyer geliştirilmenin bir bütün hale getirilmesidir.

Muhasebe eğitiminin muhasebe alanında kariyer yapmayı düşünen ve düşünmeyen öğrenciler üzerinde etkili olduğu tespit edilmiştir. Muhasebe alanında kariyer yapmayı düşünen öğrencilerin bu seçiminde ilgi ve yeteneklerinin en önemli faktör olduğunu belirtmişlerdir. Ayrıca muhasebe eğitimi sayesinde mesleki kariyerlerinde sorumluluk sahibi, hukuka bağlı, hayatta sürekli öğrenme anlayışını benimsemiş ve bu anlayışa bağlı olarak geçmiş performans gözden geçirme, mevcut durumu denetleme ve geleceği planlama melekelerini elde ettikleri görülmektedir.

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# MUŞ İLİ'NİN DEPREM TEHLİKESİ

## SEISMICITY OF MUS PROVINCE

Ercan IŞIK

Bitlis Eren Üniversitesi, Mühendislik – Mimarlık Fakültesi

İnşaat Müh. Bölümü

ercanbitliseren@gmail.com

**ÖZET:** Bu çalışmada, Türkiye’de yüksek deprem potansiyeline sahip ve bir anlamda küresel enerji koridoru olarak adlandırılabilir Doğu Anadolu Bölgesinin önemli şehirlerinden Muş ili ve civarının deprem tehlikesinin ortaya konulması amaçlanmaktadır. Muş tarihsel ve aletsel dönem depremleri incelendiğinde sismik açıdan oldukça hareketli olan bir bölgede yer almaktadır. Çalışma alanı depremselliği incelenirken magnitüd-frekans ilişkisi, sismik risk ve dönüş periyotları hesaplanmıştır. Deprem riskleri jeolojik olarak fayların belirlenmesi ile elde edilebileceği gibi daha önceki deprem kayıtlarından faydalanılarak ta bulunabilmektedir. Muş şehir merkezine 150 km yarıçapındaki alanda 1900–2012 yılları arasında meydana gelen ve  $M \geq 4$  olan depremler Gutenberg-Richter bağıntısı dikkate alınarak bölgenin deprem riski istatistiksel olarak ortaya konulmuştur. Muş ve civarında 6 büyüklüğündeki bir depremin 100 yıl içinde gerçekleşme olasılığı %100 olarak hesaplanmıştır. Bu çalışma depremsellik ögesi ihmal edilen Muş ve civarında yapılacak çalışmalara katkı sağlayacağı gibi, yapılaşma esnasında deprem etkisinin dikkate alınması gerektiğini gözler önüne sermektedir.

**Anahtar Kelimeler:** Muş, azalım ilişkileri, depremsellik, Gutenberg-Richter

### ABSTRACT

In this study, the earthquake hazard of Mus province and its surrounding located in region which is seismically quite active is aimed to be presented. Analyzing the seismicity of studied area the relation between magnitude-frequency, seismic risk and cycling periods are calculated. Seismic risk of Mus were statically calculated by using the equation of Gutenberg-Richter for earthquakes which are  $M \geq 4$  that happened in between 1900-2012 of a radius 150km . In Mus and its surrounding, the probability of an earthquake of 6 magnitude in 100 years is calculated as %100. This study is supposed to contribute to the studies to be carried out in Mus and its districts where its seismicity has been neglected. It unfolds the necessity of earthquake effects to be kept in mind during constructing. Due to seismic risks the reality of earthquake should not be forgotten in Mus.

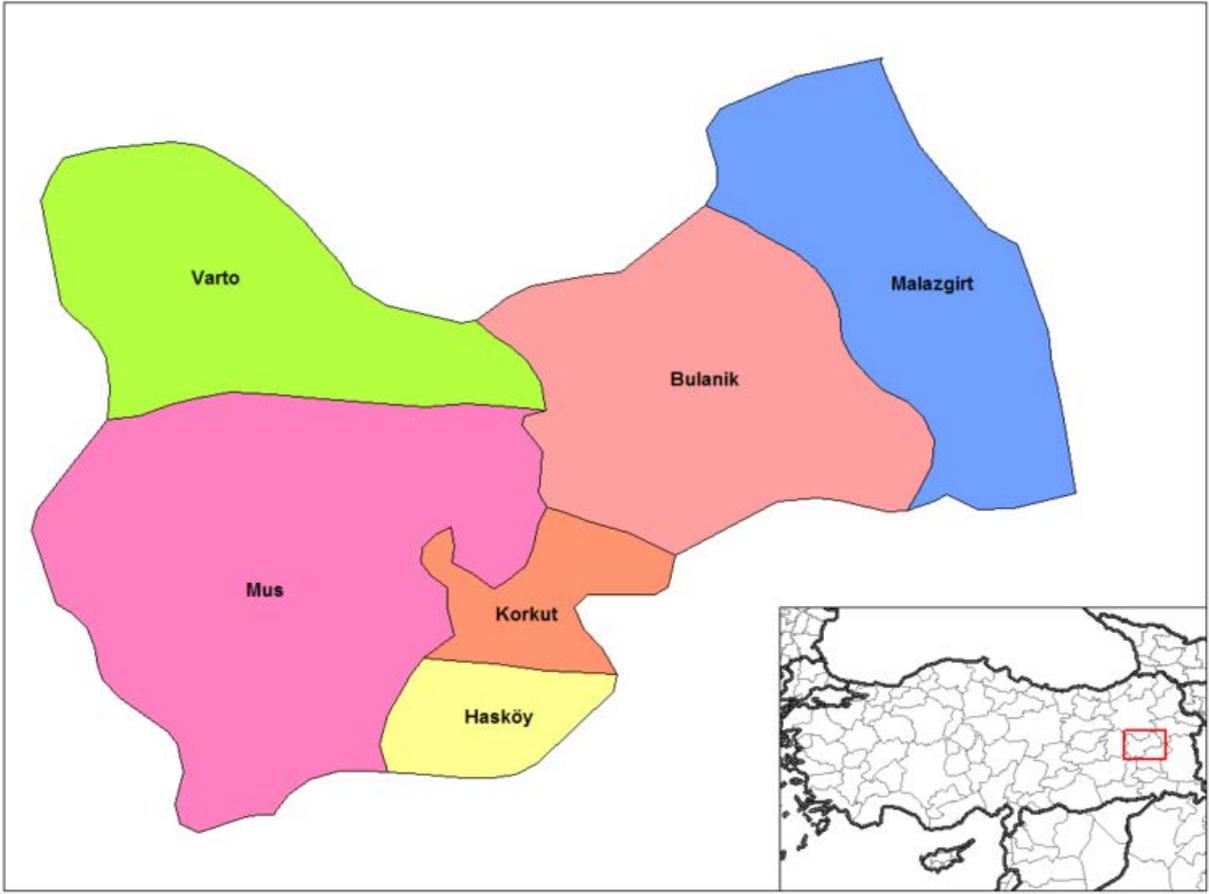
**Keywords:** Mus, attenuation relationships, seismicity, Gutenberg-Richter

## 1-Giriş

Depremsellik; jeolojik, tektonik ve istatistiksel verilere dayanmaktadır. Deprem oluş tarihi ve zamanı, merkez ve merkez üstü konumu, kaynak parametreleri ve yarattığı etkilerle ilgili makrosismik veriler, bir yörenin deprem tehlikesinin belirlenmesindeki en önemli unsurlardandır. Bir bölgenin depremselliği o bölgede gelecekte olabilecek bir depremin göstergesidir. Bir yerleşim biriminin olası bir depremde göstereceği performans, yapısal hasar durumu ve buna bağlı olarak can kaybı, yaralanmalar ve mal kaybını belirlemek amacı ile değişik bilimsel modeller üzerinde çalışmalar devam etmektedir. Yerleşim birimlerinin olasılığa dayalı sismik tehlike analizi gelecek depremlerin konumu, oluş zamanı, büyüklüğü ve diğer özellikler olasılık hesaplarına dayalı olarak tahmin edilmektedir.

Özellikle son yıllarda dünyada ve ülkemizde yaşanan yıkıcı depremler ve bu depremler sonucunda oluşan büyük çaplı can ve mal kayıpları deprem konusunda yapılan çalışmaları, araştırmaları ve alınacak önlemlerin önemini gündeme getirmiştir. Muş İli ve özellikle yakın çevresinin depremselliği ve buralarda geçmişte meydana gelen depremlerden dolayı Muş incelenmeye değer bir konumdur.

Muş, Doğu Anadolu Bölgesinde,  $41^{\circ}06'-41^{\circ}47'$  doğu boylamları,  $38^{\circ}29'-39^{\circ}29'$  kuzey enlemleri arasında yer alan,  $8.196 \text{ km}^2$  lik yüzölçüme sahip vadiler arasında kurulmuş tarihi bir şehirdir (Çevre Durum Raporu, 2010) (Şekil 1).



Şekil 1. Muş ili ve yer bulduru haritası

## 2-Tektonik Yapı

Türkiye’de güncel sismik aktivitenin yoğun olarak yaşadığı bölgelerden biri de Doğu Anadolu Bölgesidir. Doğu Anadolu Bölgesinin genel tektonik yapısı ağırlıklı olarak Bitlis Bindirme Zonu olarak bilinen deformasyon zonu boyunca Arap levhası ile Anadolu levhasının çarpışması ile kuzeye doğru hareketi ile kontrol edilmektedir (Şekil 2). Çarpışma Karlıova Üçlü Birleşim noktasında birleşen sağ yönlü doğrultu atımlı Kuzey Anadolu Fayı ve sol yönlü Doğu Anadolu Fayı ile yönetilmektedir (Şekil 2). Bunun yanı sıra Karlıova Üçlü birleşim noktasının doğusunda bu çarpışma sebebi ile çoğunlukla KB-GD doğrultulu sağ yönlü, KD-GB doğrultulu sol yönlü faylar bölgenin baskın elemanlarıdır. D-B doğrultulu Muş – Van Gölü ve Pasinler rampa havzaları Doğu Anadolu Bölgesinin göze çarpan diğer tektonik elemanlarıdır.

Doğu Anadolu bölgesi diri fay yoğunluğunun en fazla olduğu bölgelerden biridir. Doğu Anadolu Fayı, Türkiye’nin doğusunda Karlıova ile İskenderun Körfezi arasında KD-GB doğrultusunda uzanan yaklaşık 550km’lik uzunluğa sahip sol yanallı doğrultu atımlı bir faydır (Şekil 2). Bitlis Bindirme Zonu, Güneydoğu Türkiye’den İran’daki Zağros dağlarına kadar uzanan, kıta-kıta ve kıta-okyanus çarpışma sınırı olarak tarif edilecek bir komplekstir. Karlıova üçlü birleşim noktasının doğusunda kalan K-G yönlü sıkışma tektonik rejimi ile karakterize edilmektedir (Şekil 2).



Bu faylar sismik olarak aktif durumda olup birçok depreme kaynak oluşturmaktadırlar. 20. yüzyıldan önce Muş ve civarında önemli hasarlara sebep olmuş depremlerin bir kısmı Tablo 1’ de sunulmuştur.

Tablo 1. Muş ve çevresinde 20. Yüzyıldan önce oluşmuş önemli depremler

| No | Tarih      | Enlem (o) | Boylam(o) | Bölge                       | M   | I    |
|----|------------|-----------|-----------|-----------------------------|-----|------|
| 1  | 1012       | 39.10     | 42.50     | Malazgirt                   |     | VII  |
| 2  | 1208       | 38.70     | 42.50     | Ahlat-Van-Bitlis-Muş        |     |      |
| 3  | 1245       | 38.74     | 42.50     | Ahlat - Bitlis- Van - Muş   |     | VIII |
| 4  | 1276       | 38.90     | 42.50     | Bitlis- Ahlat -Erciş – Van  |     | VIII |
| 5  | 1282       | 38.90     | 42.90     | Ahlat – Erçiş               |     | VII  |
| 6  | 1345       | 39.10     | 42.50     | Malazgirt                   |     | VIII |
| 7  | 1363       | 38.70     | 41.50     | Muş ve civarı               |     | IX   |
| 8  | 1439       | 38.50     | 42.10     | Nemrut-Van-Bitlis-Muş       |     | VI   |
| 9  | 1441       | 38.35     | 42.10     | Nemrut-Van-Bitlis-Muş       |     | VIII |
| 10 | 1582       | 38.35     | 42.10     | Bitlis ve civarı            |     | VIII |
| 11 | 1646       | 38.50     | 43.40     | Van ve civarı               |     | VII  |
| 12 | 1647       | 39.15     | 44.00     | Van - Muş -Bitlis           |     | IX   |
| 13 | 1696       | 39.10     | 43.70     | Çaldıran - Bitlis           | 6,8 | X    |
| 14 | 1715       | 38.70     | 43.50     | Van - Erçiş                 | 6,6 | VIII |
| 15 | 1859       | 39.90     | 41.30     | Erzurum                     |     | IX   |
| 16 | 1869       | 38.40     | 42.10     | Bitlis ve civarı            |     | VII  |
| 17 | 1871       | 38.50     | 43.40     | Van -Nemrut                 | 5,5 | VII  |
| 18 | 1875       | 39.90     | 41.30     | Erzurum                     |     | X    |
| 19 | 30.05.1881 | 38.50     | 43.40     | Van – Bitlis- Muş           | 7,3 | IX   |
| 20 | 1891       | 38.80     | 42.50     | Malazgirt- Adilcevaz-Bitlis | 5,5 | VIII |
| 21 | 1892       | 39.10     | 42.50     | Malazgirt - Muş             |     | VII  |
| 22 | 1895       | 39.10     | 42.50     | Malazgirt                   |     | VIII |

Aletsel dönemde de Muş ve civarında bölgeyi etkilemiş önemli depremlerin sayısı oldukça fazladır. Muş ve civarında önemli hasarlara sebep olmuş depremlerin bir kısmı Tablo 2’de sunulmuştur.

Tablo 2. Muş ve çevresinde aletsel dönemde oluşmuş önemli depremler

| No | Tarih | Bölge              | M   |
|----|-------|--------------------|-----|
| 1  | 1903  | Malazgirt(Muş)     | 6.7 |
| 2  | 1924  | Erzurum-Horasan    | 6.8 |
| 3  | 1941  | Erçiş-Van          | 5.9 |
| 4  | 1946  | Varto - Hınıs      | 5.9 |
| 5  | 1949  | Karlıova-Bingöl    | 6.7 |
| 6  | 1950  | Varto              | 5.2 |
| 7  | 1959  | Varto - Hınıs      | 5.3 |
| 8  | 1966  | Varto              | 6.9 |
| 9  | 1971  | Bingöl             | 6.8 |
| 10 | 1975  | Lice               | 6.6 |
| 11 | 1976  | Muradiye -Çaldıran | 7.5 |
| 12 | 1982  | Bulanık            | 5.2 |
| 13 | 1983  | Erzurum            | 6.9 |
| 14 | 2003  | Bingöl             | 6.4 |

### 3. Metodoloji

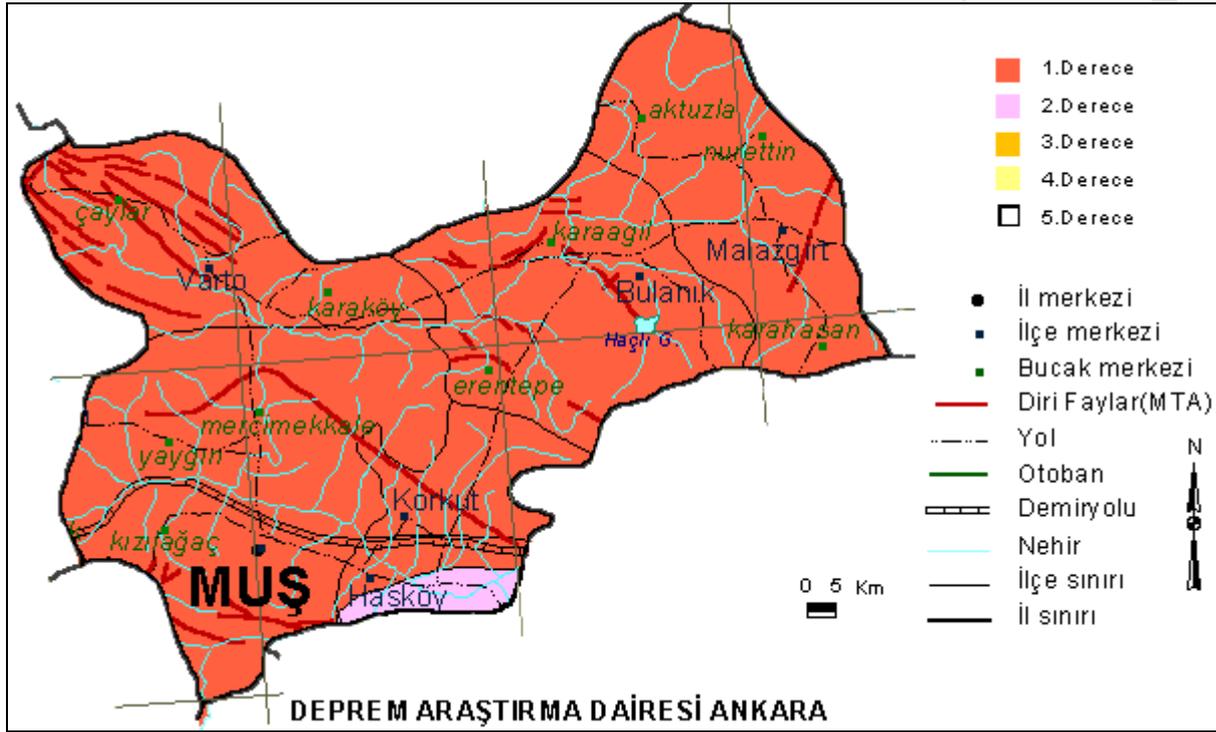
Bir bölgenin depreme maruz kalma derecesi, bu bölgenin sismisitesini göstermektedir. Bir bölgenin sismisitesinde en önemli yeri jeolojik formasyonların kırılmasından oluşan faylar meydana getirmektedir. Bölgelerin deprem riskleri jeolojik olarak bu fayların belirlenmesi ile elde edilebileceği gibi daha önceki deprem kayıtlarından faydalanılarak ta bulunabilmektedir. Önceden depreme maruz kalmış bölgeler gelecekte de benzer şekilde depremlerden zarar görecektir bölgeler olarak görülmektedir (Celep, 1996).

Hasar ve can kaybı yaratabilecek bir depremden kaynaklanan yer hareketinin belirli bir yerde ve belli zaman periyodunda meydana gelme ihtimali deprem tehlikesi olarak tanımlanmaktadır. Deprem riski, deprem nedeni ile hasar,

mal ve can kaybı ihtimali olarak tanımlanabilir. Risk şu soruların yanıtlarının toplamıdır: Ne büyüklükte bir deprem, ne kadar uzaklıkta, nasıl bir zeminde, ne tür bir yapıda, ne değerinde hasar ve kayba neden olur? 'Ne düzeyde tehlike?' sorusunun yanıtını ararken yapılacak ilk iş nerede deprem olabileceğini deterministik olarak tanımlamak ya da olasılıksal olarak kestirmektir. Deprem tehlikesi, deprem riskinin önemli bir ögesidir (Özmen,2008)(Türkelli, 2008)(Eyidoğan, 2003).

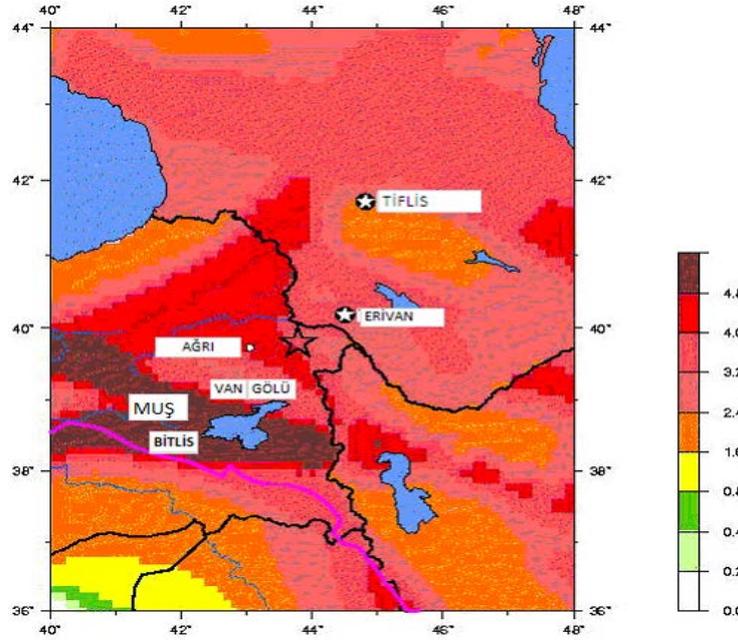
Van Gölü, Arabistan levhası ile Avrasya Levhasının çarpışması sonucu oluşan tektonik basınç sonucu oluşmuştur (Öztürk, 2005). Bu tektonik hareketin devam ediyor olması Van Gölü Havzasının depremsellik riskini artırmaktadır. Van Gölü havzasında meydana gelecek yıkıcı depremler bu havzaya yakın bir konumda bulunan Muş il merkezi ve ilçelerini yakından etkileyecektir. Muş ve civarı, Kuzey Anadolu Fayı ile Doğu Anadolu Fayı'nın kesişim noktası olan Karlıova'ya oldukça yakın bir bölgede bulunmaktadır. Muş İli, Varto, Karlıova, Malazgirt, Bingöl, Van Gölü, gibi deprem merkezlerine yakın olup bu bölgelerin de etkisi altındadır. Muş'ta şiddetli depremler sık sık hissedilmektedir.

Muş, Bakanlar Kurulunun 18.04.1996 tarih ve 96/8109 sayılı kararı ile geçerli kılınan Türkiye Deprem Bölgeleri Haritasında 1.derecede tehlikeli deprem kuşağında yer almaktadır (Şekil 4).



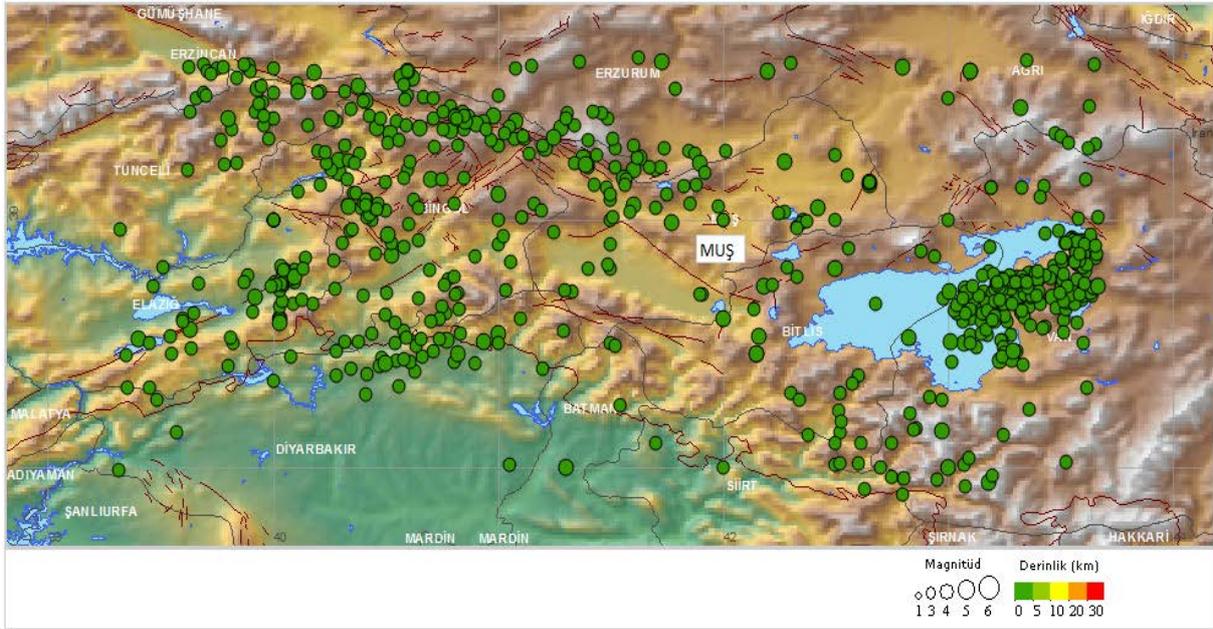
Şekil 4. Muş ili deprem haritası (Bayındırlık, 1996)

Muş şehri Doğu Anadolu sıkışma bölgesinde yer almaktadır. Muş ili ve civarı depremsellik açısından oldukça riskli bir kuşakta yer almaktadır. Sismik tehlike analizleri ile ilgili yapılan bilimsel çalışmalar da bu durumu gözler önüne sermektedir (Şekil 5).



Şekil 5. Muş İli'nin de içinde bulunduğu Doğu Anadolu Bölgesinin sismik risk haritası (%10 aşılma olasılığı 50 yıl ekonomik ömür için hesaplanan pik yer ivmesi değerleri) (Usgs)

Bu çalışmada kullanılan veriler Muş şehir merkezine 150 km yarıçapındaki daire içerisinde 70.650 km<sup>2</sup> lik alanda Deprem Dairesi Başkanlığı'nın veritabanındaki deprem verileri kullanılarak elde edilmiştir (Şekil 6).



Şekil 6. 1900'den günümüze kadar Muş ve civarında meydana gelen  $M \geq 4$  olan depremlerin dağılımı

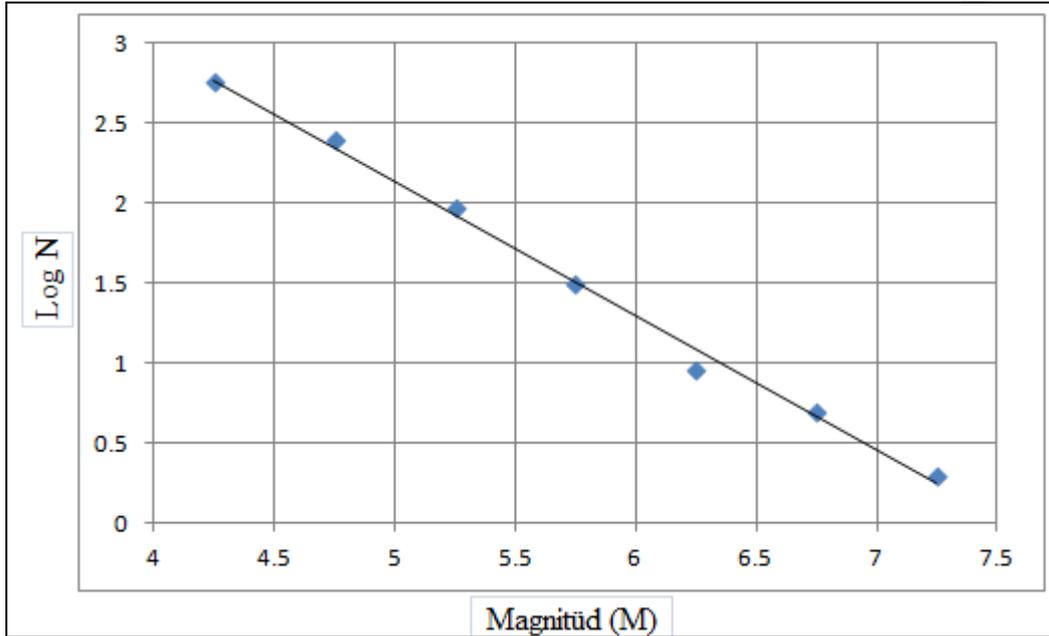
Magnitüdün fonksiyonu olarak depremlerin oluş frekansı incelendiğinde, genellikle doğrusal bir ilişki ile yorumlanmaya çalışılır. Depremlerin magnitüdü ile oluş sayıları arasında ilk defa Gutenberg ve Richter (1944) tarafından verilen;

$$\log N = a - b.M$$

Bağıntısı, bir bölgenin deprem etkinliğini yansıtmak için kullanılan en önemli bağıntılardan biridir (Gutenberg, 1944). Burada N, verilen bir bölge ve periyot için, magnitüdü M'e eşit veya daha büyük olan depremlerin sayısını, a ve b ise regresyon katsayılarını göstermektedir (Dowrick, 2003). Bu değerlerin Muş ili için hesaplamaları yapılırken Tablo 3' de gösterilmiş olan ve  $M \geq 4$  olan depremler dikkate alınmıştır. Dikkate alınan deprem magnitüd değerlerinin logaritmik değerleri Tablo 3'de hesaplanmıştır. Hesap sonucu elde edilen değerler Şekil 7' teki grafikte gösterilmiştir.

Tablo 3: Deprem magnitüd değerlerinin logartimik değerleri

| M | M =0.5     | Ort. Aralık | Frekans | Log N   | Yığınsal frekans | Log N   |
|---|------------|-------------|---------|---------|------------------|---------|
|   | 4.0 -- 4.5 | 4.25        | 321     | 2.50650 | 570              | 2.75587 |
|   | 4.5 -- 5.0 | 4.75        | 156     | 2.19312 | 249              | 2.39620 |
|   | 5.0 -- 5.5 | 5.25        | 62      | 1.79239 | 93               | 1.96848 |
|   | 5.5 -- 6.0 | 5.75        | 22      | 1.34242 | 31               | 1.49136 |
|   | 6.0 -- 6.5 | 6.25        | 4       | 0.60205 | 9                | 0.95424 |
|   | 6.5 -- 7.0 | 6.75        | 3       | 0.47712 | 5                | 0.69897 |
|   | 7.0 -- 7.5 | 7.25        | 2       | 0.30103 | 2                | 0.30103 |



Şekil 7. Muş İli için Gutenberg-Richter bağıntısı

a ve b regresyon katsayıları hesaplanırken en küçük kareler yöntemi uygulanarak bilgisayar ortamında %99 korelasyon katsayısı ile hesaplanmıştır. Muş İli için hesaplanan Gutenberg-Richter bağıntısı;

$$\log N = 6.345 - 0,841 M \text{ olarak bulunmuştur.}$$

a parametresi inceleme alanının genişliğine, gözlem dönemine ve deprem düzeyine bağlıdır. b değeri ise bölgenin tektonik karakteristiğini belirleyen bir parametre olarak kabul edilmektedir (Kalyoncuoğlu,2005).

Bu şekilde hesaplanan a ve b sabitleri ile istenen magnitüdü bir depremin, istenen bir periyot aralığında olma olasılığı hesaplanabilir. İncelenen alanın depremsellik parametreleri ise;

$$a' = a - \log(b \ln 10)$$

$$a_1 = a - \log T$$

$$a'_1 = a' - \log T$$

bağıntıları ile hesaplanabilmektedir. Verilen bir dönemde magnitüdü verilen bir M değerinden büyük veya ona eşit olan depremlerin yıllık ortalama oluş sayıları,

$$n(M) = 10^{a'_1 - bM}$$

bağıntısı ile bulunabilir. Herhangi bir bölgede  $T_1$  yıllık bir gözlem aralığı için verilen herhangi bir M magnitüdü depremin T yıl içinde oluşma riski (Gencoğlu, 1972, Taban ve Gencoğlu 1975);

$$R(M) = 1 - e^{-n(M)T}$$

bağıntısı ile hesaplanabilir. Bunların dönüş periyotları ise,

$$Q = 1 / n(M)$$

bağıntısından hesaplanabilir.

Muş İli için yukarıdaki bağıntılardan yararlanılarak deprem tehlikesini belirlemede kullanılan parametreler hesaplanmış ve Tablo 4’de gösterilmiştir.

Tablo 4: Deprem tehlikesini belirlemede kullanılan parametreler

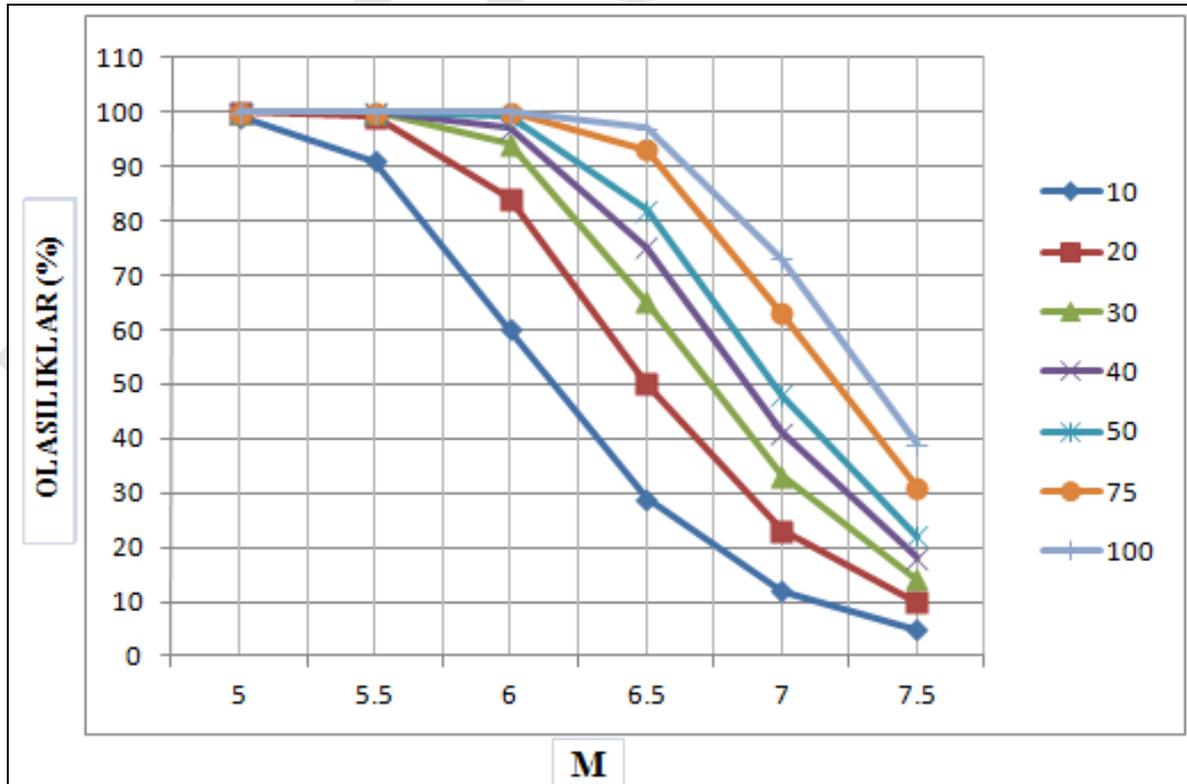
| a     | b     | a <sub>1</sub> | a'     | a' <sub>1</sub> |
|-------|-------|----------------|--------|-----------------|
| 6.345 | 0.841 | 4.2958         | 6.0579 | 4.0087          |

Deprem tehlikesini belirlemede kullanılan parametreler hesaplandıktan sonra 10, 20, 30, 40, 50, 75 ve 100 yıllık periyotlar ve bazı magnitüd değerleri için sismik tehlike değerleri ve dönüş periyotları hesaplanmıştır (Tablo 5).

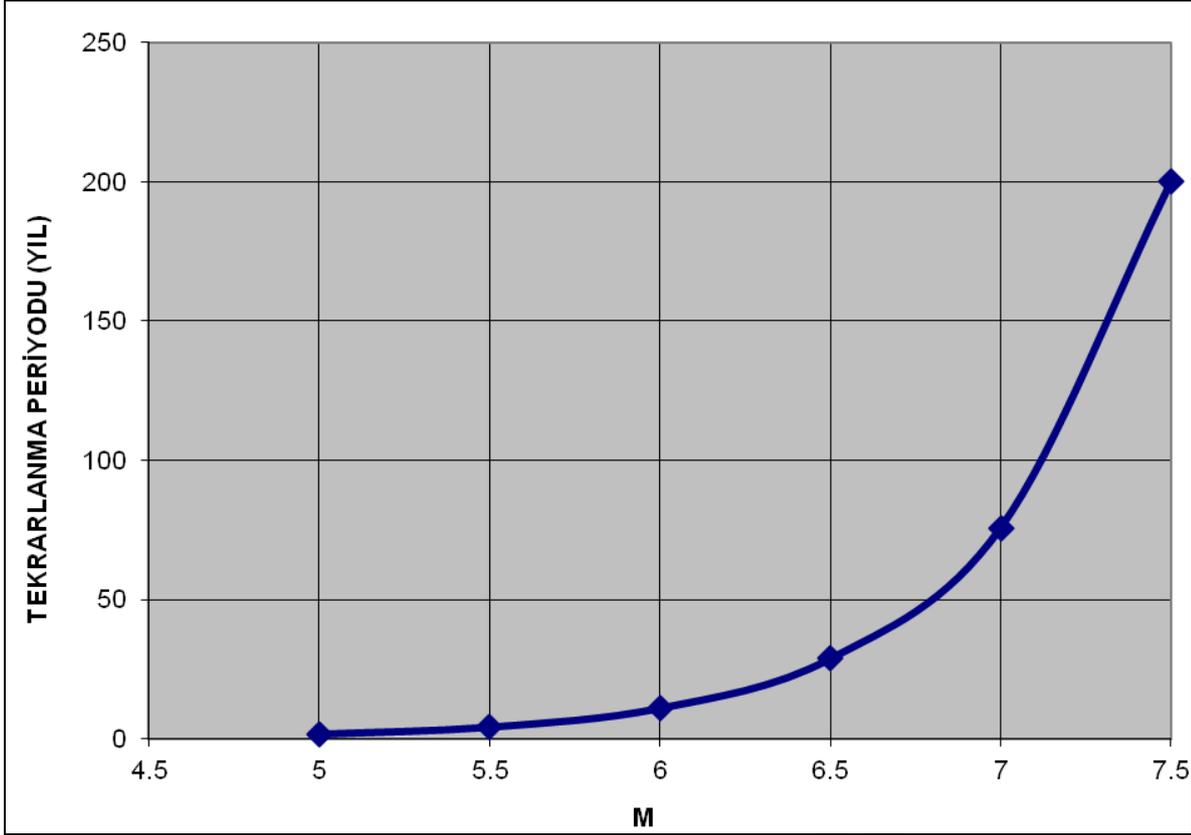
Tablo 5: Muş Şehir merkezli 150Km yarıçaplı bir alan için depremlerin gelecekte beklenen oluşumları ve dönüşüm periyotları

| M   | N(M)   | SİSMİK RİSK (%) |     |     |     |     |     |     | Dönüş Periyodu |
|-----|--------|-----------------|-----|-----|-----|-----|-----|-----|----------------|
|     |        | Yıllar          |     |     |     |     |     |     |                |
|     |        | 10              | 20  | 30  | 40  | 50  | 75  | 100 |                |
| 5.0 | 0.6363 | 99              | 100 | 100 | 100 | 100 | 100 | 100 | 1.6            |
| 5.5 | 0.2416 | 91              | 99  | 100 | 100 | 100 | 100 | 100 | 4.1            |
| 6.0 | 0.0918 | 60              | 84  | 94  | 97  | 99  | 100 | 100 | 10.9           |
| 6.5 | 0.0348 | 29              | 50  | 65  | 75  | 82  | 93  | 97  | 28.7           |
| 7.0 | 0.0132 | 12              | 23  | 33  | 41  | 48  | 63  | 73  | 75.8           |
| 7.5 | 0.0050 | 5               | 10  | 14  | 18  | 22  | 31  | 39  | 200.0          |

Muş ili için yapılan hesaplamalardan elde edilen sonuçlar Şekil 8 ve Şekil 9’da gösterilmiştir. Buna göre Muş ve civarında 6 büyüklüğündeki bir depremin 100 yıl içinde gerçekleşme olasılığı %100 olarak hesaplanmıştır.



Şekil 8: Belli Ekonomik Ömürler Göre Çeşitli Magnitüd Büyüklüklerinin Aşılma Olasılıkları



Şekil 9: Çeşitli Magnitüd Büyüklüklerine Ait Dönüş Periyotları

## SONUÇLAR

Bu çalışma ile Muş ve yakın çevresinin deprem tehlikesi hesaplanmıştır. 1900–2012 yılları arasında oluşmuş depremler dikkate alınarak magnitüd-frekans ilişkisi belirlenmiş ve Muş için  $a= 6.345$  ve  $b = 0.841$  olarak hesaplanmıştır. Deprem verilerinin istatistiksel analiz sonuçlarına göre 6.0, 6.5, 7.0, ve 7.5 büyüklüklerindeki depremlerin 50 yıllık bir dönemde oluşma ihtimalleri sırası ile %99, %82, %48 ve %22'dir.

Bölge aktif bir tektonik hüküm sürmesine rağmen tektonik yapının bütün unsurlarıyla iyi derecede bilindiğini söylemek zordur. Bu nedenle gelecekteki deprem tehlikesi açısından bölge ile ilgili sismotektonik çalışmaların yapılması büyük önem arz etmektedir.

Muş ve civarı hem Muş'taki depremlerin hem de uzak alanda oluşacak depremlerin tehdidi altındadır. Bu bağlamda hem Muş'ta hem Muş'a komşu olan Bingöl, Van Gölü Havzasında deprem üretebilecek fayların etkisi göz ardı edilmemelidir.

Muş İli ve civarında hem tarihsel hem de aletsel dönemde büyük ve hasar yapıcı depremlerin etkisinde kalmıştır. Bu da geçmişte olduğu gibi gelecekte de hasar yapacak depremlerin oluşacağına göstergesidir. Tektonik olarak son derece hareketli kuşaklar içerisinde kalan Muş ili civarında yapılaşma esnasında deprensellik faktörü göz önünde bulundurulmalı ve ilgili yönetmeliklere hassasiyetle uyulmalıdır. Mevcut yapılar içinse deprem riskinin azaltılması yönünde tedbirler alınırken yapı stoğu tespit çalışmalarından sonra güvenli olmayan ve güçlendirilmesi ekonomik olmayan yapılar gerekli mühendislik çalışması yapılarak hazırlanan projelerle güçlendirilmelidir.

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# NESNEYE YÖNELİK YAZILIM METRİKLERİNDEN TEMEL SINIF UYUM ÖLÇÜTLERİNİN İNCELENMESİ

Hayrettin Evirgen, Ahmet Arslan ,Serkan Darga

*Sakarya Üniversitesi Bilgisayar Mühendisliği Bölümü Sakarya, 54187 Türkiye*

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## Özet

Yazılım sektörünün gelişmesi ile yazılımlarda kalite ihtiyacı kendini hissettirmiştir. Kaliteyi sağlamak için çeşitli çalışmalar yapılmış bu çalışmaların sonucunda kaliteyi ölçme ihtiyacı doğmuştur. Ölçme işlemi yazılım metrikleri aracılığıyla gerçekleştirilmektedir. Bu metrikler arasında; nesneye dayalı programlamanın temel taşı olan sınıfların, sahip olduğu metod ve özelliklerin birbiri ile uyumunun derecesini ölçen sınıf uyumu(cohesion) metrik kümesi önemli bir yere sahiptir. Sınıf uyumunu ölçmek için bu güne kadar yapılan çalışmalar göreceli olarak bir başarı sağlasa da henüz olgunluk seviyesine ulaşmamıştır.

Bu çalışmada temel sınıf uyum metrikleri incelenmiş, bu metriklerin zayıf noktaları vurgulanarak ileride yapılacak metrik geliştirme çalışmalarının motivasyonu konusunda katkı sağlamak amaçlanmıştır.

Keywords: Öğrenim Yönetim Sistemleri; ÖYS; Sakai; cohesion; yazılım metrikleri;

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# OKULDAN AYRILAN ÖĞRENCİ PROFİLİNİN BİRLİKTELİK KURALI İLE ANALİZİ

## ANALYSIS OF DROP OUT STUDENT PROFILE BY USING ASSOCIATION RULE

Murat KARABATAK  
Yazılım Mühendisliği Bölümü  
Fırat Üniversitesi, Teknoloji Fakültesi  
Elazığ / Türkiye  
mkarabatak@firat.edu.tr

Ahmet Tekin  
Bilgisayar ve Öğretim Teknolojileri Bölümü,  
Fırat Üniversitesi, Eğitim Fakültesi  
Elazığ / Türkiye  
atekin@firat.edu.tr

**Özet:** Birçok kurumda olduğu gibi yükseköğretim kurumlarının veritabanlarında da çok büyük boyutlarda veriler saklanmaktadır. Bu verilerin çözümlenerek anlamlı bilgilerin ortaya çıkarılması, yükseköğretim kurumlarının birtakım tedbirler alarak, eğitimdeki kaliteyi artırmasını sağlayacaktır. Yükseköğretim kurumlarındaki temel problemlerden biri de çeşitli sebeplerle öğrencilerin okuldan ayrılmalarıdır. Okuldan ayrılan öğrencilere ait verileri çözümlenme ve anlamlı bilgileri ortaya çıkarmada istatistikî yöntemlerin yanında veri madenciliği yöntemlerinin de kullanılması, verilerin işlenmesi ve çözümlenmesinde büyük avantajlar sağlamaktadır. Veri madenciliği algoritmaları kullanılarak elde edilen bilgilerle, gelecekte okuldan ayrılma riski olan öğrenciler için birtakım tedbirler alınması sağlanabilir. Birliktelik kuralı, büyük veriler içerisinde anlamlı bilgilerin ortaya çıkarılmasında kullanılan yaygın yöntemlerden biridir. Bu çalışmada, okuldan ayrılan öğrencilere ait verilere, birliktelik kuralı yöntemi uygulanarak, okuldan ayrılan öğrenci profiline ait gizli örüntüler ortaya çıkarılmıştır.

**Anahtar Kelimeler:** Öğrenci Profili, Veri Madenciliği, Birliktelik Kuralı, Yükseköğretim.

**Abstract:** Similar to other institution's databases, very large data is stored in the higher education institutions databases. Extracting the significant information by analyzing this data will increase the quality of education by taking a number of precautions. One of the main problems of higher education institution is the student's drop out that occur based on various reasons. In addition to the statistical methods, during data analysis of the students who drop out of school and extracting meaningful information, data mining techniques provides great advantages in processing and analyzing the data. Based on the extracted information by using data mining algorithms, some further precautions can be taken for students who are under dropout risk. Association rule is one of the common methods that is used to extract meaningful information the large data. In this study, various hidden patterns are extracted for profile of drop out student by using association rule method on the student's data.

**Keywords:** Profile of Student, Data Mining, Association Rule, Higher Education.

### Giriş

Birçok kurumda olduğu gibi yükseköğretim kurumlarında da çok büyük boyutlarda veriler üretilmektedir. Yükseköğretim kurumlarındaki öğrenci, ders, akademik ve idari personel, yönetim sistemleri vb. veriler stratejik

verilerdir. Stratejik verilerin çözümlenerek anlamlı bilgilerin ortaya çıkarılması, yükseköğretim kurumlarının birtakım tedbirler alarak, eğitimdeki kaliteyi artırmasını sağlayacaktır. Veriyi çözümlenmek ve anlamlı bilgileri ortaya çıkarmada istatistikî yöntemler her zaman kullanışlı olmayabilmektedir. Bu durumlarda verileri işlemek ve çözümlenmek için veri madenciliği yöntemleri kullanılmaktadır.

Yükseköğretim kurumları, öğrenci ve mezunların yol haritalarını tahmin etmeye odaklanmıştır. Kurumlar hangi öğrencilerin özel ders programlarına kayıt yaptıracağı, hangi öğrencilerin mezun olabilmesi için akademik yönlendirmeye ihtiyacı olacağı veya hangi öğrencilerin okuldan ayrılabilceği gibi soruların cevaplarını bilmek isterler. Bu gibi soruların cevapları kurumlar için önemlidir ve bu soruların cevapları veri madenciliği yöntemleri ile bulunabilmektedir (Luan, 2001). Delavari ve ark. (2005), yükseköğretim kurumları için veri madenciliği yeteneklerini kullanan bir karar sistemi tasarlamıştır. Karar ağacı ile sınıflandırma yöntemi kullanılarak, Bilgi Teknolojileri Fakültesindeki önemli derslerden biri olan Programlama II dersindeki öğrenci performansını belirlemeyi amaçlamıştır. Vranic ve ark. (2007), Elektrik Mühendisliği Temelleri dersinde, öğrencilerin çeşitli konuları öğrenme yeteneğini ve öğrenci davranışlarını daha iyi anlamayı amaçlamıştır. Ayrıca bu derste önceki yıllardaki öğrenci başarısına bakarak gelecek yılki öğrencilerin başarısını da veri madenciliği yöntemleri ile tahmin etmeye çalışmıştır. Karabatak ve İnce (2004) ise yaptığı çalışmada öğrencilerin tüm derslerini dikkate almış ve 4 yıllık öğretim sürecindeki tüm ders notları arasındaki ilişkileri birliktelik kuralı ile ortaya çıkarmıştır. Bu sayede öğrencilerin gelecekte derslerden alacağı notların tahmini yapılarak, hangi dersten başarılı veya başarısız olabilecekleri konusunda ön fikir sahibi olmaları ve çalışmalarını bu doğrultuda düzenlemeleri gerektiği vurgulanmıştır. Zaiane ve Luo (2001), eğitimciler ve öğrenme süreçlerinin daha iyi değerlendirmesi amacıyla web-tabanlı öğrenme ortamının tasarımında veri madenciliği ve makine öğrenmesi tekniklerinin kullanılabilirliğini tartışmıştır. Romero ve ark. (2008) ise, eğitim ve öğrenme yönetim sistemlerinden biri olan Moodle'ın verilerine birliktelik kuralı, kümeleme, sınıflandırma gibi veri madenciliği teknikleri uygulamıştır. E-öğrenme yöneticileri ve çevrimiçi eğitimcileri hem teorik hem de pratik olarak tanıştırmak amaçlanmıştır. Bir diğer çalışmada ise Jadric ve ark. (2010), öğrencilerin okul türlerine ve giriş puanlarına göre, veri madenciliği yöntemlerini kullanarak, öğrencilerin okuldan ayrılma durumlarını incelemiştir. Ayrıca yazar veri madenciliği uygulamalarının bu alanda henüz yeterli olmadığını vurgulamıştır.

Bu çalışmada, Fırat Üniversitesi'nde okurken çeşitli sebeplerle okuldan ayrılan öğrencilerin veritabanından elde edilen verilerine, market sepet analizi olarak bilinen birliktelik kuralının nasıl uygulanacağı anlatılmış ve elde edilen birliktelik kuralları verilmiştir. Fırat Üniversitesi Öğrenci İşleri Dairesi Başkanlığından ve Öğrenci İşleri Otomasyonundan temin edilen verilerde, öğrencilere ait özel verileri (TC kimlik no, adı, soyadı, anne-baba adı vb.) gizli tutularak, gizlilik içermeyen diğer veriler (memleket, cinsiyet vb.) kullanılmıştır. Bu nedenle elde edilen kurallar bazı stratejik bilgileri içermemektedir.

## Yöntem

Veri madenciliği; büyük miktarda veri içinden gelecekle ilgili tahmin yapılmasını sağlayacak bağıntı ve kuralların bilgisayar programları kullanarak aranması olarak tanımlanmaktadır (Karabatak, 2008). Bu çalışmada da, elde edilen veri kümesinden, anlamlı bilgilerin çıkarılması amacıyla veri madenciliği algoritmalarından biri olan birliktelik kuralı algoritması kullanılmıştır. Birliktelik kuralı, okuldan ayrılan öğrenci profilinin analizinde büyük katkılar sağlayacaktır. Birliktelik kuralı üretilirken, Matlab programı kullanılmıştır. Matlab ortamında hazırlanan program ile elde edilen verilerden birliktelik kuralları üretilmiş ve elde edilen kurallar verilmiştir.

## Veri Madenciliği

Veri madenciliği, elde edilen verilerden üstü kapalı, çok net olmayan, önceden bilinmeyen ancak potansiyel olarak kullanışlı bilginin çıkarılmasıdır. Bu da; kümeleme, veri özetleme, değişikliklerin analizi, sapmaların tespiti gibi belirli sayıda teknik yaklaşımları içermektedir. Kısaca veri madenciliği; geniş veri tabanlarındaki veriler arasından bilgi çıkarma işlemidir (Frawley ve ark., 1991).

Veri madenciliği, temelde iki ana başlıkta incelenmektedir. Birincisi, elde edilen örüntülerden sonuçları bilinmeyen verilerin tahmini için kullanılan tahmin edici (Predictive) diğeri ise elde edilen verinin tanımlanmasını sağlayan tanımlayıcıdır (Descriptive) (Akpınar, 2000). Veri madenciliği modellerini gördükleri işlevlere göre sınıflama ve regresyon, kümeleme ve birliktelik kuralları olmak üzere üç ana başlık altında incelemek mümkündür. Bu çalışmada veri madenciliği modellerinden birliktelik kuralı kullanılmıştır.

## Birliktelik Kuralı

Günümüzde, birçok alandaki veriler bilgisayarlarda ve veritabanları üzerinde saklanmaktadır. Bu verilerden, istenilen ve kayda değer bilgilere ulaşmak için kullanılan tekniklerden biri de birliktelik kurallarıdır. Birliktelik kuralları, işlemlerden oluşan ve her bir işlemin de ürünlerin birlikteliğinden oluştuğu düşünülen bir veri tabanında, bütün ürün birlikteliklerini tarayarak, sık tekrarlanan ürün birlikteliklerini veri tabanından ortaya çıkarmaktır (Agrawal, 1996). Genellikle büyük süpermarketlerde oluşan verilere uygulanan birliktelik kuralı, market sepet analizi olarak adlandırılmaktadır. Birçok kuruluş, market sepet verilerini kullanarak bu verilerden büyük faydalar sağlamayı amaçlamaktadır. Bir süpermarkette, “Eğer  $X$  ürününü alan müşterilerin  $Y$  ürününü de çok yüksek bir olasılıkla aldıkları biliniyorsa veya bir müşteri  $X$  ürününü alıyor ama  $Y$  ürününü almıyorsa” şeklinde elde edilen sonuçlar, o süpermarket için çok önemli bilgilerdir ve bu bilgiler birliktelik kuralı ile elde edilebilmektedir.

Birliktelik kuralı bulma işlemi, yoğun nesne kümesi hesaplamaya dayalı bir işlem olup büyük veritabanları üzerinde uygulanması oldukça pahalı bir işlemdir. Bu nedenle daha önceden tespit edilen birliktelik kurallarının korunması da oldukça önemli bir konu olmaktadır (Koyuncu, 2004). Birliktelik kuralı, birçok alanda geniş kullanım alanına sahiptir ve nesnelerin veya niteliklerin bir arada olma durumlarını belirlemede kullanılmaktadır. Bu çalışmada birliktelik kuralı kullanılarak, okuldan ayrılan öğrenci profili çıkarılmakta ve öğrencilerin nitelikleri arasındaki ilişkilerin elde edilmesi amaçlanmaktadır.

## Veri Toplama ve Hazırlama

Veritabanlarından elde edilen ham verilerin işlenmesi, veri madenciliğinde her zaman bazı problemler ortaya çıkarmaktadır. Veritabanının boyutu, gürültülü veriler, boş veriler, eksik veriler vb. bunların sorunların birkaçını oluşturmaktadır. Bu sorunları giderebilmek ve veritabanındaki ham verilere veri madenciliği algoritmalarını uygulayabilmek için verilere bazı dönüşüm işlemlerin uygulanması gerekmektedir. Verilerin hazırlanması, toplanması, değer biçilmesi, birleştirme, temizleme ve seçim vb. gibi bazı işlemler gerekebilmektedir. Fırat Üniversitesi öğrencilerinin bilgilerini barındıran veritabanı, 2004 yılından 2012 yılına kadar çeşitli sebeplerle okuldan ayrılan 2475 öğrenciye ait veriye sahiptir. Ancak veritabanında tutarsız, eksik ve hatalı veriler bulunduğundan bu veriler araştırma dışında tutulmuş ve 2454 veri üzerinde birliktelik kuralı uygulanarak analizler yapılmıştır. Okuldan ayrılan öğrencilere ait ayrılış sebebi, cinsiyet, memleket, öğretim türü, ortalama ve ayrılış kodu gibi bilgileri içeren ham verilerden bir kesit, Şekil 1’de görülmektedir. Veritabanı modeli olarak ilişkisel veri modeli kullanıldığından dolayı, Şekil 1’de görülen ayrılış kodlarının ne anlama geldiği yine farklı bir tabloda tutulmakta ve bu tablolar ilişkilendirilerek sorgulanıp ham verilerden anlamlı bilgiler elde edilebilmektedir.

|    | NUMARA   | BOLKOD | MEMTRKODU | SGK | CINSIYET | ASKERLIK | OI | SINIF | YAS | AYRILISKODU | ort      |
|----|----------|--------|-----------|-----|----------|----------|----|-------|-----|-------------|----------|
| 1  | 06554513 | 554    | 31        | 0   | 1        | 2        | 2  | 1     | 2   | 2           | 3        |
| 2  | 06126043 | 126    | 12        | 0   | 1        | 2        | 1  | 2     | 2   | 7           | 0        |
| 3  | 07472013 | 472    | 1         | 0   | 1        | 2        | 1  | 1     | 2   | 1           | NULL     |
| 4  | 07315049 | 315    | 21        | 0   | 1        | 2        | 1  | 1     | 2   | 2           | 3,388888 |
| 5  | 10700065 | 700    | 78        | 0   | 1        | 2        | 1  | 2     | 2   | 1           | 2        |
| 6  | 04802021 | 802    | 23        | 1   | 1        | 2        | 1  | 2     | 2   | 7           | 0,168674 |
| 7  | 10805537 | 805    | 23        | 0   | 1        | 2        | 2  | 2     | 3   | 1           | 0        |
| 8  | 06133522 | 133    | 23        | 0   | 1        | 2        | 2  | 2     | 2   | 7           | 2,267857 |
| 9  | 08472502 | 472    | 23        | 4   | 1        | 2        | 2  | 3     | 2   | 1           | 1,188235 |
| 10 | 04230031 | 230    | 34        | 1   | 2        | 1        | 1  | 3     | 2   | 7           | 0,368852 |
| 11 | 06555002 | 555    | 44        | 0   | 2        | 2        | 1  | 1     | 2   | 2           | 1,738095 |
| 12 | 06520530 | 520    | 42        | 0   | 1        | 2        | 2  | 2     | 1   | 2           | 2,843137 |
| 13 | 07156022 | 156    | 23        | 0   | 2        | 2        | 1  | 2     | 2   | 7           | 0        |
| 14 | 08852525 | 852    | 12        | 0   | 1        | 2        | 2  | 1     | 2   | 1           | NULL     |
| 15 | 04135043 | 135    | 23        | 1   | 1        | 2        | 1  | 2     | 2   | 7           | 0,360465 |
| 16 | 05530027 | 530    | 53        | 1   | 1        | 2        | 1  | 2     | 2   | 1           | 0,29518  |
| 17 | 04230047 | 230    | 41        | 3   | 1        | 2        | 1  | 1     | 2   | 2           | 1,621951 |
| 18 | 05260601 | 260    | 31        | 1   | 1        | 2        | 1  | 3     | 2   | 7           | NULL     |
| 19 | 09556533 | 556    | 2         | 4   | 2        | 2        | 2  | 2     | 2   | 2           | 3,27027  |

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### Şekil 1: Okuldan Ayrılan Öğrencilere Ait Ham Veriler

Tablo 1'deki verilerden, Birliktelik kuralı kullanarak anlamlı sonuçlar üretebilmek için ham verilerin kullanılması problemler doğurabilmektedir. Bu nedenle, veri dönüştürme aşaması uygulanarak Tablo 1'deki gibi etiketlenilmiş veriler elde edilmiştir. Veritabanına, algoritmanın uygulanabileceği uygun formata getirildikten sonra birlikteli uygulanmış ve sonuçlar elde edilmiştir.

**Tablo 1:** Okuldan Ayrılan Öğrencilere Ait Bazı Verilerin Etiketlendirilmiş Biçimi

| <table border="1"> <thead> <tr> <th>Memleket – 1</th> </tr> </thead> <tbody> <tr> <td>23-----&gt;1 Elazığ</td> </tr> <tr> <td>44-21-12-62-----&gt;2 Komşu iller (Malatya, Diyarbakır, Bingöl, Tunceli)</td> </tr> <tr> <td>Diğer iller-----&gt;3</td> </tr> </tbody> </table> | Memleket – 1 | 23----->1 Elazığ   | 44-21-12-62----->2 Komşu iller (Malatya, Diyarbakır, Bingöl, Tunceli) | Diğer iller----->3   | <table border="1"> <thead> <tr> <th>Ayrıış Sebebi - 4</th> </tr> </thead> <tbody> <tr> <td>1-----&gt;Kendi İsteđi ile (harç, ders kaydı)</td> </tr> <tr> <td>2-----&gt;Yatay Geçiş ile</td> </tr> <tr> <td>3-----&gt;Diđer (disiplin cezası, devamsızlık, vefat, farabi vb.)</td> </tr> </tbody> </table> | Ayrıış Sebebi - 4 | 1----->Kendi İsteđi ile (harç, ders kaydı) | 2----->Yatay Geçiş ile | 3----->Diđer (disiplin cezası, devamsızlık, vefat, farabi vb.) |
|---|--------------|--------------------|---|--|---|-------------------|--|------------------------|--|
| Memleket – 1  |              |                    |   |  |   |                   |  |                        |  |
| 23----->1 Elazığ  |              |                    |   |  |   |                   |  |                        |  |
| 44-21-12-62----->2 Komşu iller (Malatya, Diyarbakır, Bingöl, Tunceli)   |              |                    |   |  |   |                   |  |                        |  |
| Diğer iller----->3  |              |                    |   |  |   |                   |  |                        |  |
| Ayrıış Sebebi - 4   |              |                    |   |  |   |                   |  |                        |  |
| 1----->Kendi İsteđi ile (harç, ders kaydı)  |              |                    |   |  |   |                   |  |                        |  |
| 2----->Yatay Geçiş ile  |              |                    |   |  |   |                   |  |                        |  |
| 3----->Diđer (disiplin cezası, devamsızlık, vefat, farabi vb.)  |              |                    |   |  |   |                   |  |                        |  |
| <table border="1"> <thead> <tr> <th>Cinsiyet – 2</th> </tr> </thead> <tbody> <tr> <td>Erkek -----&gt;1</td> </tr> <tr> <td>Kız -----&gt;2</td> </tr> </tbody> </table>  | Cinsiyet – 2 | Erkek ----->1      | Kız ----->2   | <table border="1"> <thead> <tr> <th>Ortalama – 5</th> </tr> </thead> <tbody> <tr> <td>&lt;1,5-----&gt;1</td> </tr> <tr> <td>1,5-2,5-----&gt;2</td> </tr> <tr> <td>&gt;2,5-----&gt;3</td> </tr> </tbody> </table> | Ortalama – 5  | <1,5----->1       | 1,5-2,5----->2                             | >2,5----->3            |  |
| Cinsiyet – 2  |              |                    |   |  |   |                   |  |                        |  |
| Erkek ----->1   |              |                    |   |  |   |                   |  |                        |  |
| Kız ----->2   |              |                    |   |  |   |                   |  |                        |  |
| Ortalama – 5  |              |                    |   |  |   |                   |  |                        |  |
| <1,5----->1   |              |                    |   |  |   |                   |  |                        |  |
| 1,5-2,5----->2  |              |                    |   |  |   |                   |  |                        |  |
| >2,5----->3   |              |                    |   |  |   |                   |  |                        |  |
| <table border="1"> <thead> <tr> <th>Öğretim – 3</th> </tr> </thead> <tbody> <tr> <td>1. Öğretim -----&gt;1</td> </tr> <tr> <td>2. Öğretim -----&gt;2</td> </tr> </tbody> </table>   | Öğretim – 3  | 1. Öğretim ----->1 | 2. Öğretim ----->2  |  |   |                   |  |                        |  |
| Öğretim – 3   |              |                    |   |  |   |                   |  |                        |  |
| 1. Öğretim ----->1  |              |                    |   |  |   |                   |  |                        |  |
| 2. Öğretim ----->2  |              |                    |   |  |   |                   |  |                        |  |

### Elde Edilen Birliktelik Kuralları

Bu çalışma kapsamında, okuldan ayrılan öğrencilerin verilerine, veri madenciliđi algoritmalarından biri olan birliktelik kuralı uygulanarak  $X \rightarrow Y$  formatında kurallar elde edilmiştir. Bu kurallardaki X ve Y ifadeleri; cinsiyet, memleket, öğretim türü, ortalama ve ayrılış sebebi gibi verileri içermektedir. Çalışmada, farklı destek ve güven değerleri için birçok kural elde edilmiştir. Bu kurallardan bazıları Tablo 3'de verilmiştir. Tablo 2'de verilen kurallardan örneđin 1'inci kural, "5.1----->4.1- güven= yüzde 87.05" formatında olup, Tablo 1'de gösterilen dönüştürme işlemleri tekrar geriye doğru çözüldüğünde, "ayrılan öğrencilerden ortalaması 1,5'den küçük olanların yüzde 87.05'inin ayrılış sebebi kendi isteđi iledir" sonucunu ortaya koymaktadır.

**Tablo 2:** Farklı Destek Deđerleri İçin Elde Edilen Kurallardan Bazıları

|  |  |
|--|--|
| 5.1----->4.1- güven= yüzde 87.05         | 1.1-5.1----->2.1- güven= yüzde 87.15         |
| 1.1-5.1----->2.1- güven= yüzde 87.15     | 1.3-5.3----->4.2- güven= yüzde 93.11         |
| 1.3-5.3----->4.2- güven= yüzde 93.11     | 3.2-5.1----->4.1- güven= yüzde 90.66         |
| 3.2-5.1----->2.1- güven= yüzde 87.65     | 1.3-2.1-5.3----->4.2- güven= yüzde 91.71     |
| 3.2-5.1----->4.1- güven= yüzde 90.66     | 1.3-2.2-5.3----->4.2- güven= yüzde 95.09     |
| 1.3-2.1-5.3----->4.2- güven= yüzde 91.71 | 1.3-3.1-5.3----->4.2- güven= yüzde 93.42     |
| 1.3-2.2-5.3----->4.2- güven= yüzde 95.09 | 1.3-3.2-5.3----->4.2- güven= yüzde 92.62     |
| 1.3-3.1-5.3----->4.2- güven= yüzde 93.42 | 2.1-3.2-5.1----->4.1- güven= yüzde 91.07     |
| 2.1-3.2-5.1----->4.1- güven= yüzde 91.07 | 2.2-3.1-5.3----->4.2- güven= yüzde 90.41     |
| 5.1----->2.1- güven= yüzde 82.90         | 1.3-2.1-3.1-5.3----->4.2- güven= yüzde 92.20 |

Elde edilen kurallardan bazılarının açıklamaları aşağıda verilmektedir:

- Ayrılan öğrencilerden, memleketi Elazığ ve ortalaması 1,5'den küçük olanların yüzde 87,15'inin cinsiyeti erkektir.
- Ayrılan öğrencilerden, memleketi diğer iller olan ve ortalaması 2,5'dan büyük olanların yüzde 93,11'inin ayrılış sebebi yatay geçiştir.
- Ayrılan öğrencilerden, öğretim türü 2. öğretim olan ve ortalaması 1,5'dan küçük olanların yüzde 87,65'i erkektir. Erkeklerin oranı normalde %69 olduğu düşünülürse öğretim türü ve ortalama değişkenlerinin etkisi ile %87,65'e çıktığı görülmektedir.
- Ayrılan öğrencilerden, memleketi diğer iller olan ve cinsiyeti erkek olan ve öğretim türü 1. öğretim olan ve ortalaması 2,5'dan büyük olanların yüzde 92,20'sinin ayrılış sebebi yatay geçiştir.
- Ayrılan öğrencilerden, ortalaması 1,5'dan küçük olanların yüzde 82,90'ı erkektir.

## Sonuçlar

Bu çalışmada veri madenciliği yöntemlerinden birliktelik kuralı kullanılarak, okuldan ayrılan öğrencilerin ayrılma sebeplerine ilişkin öğrenci profili ortaya çıkarılmıştır. Bu sonuçlara göre cinsiyeti erkek, memleketi Elazığ ve ortalaması 1,5'dan küçük olanların genelde kendi isteği ile okuldan ayrıldıkları, ortalaması 2,5'den büyük olanların ve memleketi Elazığ dışında olanların ise genelde yatay geçiş sebebi ile okuldan ayrıldıkları görülmektedir. Yine kız öğrencilerin daha çok yatay geçiş ile erkek öğrencilerin ise daha çok kendi isteği ile okuldan ayrıldıkları gibi sonuçlar da ortaya çıkmaktadır. Elde edilen bu gibi veriler ile ihtimaller değerlendirilerek, stratejik kararlar ile erkenden, öğrencinin okuldan ayrılmaması için çözümler bulunabilir. Her ne kadar market sepet analizi olarak bilinse de birliktelik kuralı uygulanarak öğrencilere ait birçok veri değerlendirmeye alınıp, eğiti kalitesini yükseltebilecek, yeri geldiğinde önceden önlemler alınmasını sağlayacak bilgiler elde edilebilmektedir. İster eğitim kurumları olsun, ister diğer kurumlar olsun toplanan büyük boyutlardaki verilerin işlenerek anlamlı sonuçların çıkarılması ve bunların değerlendirilmesi günümüzde özellikle üzerinde durulması gereken önemli bir konudur.

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# ON SCALAR QUARK LEAKAGE THROUGH THE POWER-LAW AND LOGARITHMIC CONFINING POTENTIALS IN THE KLEIN-GORDON EQUATION

L.K Sharma & P.V.C Luhanga  
 Department of Physics, University of Botswana  
 Gaborone  
 Botswana

Corresponding author e-mail: [sharmalk@mopipi.ub.bw](mailto:sharmalk@mopipi.ub.bw)

**Abstract:** Motivated from a phenomenological viewpoint, three confining potentials have been studied in the Klein-Gordon equation framework. In particular we study the phenomena of quark leakage for these potentials. The transmission coefficient values have been obtained for all the potentials, using WKB [Wentzel, Kramers & Brillouin] method and compared with potentials already discussed by previous authors. We observe that one of the potentials considered by us strongly supports the existence of free quarks because of the comparatively large values of transmission coefficients, as predicted by our model.

*Keywords:* Confining potentials; tunnelling phenomenon; quark leakage; transmission coefficients.

## 1. Introduction and Motivation

Mankind has sought the elementary building blocks of matter ever since the days of the Greek philosophers. Over time, the quest has been successively refined from the original notion of indivisible “atoms” as the fundamental elements to the present idea that objects like quarks lie at the heart of all matter.

With the new discoveries being made at the Large Hadron Collider at CERN, interest in hadron spectroscopy has still not waned. Many attempts have been made in the past as well in the present to study the hadron spectroscopy, using both the non-relativistic Schrödinger equation and the relativistic wave equations viz., the Klein-Gordon and the Dirac equations.

It may be noted that the model involving fractionally charged quarks was proposed by Gell-Mann (1964) and Zweig (1964) to account for the explosion of subatomic particles discovered in accelerator and cosmic ray experiments during 1950s and early 1960s. Their model won acceptance because of a few semiquantitative tests e.g., a large weight of circumstantial evidence and many quantitative facts about strong interactions which it apparently explains. Since then, however, there have been many unsuccessful attempts to find quarks at accelerators, in sea water, in rocks and in cosmic rays. Though La Rue et al (1977) have claimed that they have found some evidence for quarks in their superconducting levitation experiment involving niobium pellets.

There have been many attempts to understand the physical mechanism of quark confinement. However, none of them is completely convincing and satisfactory. Even the most ambitious attempts based on quantum chromodynamics (QCD) provide rather vague explanations of the mechanism of confinement. The problem was earlier attacked also with the help of less ambitious but more plausible models like naïve strings, bags, suitable potentials *etc.* The problem of confinement was also tried, treating hadrons as systems of quark solitons with some suitable non-linear interactions (Werle, 1993).

Kang and Schnitzer (1975) have calculated meson spectra, using a potential function  $ar + b$  as the fourth component of a four-vector in the Klein-Gordon equation. The quark-antiquark bound-state energy values (which correspond to meson masses) were calculated using WKB approximation. Gunion and Li (1975) have studied the same potential as a Lorentz scalar in the Klein-Gordon and Dirac equations. The motivation of their using the linear potential came from field-theoretic arguments. Sharma with his collaborators (2008, 2007, 2004, 2003, 1998, 1988, 1984, 1983, 1982, 1982, 1980) has extensively studied quark confinement and have calculated bound-state spectra for both the light and heavy mesons e.g., the bound-states for  $c\bar{c}$ ,  $b\bar{b}$ ,  $s\bar{s}$  etc., spectra have been calculated by them. Recently Sharma et al (2000, 2003) have also evaluated the spectra of  $t\bar{t}$ , the so called toponium meson which has yet to be observed. The heavy top quark was detected by two teams working at Fermi National Laboratory, the first one the so called CDF team (Abe et al. 1995) reported its mass as  $176 \pm 13 GeV$  and the other team the  $D\phi$  collaboration (Abachi et al. 1995) estimated its mass as  $199 \pm 30 GeV$ . The top quark appears to be a point-like particle: it has no internal structure that one can discern.

In the above context it is always interesting to study the phenomenon of quark leakage, using different potential models. The application of linear (Kang & Schintzer, 1975) and the oscillator potentials (Ram & Halasa, 1979) in a relativistic

framework such as the Klein-Gordon equation gives rise to the phenomenon of tunnelling and hence to the leakage of quarks. Ram (1978) has discussed numerically the tunnelling phenomenon for a linear potential and also Kajwadkar & Sharma (1983) have obtained transmission coefficients for two potentials viz., logarithmic and cubic power potentials.

To get a deeper insight into the phenomena of quark leakage, we deal in this paper numerically, with the quark leakage for three different potential models. It may be interesting to note that all the three potentials have already been successfully applied in explaining the meson spectroscopy.

Potentials considered by us here are:

(I)– A fractional power potential (Martin, 1980) given by

$$V_I(r) = g_1 r^{0.1} - V_0, \quad (1)$$

(II)- A power law potential (Sharma & Sharma, 1984) of the form

$$V_{II}(r) = g_1 (r)^{\frac{m_0}{2m_q}} - V_0, \quad (2)$$

with  $m_0 = 1\text{GeV}$  and  $m_q$  being the quark mass.

(III)- A logarithmic potential of the type (Jena, 1983)

$$V_{III}(r) = g_1 \log(1+r) - V_0 \quad (3)$$

Here in all the three potentials (I), (II) and (III),  $g_1, V_0 > 0$ .

In the following section 2, we study the tunnelling phenomenon for all the three above mentioned potentials by evaluating expressions for their corresponding transmission coefficients.

Finally, in section 3, we give a brief discussion on the results obtained by us in section 2.

## 2. Theory

The motion of a quark in one-body central potential  $V(r)$  is governed by the following relativistic Klein-Gordon equation ( $c = \hbar = 1$ ):

$$(-\nabla^2 + m^2)\psi(r) = [E - V(r)]^2 \psi(r). \quad (4)$$

The radial part of this equation can be simplified to the form

$$\frac{d^2 U(r)}{dr^2} + 2m[\bar{E} - V_{eff}(r)]U(r) = 0. \quad (5)$$

Where

$$U(r) = rR(r),$$

$$\psi(r) = R(r)Y_l^m(\theta, \phi)$$

$$\bar{E} = \frac{E^2 - m^2}{2m}, \quad (6) \quad \text{and}$$

$$V_{eff} = \frac{1}{2m} \left[ \frac{l(l+1)}{r^2} + 2EV - V^2 \right]$$

Following Merzbacher (1970), we use the WKB approximation and obtain the following expression for the transmission coefficients of s-states ( $l = 0$ )

$$T = \frac{4}{\left(2\theta + \frac{1}{2\theta}\right)^2}. \quad (7)$$

Here

$$\theta = \exp\left[\int_{r_1}^{r_2} k(r) dr\right] \quad (8)$$

With

$$k(r) = \left[2m(V^{eff} - \bar{E})\right]^{\frac{1}{2}}, \quad (9)$$

where  $r_1$  and  $r_2$  are the roots of the equation  $k(r) = 0$ .

### 3. Results and Discussion

The values of these transmission coefficients obtained for different values of  $m$  and  $g_1$  are depicted in Tables 1 and 2. For the purpose of comparison, the transmission coefficients for linear (Kang & Schnitzer, 1975); cubic and logarithmic potentials [ of the type  $g \ln \frac{r}{r_0}$  ] (Kajwadkar & Sharma, 1983) have also been shown in Table 1. It

may be noted that our equations (4), (5) and (6) can also be used in the calculations of transmission coefficients for a system consisting of quark and anti-quark but with the following substitutions (Kang & Schnitzer, 1975; Ram & Halasa, 1979; Iyer & Sharma, 1982; Sharma & Iyer, 1982):

$$V^{eff} = \frac{1}{2m} \left[ \frac{l(l+1)}{r^2} + \frac{1}{2}EV - \frac{1}{4}V^2 \right] \quad (10)$$

and

$$\bar{E} = \frac{\frac{1}{4}E^2 - m^2}{2m} \quad (11)$$

The values of these transmission coefficients for different mesons along with parameters actually used in obtaining the meson spectra, are shown in Table 3.

#### Our principal observations made in this paper are:

- (A) The smaller the effective power of the potential, the lower is the value of the transmission coefficient. Consequently the probability of leakage of quark is higher for the potential with larger effective power (Table 1).
- (B) For potential (3), the transmission coefficients are comparable with those obtained for the logarithmic potential (Kajwadkar & Sharma, 1983), see- Table 1.
- (C) The fall in the value of transmission coefficient with increasing mass is steeper for smaller values of effective power (Fig. 1). From Fig. 1 and Table 3, it is also evident that the transmission coefficients for potential (1) are very small while for the potential (2) they are much higher.
- (D) The effect of the variation in  $g_1$  is perceptibly larger for potential (1). For this potential, there is a sharp rise in the value of transmission coefficient with increasing value of  $g_1$  (Fig. 2). For large values of  $g_1$ , however, the transmission coefficient for potential (1) attains almost a constant value. While for potential (2), it is nearly

constant for all values of  $g_1$ . For potential (3), the variation in the values of the transmission coefficients with the values of  $g_1$  lies in between those obtained for potentials (1) and (2) within the range considered.

- (E) Potential (2) supports strongly the existence of free quarks because of comparatively large values of transmission coefficients predicted by this model. Potential (1) on the other hand, gives rise to a very small possibility of quark leakage. Particularly, as can be seen from Table 3, leakage of quarks for all the three mesons are practically zero for potential (1). For  $\rho$  meson, values of transmission coefficients predicted for potential (2) are higher than those obtained for linear and oscillator potentials. For  $\phi(s\bar{s})$  mesons, transmission coefficients predicted by potential (2) are independent of energy [since  $m_s$  has been chosen to be equal to 0.5 GeV, consequently potential (2) becomes a linear potential]. Similar observations were found by Kang and Schnitzer (1975) and Ram and Halasa (1979) for the linear potential.
- (F) It may be of interest to note that the potential (2) for meson state  $\rho$  with the parameters chosen gets transformed to an oscillator potential. The calculated values of  $T$  are in agreement with the corresponding values for the oscillator potential calculated by Ram & Halasa (1979) [see Table 3]. Similarly, for  $\phi$  meson states, the parameters chosen transform potential (2) to a linear potential and the values of calculated  $T$  drop and agree with the values calculated by Kang & Schnitzer (1975).
- (G) From Fig. 1, we see that as the mesons get heavier, it becomes harder for them to leak through the confining potential barrier. From Fig. 2 we observe that at low  $g_1$  values, the transmission coefficient associated with potential (1) decreases more rapidly as the meson mass increases, followed by those associated with the third and lastly the second potentials. However, at higher  $g_1$  values, the transmission coefficient that decreases the greatest is for the third potential, with the first being the least decreasing with increasing meson mass.
- (H) From Fig. 2, we observe that the value of transmission coefficient increases as  $g_1$  increases. For potential (2), the transmission coefficient rises from low values of  $g_1$ , approaching some asymptotic value as  $g_1$  increases. For the first and the third potentials, the transmission coefficient remains very close to zero as  $g_1$  increases, after which it jumps to the common asymptotic value. This “jump” occurs at greater values for the first potential than for the third. For heavier mesons, the transmission coefficient increases much more slowly to attain the common asymptotic value.

**Table 1:** Transmission coefficients  $T$  for the three potentials (I), (II) and (III).

For potential (I)  $g_1 = 1.0(GeV)^{1.1}$ ,  $V_0 = 0$  and  $E = 1.0 GeV$

For potential (II)  $g_1 = 1.0(GeV)^{\frac{(1+2m)}{2m}}$ ,  $V_0 = 0$ , and  $E = 1.0 GeV$

For potential (III)  $g_1 = 1.0 GeV$ ,  $V_0 = 0$ , and  $E = 1.0 GeV$

| Quark mass $m$ (GeV) | T for potential (I)<br>$V_I = r^{0.1}$ | T for potential (II)<br>$V_{II} = r^{m_0/2m}$<br>$m_0 = 1 GeV$ | T for potential (III)<br>$V_{III} = \log(1+r)$ | T for Linear potential (Ram, 1978) $\alpha = 1$ | T for cubic potential (Kajwadkar, et al, 1983) | T for logarithmic potential (Kajwadkar et al, 1983) |
|----------------------|--|--|--|---|--|---|
| 0.1                  | 0.520                                  | 0.638  | 0.609  | 0.63  | 0.63   | 0.61  |
| 0.2                  | 0.190                                  | 0.622  | 0.518  |   | 0.62   | 0.53  |
| 0.3                  | $8.555 \times 10^{-3}$                 | 0.578  | 0.382  | 0.53  | 0.60   | 0.40  |
| 0.4                  | $4.622 \times 10^{-6}$                 | 0.498  | 0.235  | --  | --   | --  |
| 0.5                  | $3.292 \times 10^{-13}$                | 0.380  | 0.118  | 0.37  | 0.55   | 0.14  |
| 0.75                 | $3.042 \times 10^{-79}$                | 0.0834   | $8.008 \times 10^{-3}$                         | --  | --   | --  |
| 1                    | $\approx 0$                            | $3.346 \times 10^{-3}$   | $1.285 \times 10^{-4}$                         | 0.04  | 0.27   | $4.6 \times 10^{-4}$                                |
| 1.25                 | $\approx 0$                            | $1.047 \times 10^{-6}$   | $3.731 \times 10^{-7}$                         | --  | --   |   |
| 1.5                  | $\approx 0$                            | $5.647 \times 10^{-15}$  | $1.249 \times 10^{-10}$                        | --  | --   |   |
| 2                    | $\approx 0$                            | $1.027 \times 10^{-85}$  | $1.313 \times 10^{-21}$                        | --  | --   |   |

**Table 2:** Transmission coefficients T for potentials (I), (II) and (III) for different values  $g_1$ . Other parameters are:  $E = 1.0 GeV$ ,  $m = 1.0 GeV$ , and  $V_0 = 0$ . Units of  $g_1$  for different potentials are same as used in Table I.

| Quark mass (GeV) | $g_1 = 0.9$                     |                                       |                                       | $g_1 = 2.0$                     |                                       |                                       | $g_1 = 3.0$                     |                                       |                                       |
|------------------|---------------------------------|---------------------------------------|---------------------------------------|---------------------------------|---------------------------------------|---------------------------------------|---------------------------------|---------------------------------------|---------------------------------------|
|                  | T for potential $V_I = r^{0.1}$ | T for potential $V_{II} = r^{m_0/2m}$ | T for potential $V_{III} = \log(1+r)$ | T for potential $V_I = r^{0.1}$ | T for potential $V_{II} = r^{m_0/2m}$ | T for potential $V_{III} = \log(1+r)$ | T for potential $V_I = r^{0.1}$ | T for potential $V_{II} = r^{m_0/2m}$ | T for potential $V_{III} = \log(1+r)$ |
| 0.1              | 0.3307                          | 0.6377                                | 0.6016                                | 0.6399                          | 0.6380                                | 0.6306                                | 0.6400                          | 0.6382                                | 0.6347                                |
| 0.2              | 0.01146                         | 0.6209                                | 0.4903                                | 0.6394                          | 0.6261                                | 0.6025                                | 0.6400                          | 0.6282                                | 0.6188                                |
| 0.3              | $1.1883 \times 10^{-6}$         | 0.5745                                | 0.3310                                | 0.6382                          | 0.5992                                | 0.5562                                | 0.6400                          | 0.6080                                | 0.5924                                |
| 0.4              | $4.9984 \times 10^{-16}$        | 0.4860                                | 0.1763                                | 0.6354                          | 0.5567                                | 0.4937                                | 0.6399                          | 0.5795                                | 0.5560                                |
| 0.5              | $1.5854 \times 10^{-36}$        | 0.3555                                | 0.0720                                | 0.6292                          | 0.5016                                | 0.4188                                | 0.6398                          | 0.5464                                | 0.5104                                |
| 0.75             | $\approx 0$                     | 0.0557                                | $2.310 \times 10^{-3}$                | 0.5729                          | 0.3452                                | 0.2187                                | 0.6388                          | 0.4675                                | 0.3678                                |
| 1                | $\approx 0$                     | $8.8124 \times 10^{-4}$               | $1.134 \times 10^{-5}$                | 0.3529                          | 0.2141                                | 0.07743                               | 0.6344                          | 0.4138                                | 0.2186                                |
| 1.25             | $\approx 0$                     | $1.6490 \times 10^{-8}$               | $5.3099 \times 10^{-9}$               | 0.0227                          | 0.0840                                | 0.01828                               | 0.6149                          | 0.3396                                | 0.1046                                |
| 1.5              | $\approx 0$                     | $2.5034 \times 10^{-20}$              | $1.124 \times 10^{-13}$               | $2.399 \times 10^{-6}$          | 0.0168                                | $2.8730 \times 10^{-3}$               | 0.5551                          | 0.2587                                | 0.04003                               |
| 2                | $\approx 0$                     | $\approx 0$                           | $4.142 \times 10^{-29}$               | $8.9564 \times 10^{-46}$        | $4.8777 \times 10^{-6}$               | $1.9045 \times 10^{-5}$               | 0.1526                          | 0.0854                                | $3.0234 \times 10^{-3}$               |

**Table 3:** Transmission coefficients T for different Mesons. Parameters used are:

For potential  $V_I(r)$  :

$$5.996(GeV)^{1.1}, V_0 = 7.01 GeV, m_u = 0.39 GeV, m_s = 0.52 GeV \text{ and } m_c = 1.806 GeV.$$

For potential  $V_{II}(r)$  :

(i) For  $\psi$  mesons-

$$m = 2.0 GeV, m_0 = 1.0 GeV, g_1 = 2.365(GeV)^{1.25} \text{ and } V_0 = 3.8833 GeV.$$

(ii) For  $\phi$  mesons-

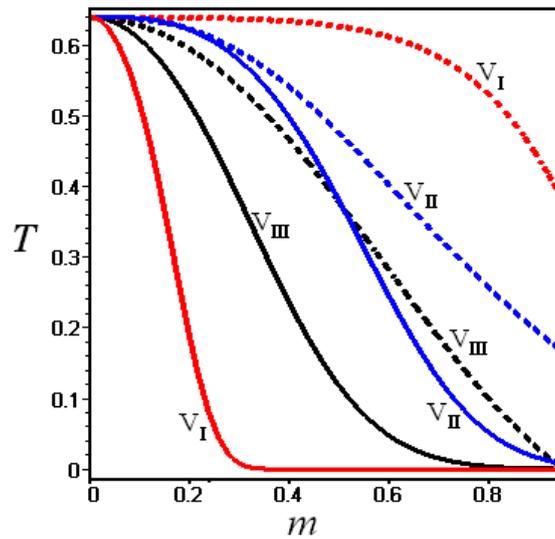
$$m = 0.5 GeV, m_0 = 1 GeV, g_1 = 0.2725(GeV)^2 \text{ and } V_0 = 1.089 GeV.$$

(iii) For  $\rho$  - mesons-

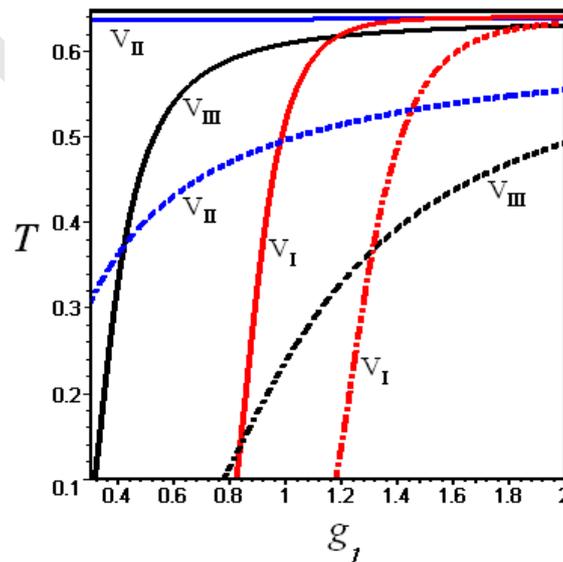
$$m = 0.25 GeV, m_0 = 1.0 GeV, g_1 = 0.037(GeV)^3 \text{ and } V_0 = 0.761 GeV.$$

| $V_I = r^{0.1} - V_0$    |                        | $V_{II} = r^{m_0/2m} - V_0$ |        | Linear potential (Kang & Schnitzer, 1975) |      | Oscillator potential (Ram & Halasa, 1979) |      |
|--------------------------|------------------------|-----------------------------|--------|---|------|---|------|
| Meson State (Energy GeV) | T                      | Meson State (Energy GeV)    | T      | Meson state (Energy GeV)                  | T    | Meson state (Energy GeV)                  | T    |
| $\rho(1s)$ (0.77)        | $2.12 \times 10^{-6}$  | $\rho(1s)$ (0.767)          | 0.4175 | $\rho(1s)$ (0.767)                        | 0.22 | $\rho(1s)$                                |      |
| $\rho(2s)$ (1.60)        | $1.92 \times 10^{-15}$ | $\rho(2s)$ (1.60)           | 0.4580 | $\rho(2s)$ (1.60)                         | 0.22 | (0.776)                                   | 0.40 |
|                          |                        | $\rho(3s)$ (2.2825)         | 0.4789 | $\rho(3s)$ (2.228)                        | 0.22 |   |      |
|                          |                        |                             |        | $\rho(4s)$ (2.754)                        | 0.22 | $\rho(4s)$                                |      |
|                          |                        |                             |        |   |      | (2.911)                                   | 0.49 |

|                   |                        |   |                         |  |  |  |                                 |
|-------------------|------------------------|---|-------------------------|--|--|--|---------------------------------|
| $\Phi(1s)(1.80)$  | $2.65 \times 10^{-34}$ | $\Phi(1s)(0.767)$<br>$\Phi(2s)(1.60)$<br>$\Phi(3s)(2.2825)$ | 0.134<br>0.134<br>0.134 | $\Phi(1s)(1.019)$<br>$\Phi(2s)(1.806)$<br>$\Phi(3s)(2.410)$<br>$\Phi(4s)(2.92)$  | $9 \times 10^{-13}$<br>$9 \times 10^{-13}$<br>$9 \times 10^{-13}$<br>$9 \times 10^{-13}$ | $\Phi(1s)(1.022)$<br>$\Phi(4s)(3.065)$ | 0.12<br>0.24                    |
| $\psi(1s)(3.095)$ | 0                      | $\psi(1s)(0.767)$<br>$\psi(2s)(1.60)$<br>$\psi(3s)(2.2825)$ | 0                       | $\psi(1s)(0.767)$<br>$\psi(2s)(1.60)$<br>$\psi(3s)(2.2825)$<br>$\psi(4s)(2.754)$ | $4 \times 10^{-37}$<br>$4 \times 10^{-37}$<br>$4 \times 10^{-37}$<br>$4 \times 10^{-37}$ | $\Psi(1s)(3.179)$<br>$\Psi(4s)(4.656)$ | $4 \times 10^{-1}$<br>$10^{-9}$ |



**Figure 1:** The variation of transmission coefficient  $T$  with the quark mass. The solid plots correspond to  $g_1 = 1.0 \text{ GeV}$  while the dashed curves are for  $g_1 = 2.0 \text{ GeV}$ .



**Figure 2:** The variation of transmission coefficient  $T$  with  $g_1$ . The solid plots correspond to  $m = 0.1 \text{ GeV}$  while the dashed curves are for  $m = 0.4 \text{ GeV}$ .

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# ONLINE TRACKING NUTRITION AND HEALTH OF HIGH SCHOOL STUDENTS

Haluk Dilmen  
 Firat University  
 Department of Informatics  
 Turkey

[hdilmen@firat.edu.tr](mailto:hdilmen@firat.edu.tr)

Fatih Ertam  
 Firat University  
 Department of Informatics  
 Turkey

[fatih.ertam@firat.edu.tr](mailto:fatih.ertam@firat.edu.tr)

**Abstract:** Nutrition and proper diet plays critic role on development of the high school students. During school age disorders due to diet of student may cause problems and open door to the some other diseases. Early detecting and tracking disorders may play important role on the youth health. We find Body Mass Index (BMI) would be relevant in our work in order to diagnose and keep track of disorders. We built computer program called Tracking Nutrition and Health (TNH) especially for high school students and kept track of height, weight, age of students to measure disorders. BMI values outside of the certain range are considered as a sign of disorder. In order to overcome disorders some tips and suggestions are given such as diet plans, exercises and etc. Activities and suggestions are being kept on the system and progress is analyzed over time to make decisions and observe progress that has been made. In this paper limitations, advantages and disadvantages of the proposed method is going to be discussed. Furthermore we will address experience, knowledge and skills we gained through implementations and research.

**Keywords:** Online Information Collection, Body Mass Index (BMI), Nutrition Disorders, Computer Programs for Monitoring.

## Introduction

Nutrition and proper diet plays critic role on development of the high school students. During school age disorders due to diet of student may cause problems and open door to the some other diseases. Early detecting and tracking disorders may play important role on the youth health. In our work we built computer program called TNH especially for high school students and kept track of height, weight, age of students to measure disorders. BMI values outside of the certain limits are considered as a sign of disorder. The project is about building up a web-based health tracking system for youth especially high school students. The desired Web oriented system would keep track of its members' health conditions and provide health suggestions to the members according to the personal information they subscribed. Our main concern on this project was to complete the user interfaces and built computer program for calculation, submission of data and displaying results and so on. The system we would like to implement is going to answer the needs of specific group of people. Instead of various and complex medical issues we will focus on more common problems such as height, weight problems Targeted users are teenagers from eleven to eighteen years old. By choosing specific user group, we did get more chance to focus on users' specific problems. We also realize making assumptions about individual especially for young people is challenging task. For privacy concerns we embed user authentication in our project. We wanted to prevent user information from unauthorized access and modification.

## Method

Body Mass Index is used to calculate individual body fat based on his or her body weight and height. The formula is very simple and universally used. BMI also can be calculated using BMI chart on (Body Mass Index Table). BMI formula can be calculated dividing body mass to individual's square of height.

$$BMI = \frac{Weight (kg)}{Height (m)^2}$$

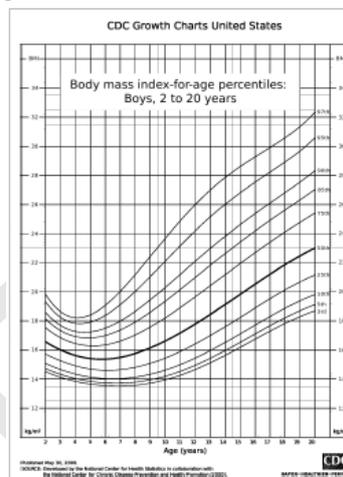
While calculation of BMI goes back to 19th century BMI gained popularity via published paper in 1972 which found BMI to be good approximation body fat percentage (JeremySinger-Vine, 2009)( Keys, Ancel. and friends, 1972). BMI is originally intended to use for population studies but because it's simplicity it is used also for individual diagnosis in spite of its inappropriateness. It provides how a person is thin or thick and allow professional to make decisions based on numeric value of BMI. For individuals we take value of BMI of 18.5 to 25 to indicate optimal weight; BMI lower than 18.5 suggests that the person is underweight while the number above 25 indicates that the person is overweight; BMI

number above 30 indicates that the person is obese (over 40 is morbidly obese). We use certain ranges of numbers to indicate students have malnutrition or disorders. World Health Organization (WHO) considers BMI less than 18.5 as underweight and a sign for eating disorder. BMI greater than 25 is diagnosed as overweight and above 30 is considered as obese (BMI Classification). Table 1 below shows ranges and their interpretations according to number defined by WHO.

**Table 1** Ranges of BMI values

| Category                              | BMI range – kg/m <sup>2</sup> | BMI Prime         |
|---------------------------------------|-------------------------------|-------------------|
| Very severely underweight             | less than 15.0                | less than 0.60    |
| Severely underweight                  | from 15.0 to 16.0             | from 0.60 to 0.64 |
| Underweight                           | from 16.0 to 18.5             | from 0.64 to 0.74 |
| Normal (healthy weight)               | from 18.5 to 25               | from 0.74 to 1.0  |
| Overweight                            | from 25 to 30                 | from 1.0 to 1.2   |
| Obese Class I (Moderately obese)      | from 30 to 35                 | from 1.2 to 1.4   |
| Obese Class II (Severely obese)       | from 35 to 40                 | from 1.4 to 1.6   |
| Obese Class III (Very severely obese) | over 40                       | over 1.6          |

BMI values above are used for adults and BMI for young's and children is used differently. Although calculation is as same as adult evaluations of BMI are done by comparing to typical values for other children of the same age. Instead of set threshold for malnutrition, the BMI percentile allows comparison with the children of the same gender and age (BMI for Children and Teens). BMI falls under 5th percentile is considered underweight, and above 95th percentile is considered to be overweight. We are giving special and careful attention to the people are categorized as underweight and overweight since that group of people are considered to have disorders according to BMI calculations. A reference BMI table for boys' age between 2 to 20 can be seen in Figure 1.



**Figure 1:** BMI for age percentiles for boys 2 to 20 years of age.

Although BMI is simple to calculate and interpret different BMI tables are available for different nationality and age and gender. To make appropriate decisions all aspects should be considered. Table for other groups and nations can be integrated into the software and more generalized system can be built as a future program. The recommended distinctions along the linear scale may vary from time to time and country to country making global longitudinal surveys problematic. As we mentioned BMI can be changed and in 1998, the U.S National Institutes of Health and the Centers for Disease Control and Prevention brought U.S definitions into line with WHO guidelines, lowering normal/overweight cut off from BMI from 28.5 to 25 and effect of this change 29 million healthy population becomes overweight (Who's fat: New definition adopted). BMI may differ from country to country and as an example BMI values for Japanese people are given in Table 2.

**Table 2** BMI Range and Categories for Japan

| Category   | BMI range – kg/m <sup>2</sup> |
|------------|-------------------------------|
| Normal     | from 18.5 to 22.9             |
| Overweight | from 23.0 to 24.9             |
| Obese      | 25.0 and above                |

BMI data is becoming more and more pertinent to the growth of children, due to the majority of their exercise habits (Barasi, M. E.,2004). BMI has been used by WHO as standard for recording obesity statistics since early 1980. However accuracy of BMI is still debated. For example one problem in elderly and children is differences in bone density and that makes difference in total weight.

TNH consists of several components. The first part is the Subscription form. Subscription form allows new users to subscribe their personal information. The information submitted by the users will be recorded in the database and become a profile for user. User information can be viewed and changed when desired or needed. Keeping user information at each step will allow us to see improvements and deterioration of individual. In figure 2 submission and data gathering is shown.



Member Registration

Name : Haluk

Surname : Dilmen

Identity Number : 12312312312

Gender : Male

Adress : Fırat Üniversitesi

Age : 36

Height : 180

Weight : 78

School : Fırat Üniversitesi

E-Mail : hdilmen2@gmail.com

Create

**Figure 2:** User information submission

The second part of the program is used for calculating BMI data for users. Based on BMI data, user will be categorized and class for user is determined. As indicated BMI range for categories are not static. From time to time depending on geographical regions and populations numbers can be interpreted differently. For example BMI number can be interpreted as a normal weight for individual in US and same number will indicate individual is overweight in Japan. Country, region, time criteria must be set for different regions and population. Once BMI data is calculated category of user is determined and written on the screen. To make interpretations and comparison easier, the user BMI is located in the Figure 3. Since regular methods mostly just finds category for subject and let them to locate BMI on the table. In some situations process of getting exact location for BMI can be confusing. Designing system automatically to locate BMI on the chart makes system more usable and user friendly. In figure 3 result of BMI calculation is shown.

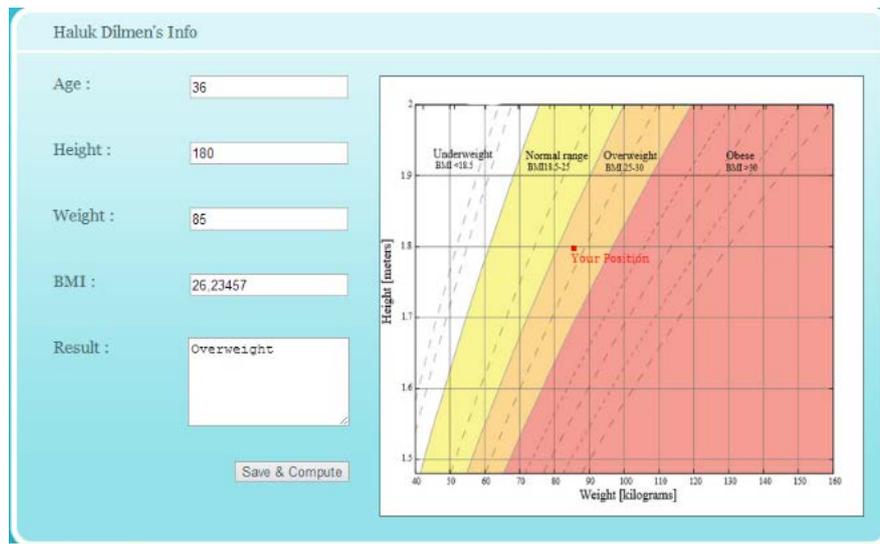


Figure 3: BMI calculation for adults

In this study our interested group was mainly young people. However since BMI calculated same way for young and the other we also make program to handle subject who is older than twenty. BMI is calculated same way but different chart is used for people are older than twenty. Result of that calculations are shown in figure 4.

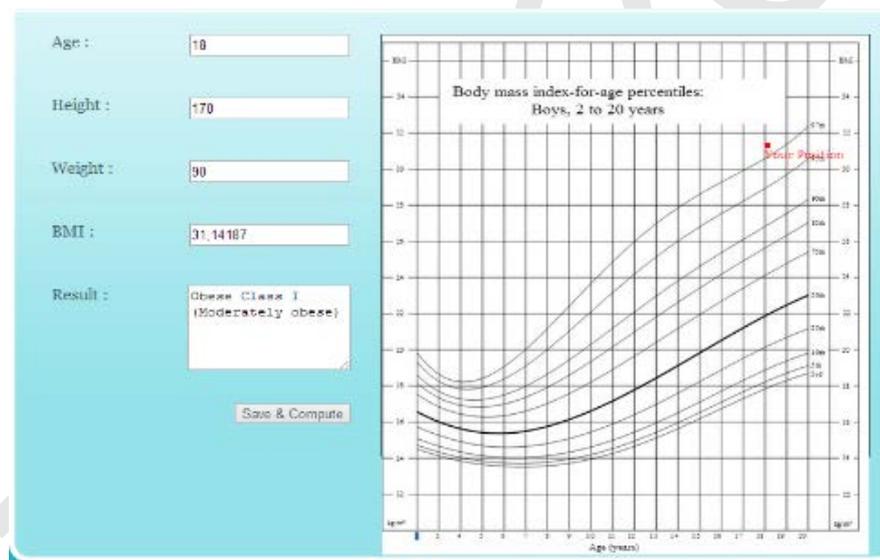


Figure 4: BMI calculation for young

The third part of the program is identifying categories to give suggestions consist of physical exercises and proper nutrition suggestions. TNH records improvements and progress has been made by subject. If no improvements are observed suggestions are adjusted accordingly. TNH is not meant to be used for medical treatment. If student conditions are worsening to get professional help TNH may suggest student to get professional help. In this study we will not consider much about health care issues instead we will focus on computer program is built for solving addressed issues.

## Conclusion and Discussion

The targeted computer program is described in above called TNH is built. Challenging issues we faced during research and implementation was the complexity of subject and methods applied to application in this area. BMI is used in this article may have different meaning for different age groups, countries and populations. Research main target youths are growing fast and people are within range of this age are under risk if the proper nutrition and care is not given. We believe the proposed system is going to help to identify and may solve issues given some tips and suggestions. BMI is used to identify and diagnose weight and height related problems. Since there is ongoing discussion about usage of BMI for diagnosing individual weight height related problems. We did not concern about is appropriateness. As a future work other measurements methods can be used instead of BMI for specific need and diagnosis.

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## Optical properties of thin semiconductors films investigated by ellipsometry

Aissa Manallah\*, and Mohamed Bouafia  
Applied Optics Laboratory  
Institute of optics and precision mechanics  
University of Setif  
Algeria

[Manallah\\_aissa@yahoo.fr](mailto:Manallah_aissa@yahoo.fr), [mohamedbouafia@gmail.com](mailto:mohamedbouafia@gmail.com)

### Abstract

The development of semiconductor materials in thin layers has highly contributed to perform electronic, photonic and photovoltaic devices. The films can be deposited in monolayer or multilayer with thicknesses which vary from atomic plane (several Angstroms) to several hundreds of nanometres. Therefore, the optical properties are very important in the characterization of such devices in dependence on their microstructure and thickness.

The aim of this work is to determine by ellipsometry the optical properties of semiconductor thin films made of gallium nitride, gallium arsenide and gallium phosphide.

Ellipsometry is an optical method based on the behaviour of polarized light. The light reflected on a surface induces a change in the polarization state which depends on the characteristics of the material (complex refractive index and thicknesses of the different layers constituting the device). The paper describes the experimental aspects concerning the semiconductor samples, the SE400 ellipsometer principle, and the results obtained by direct measurements of ellipsometric parameters ( $\psi$  and  $\Delta$ ) and modelling using Netzwin software.

**Key words:** semiconductors GaN, GaAs, GaP, ellipsometry, optical properties

# OPTIMALIZATION OF TRANSPORT AND LOGISTIC PROCESSES BY SIMULATION

Martin Kendra, Jana Lalinská, Juraj Čamaj  
Faculty of Operation and Economics of Transport and Communications  
University of Žilina  
Slovakia  
martin.kendra@fpedas.uniza.sk

**Abstract:** Logistic centres are a necessary part of the transport and logistics processes. They are beneficial in the entire scale of their importance, ranging from the economical, ecological up to the social benefits. The costs for the construction of the logistics centres are very high. It is therefore important to set up sufficient capacity for all partial parts of the logistic centre. One possibility is to use the simulation processes to verify the expected future operations in the logistics centre. This article deals with the benefits of the simulation processes and their possible use in the design of new logistics centres.

**Key words:** logistic centre, simulation process, optimization.

## Introduction

Transport and logistics is a part of every developing society. The amount of the transported goods increases every year. There is an increasing demand for the quality services. Besides the positive effects of goods transport is growing its negative impact on the environment. They are primarily:

- *exhaust emissions* – accruing from combustion of fuel in a gasoline and a diesel engines. It's all about carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen oxides, ketones, aldehydes, hydrocarbons and soot.
- *occupation of the arable land* – it's represent mainly the surface consumption on the traffic construction building and parking.
- *noise* – it's characterized as an unwanted noise, which acts to disturb a man. A traffic noise is caused by the running engine, the rolling of wheels in motion on the road, the airflow and the audible warning devices.
- *vibration* – is caused by vibrating of elastic bodies or environment which certain points mechanically vibrate. Dynamic forces are the main causes of inaccuracies in the manufacturing of parts and components. Vibrations may be caused by the technical condition of the vehicle, vehicle construction, traffic road construction, contiguous constructions, etc.
- *congestion* – is especially characterized for larger cities. They arise from the continuous increase in the number and use of cars and trucks. This trend is not enough to adjust the capacity of road and rail infrastructure, resulting in solving down traffic, increase noise and emissions in the air.
- *accidents* – characterized by the exact material claims which are caused on the vehicles or contiguous constructions. It is more difficult to calculate the injuries by hurting or man's death. The most serious influence on the traffic accident are – psychological factors, technical factors, meteorological factors (Lábaj, J., Patsch, M., Barta, D., 2009).

It is necessary to find out a compromise between the demand for the transport and the requirement of the environment protection.

Each mode of transport has its own strengths and weaknesses. It is necessary to do the transport of goods with a combination of such modes of transport where the negative impact on the environment is as low as possible. A combination of different transport modes requires the good places for the transshipment, the storage and the beneficiation of the goods. The modern logistic centres meet these requirements.

The construction of the logistics centres is very expensive. It is very difficult to properly design the capacity and number of the handling areas and equipments.

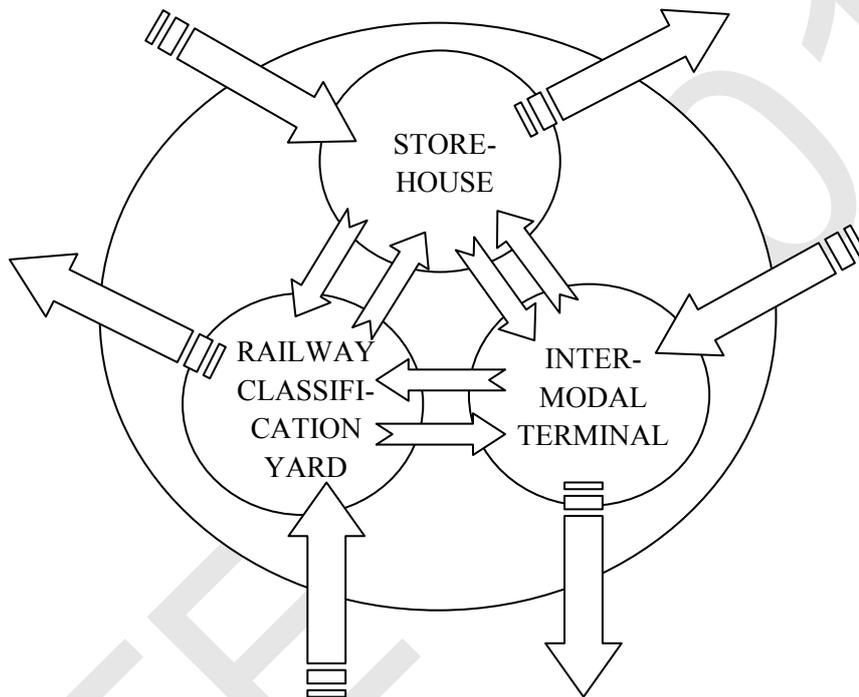
## Statement of a problem

The logistical centres are inseparable part of forward market economy. Logistical centres not only serve commodity with clients but sustain of useful reserves of products and accelerate international market. The term “logistic centre” has been used to describe centres performing a broad spectrum of logistical functions and business processes. The term combines logistics, which refers to all operations required to deliver products or services excluding produce of the goods or performing the services, which stands for a place where a particular activity is concentrated (American Heritage Dictionary of the English Language, 1992; External Costs of Transport, 2004).

The foremost tasks of logistical centres can be summarized as follows:

- the integration of the different kinds of the transport to the traffic chains,
- projection and realization complex logistical chains between suppliers and subscribers,
- practice different logistical tasks for clients,
- preparing, realization and repairs of needed infrastructure for partners,
- preparing, realization and repairs of needed informative, managing and communication system (Dolinayová, A., Čamaj, J., Průša, P., 2008).

Every logistic centre should be connected to road, rail and water infrastructure. Therefore besides the storehouse, the railway classification yard and intermodal terminal are the important parts of large modern logistic centres. Every part (storehouse, railway classification yard, intermodal terminal) can operate independently and it is possible to monitor all the processes in these partial components. It is necessary to follow the accouplements and the flows between storehouses, railway classification yard and intermodal terminal to optimize logistic processes of the entire logistic centre. Optimizing of the processes in partial parts of the logistics centre and between them can achieve the great synergies.



**Figure 1:** A simplified scheme of the logistics centre

All activities in the logistic centre are carried out gradually in the partial parts of the logistic centre. The service in the next section can be realized only after using the service in the previous section. The logistics centre can be seen as a complicated system of queuing. Every queuing system can be characterized by:

- the input current requirements,
- the queue,
- the time operation,
- the line services,
- the output current requirements.

### The method of troubleshooting

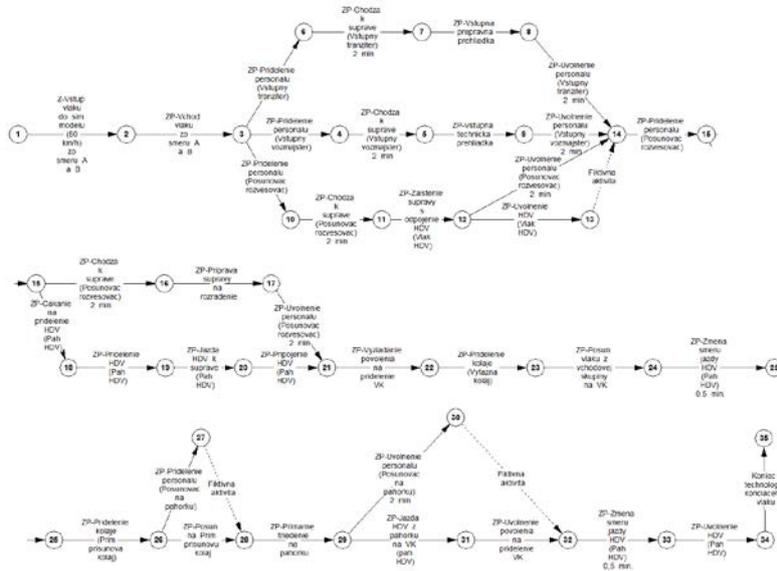
A sufficiently accurate mathematical scheme (model) must be done to be able to predict the activities of the queuing system. Modelling expected build the model, which has characteristics derived from the real system. It displays all or only those facts that are important for the process. The model is thus a simplified picture of the reality.

In simple the models can be divided into:

- *mathematical models* - are formulated as a set of the equations, describing the studied system, including the restrictions and requirements on the input and output variables,

- *analytical models* - providing results in the form of the general functions for a various values of the input data,
- *simulation models* - in terms of computer they are the algorithms, by which it is possible to simulate the events and processes (Flodr, F., 1990).

Simulation method currently seems to be practically available method suitable for the examination of the complex technological problems. Its importance is increasing, especially in the design and upgrade of the technology units. The labour input and material resources necessary to implement the simulation models are now insignificant compared to the costs associated with the experimentation in the practice.



**Figure 2:** Example of the technological diagram – railway classification yard

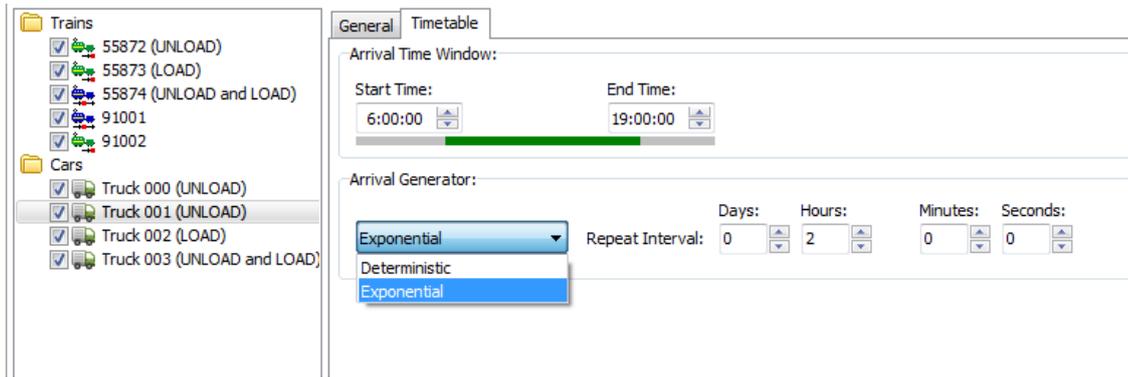
The use of the simulation model can verify the plans and intentions. They can be accordingly changed before the system is placed in the realistic conditions. The simulation modelling use is convenient for the design of large and modern logistic centres, too.

Key stages of the work in the simulation modelling are:

- analyzing of the problem,
- selecting a solution method,
- modelling of the task,
- selection of the means for the model implementing,
- programming,
- experiment preparation,
- conduct of the trial,
- evaluation.

## The analysis of the outcomes achieved

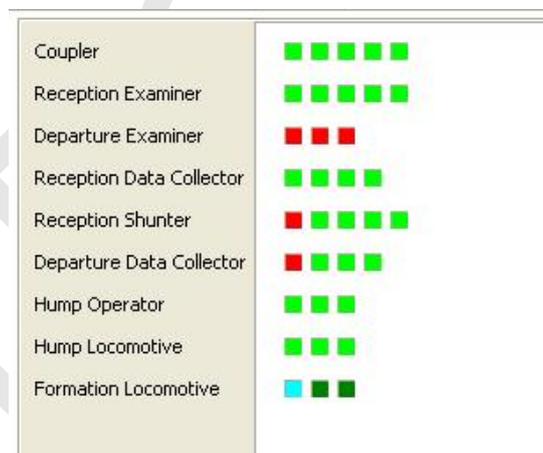
The processes which take place in the logistics centre are stochastic, not deterministic (Welterová, M., Lovíšek, M., Bariak, M., 2009). Therefore, the entry requirements into the system, the time of the handling and output current requirements can be described only by using of various probability distributions, for example normal, Poisson, Erlanger, exponential, gamma,... The disadvantage is that it is necessary to know the expected course of the input variables. They may be inferred from the statistical data obtained from the previous periods. It can be used for example  $\chi^2$  test of good compliance to verify the input data.



**Figure 3:** Example of the data entry to simulation model – store house

The basic output characteristics obtained from the simulation modelling could be:

- likelihood of the entry requirements refusal,
- average queue length of the requirements in the systems,
- maximum queue length of the requirements in the systems,
- average waiting time of the requirements in the systems,
- maximum waiting time of the requirements in the systems,
- average time which spent requirements in the systems,
- maximum time which spent requirements in the systems,
- utilization rate of the operating lines in different systems,
- limiting spaces in the systems,
- average number of the requirements contained in the systems,
- variance of the requirements contained in the systems,
- etc.



**Figure 4:** Example of the on-line data output – employers utilization

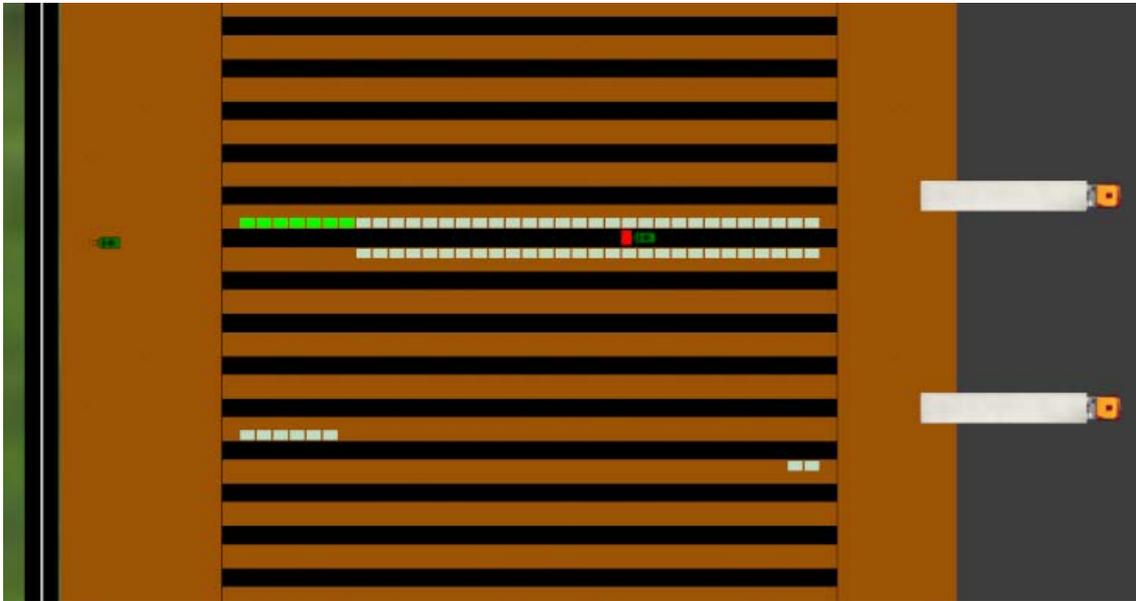
What can be suggested based on the results obtained during the simulation model:

- number of the operation lines,
- deployment of the operation lines,
- required capacity of the operation lines,
- technological process works,
- desired area for the entire system,
- financial budget of the implementation,
- required reserve funds,
- etc.

### The practical application of the results

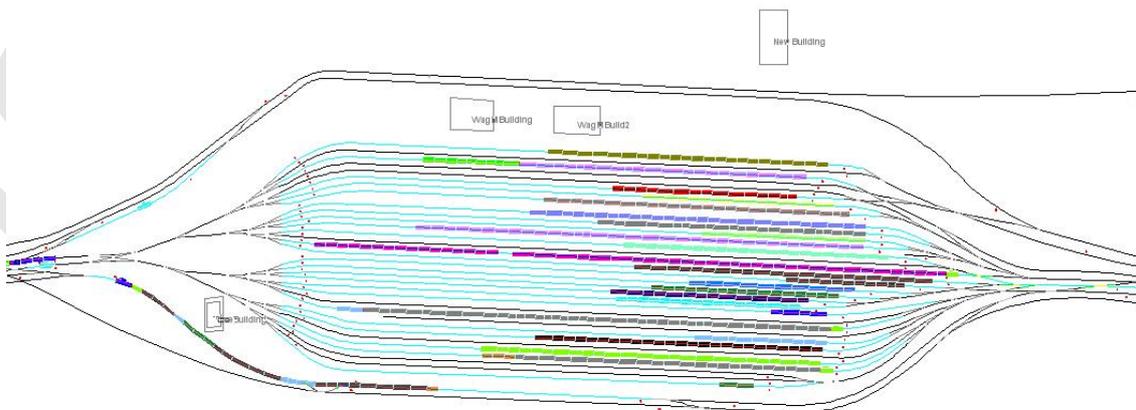
Simulation modelling can verify before the construction of logistic centre:

- for the storehouses:
  - o number and capacity,
  - o type and number of the handling equipment,
  - o size of the handling areas,
  - o storage technology,
  - o staffing demand,
  - o process times,
  - o load carrying capacity,



**Figure 5:** Example of the storehouse simulation model

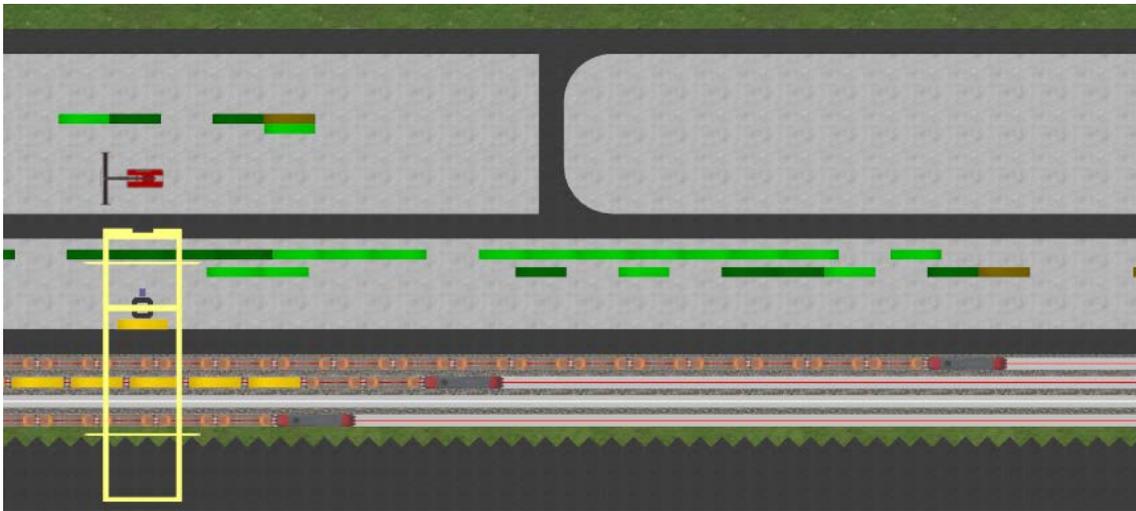
- for the railway classification yard:
  - o structure of the rail-yard,
  - o number of the tracks in the rail-yard groups,
  - o number of employees and locomotives,
  - o technology of the primary and secondary splitting,
  - o normative times,
  - o operating efficiency,



**Figure 6:** Example of the railway classification yard simulation model

- for the intermodal terminal:

- type and number of handling equipment,
- size of the handling areas,
- technology of the trans-shipment cargo units,
- staffing demand,
- process times,
- load carrying capacity.



**Figure 7:** Example of the intermodal terminal simulation model

## Conclusion

Simulation modeling provides a comprehensive and dynamic view on the whole technological process and can provide the necessary information about its behaviour. Simulation modelling is advocated as a suitable method for the verification of strategies for the construction and management of the modern logistic centres.

In second place, utilizing simulation modelling can optimize the number of handling equipment, the handling area size, the number of transport, the range of transport infrastructure. Using designated conditions eliminate any negative impact on the environment.

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# OPTIMIZATION OF BYPASS GRAFT USING FSI NUMERICAL METHOD

Hung Viet Do, Subrat Das\*, Amal Owida, Khaled Yousif\*\* and Yosry S Morsi,

Biomechanical and Tissue Engineering Group  
Swinburne University of Technology, FEIS  
PB 218, Hawthorn, VIC 3122, Australia  
[ymorsi@swin.edu.au](mailto:ymorsi@swin.edu.au)

\* School of Engineering, Faculty of Science and Technology  
Deakin University, Waurn Ponds  
\*\* Brookland Greens Medical Centre  
Balwyn Victoria, Australia

**Abstract:** It is well documented in literature that the coronary artery bypass graft is normally fail after a short period of time, due to the development of plaque known as intimal hyperplasia within the graft. Various *in vivo* and *in vitro* studies have linked the development of intimal hyperplasia to the abnormal hemodynamics and compliance mismatch. Therefore, it is essential to fully understand the relationship between the hemodynamics inside the coronary artery bypass and its mechanical and geometrical characteristics under the correct physiological conditions.

In this work, hemodynamic of the bypass graft is studied numerically. The effect of the host and graft diameters ratio, the angle of anastomosis and the graft configuration on the local flow patterns and the distribution of wall shear stress are examined. The pulsatile waveforms boundary conditions are adopted from *in vivo* measurement data to study the hemodynamics of composite grafts namely Consequence and Y grafting in terms temporal and spatial distributions of the blood flows. Moreover, various non-Newtonian and Newtonian models of blood have been carried out to examine the numerical simulation of blood flow in stenosis artery. The results are presented and discussed for various operating conditions.

**Keywords:** Bypass graft, FSI numerical Technique

## Introduction

The standard method of coronary artery bypass grafts is the patient's own artery or vein [1]. Although, other arteries have been used for grafting such as: radial, right gastroepiploic, inferior epigastric, splenic, subscapular, inferior mesenteric, ulnar and descending branch of the lateral femoral circumflex artery [2], the evidence of the best bypass conduit is still lack of confidence. From the literature, the IMA's have been exhaustively used as a bypass conduct due to the superior survival results and low incidence of atherosclerosis [3-5]. Moreover, in some cases of patients the native artery is unavailable to use as bypass grafts, due to the coronary artery disease. Although the atherosclerosis might be found in normal arteries, the myovascular recirculation surgeries are suggested with degree of stenosis >70% and multiple narrowing in multi arteries.

The internal thoracic arteries (ITAs) or internal mammary arteries (IMAs) are located inside of the chest and start from the first part of the subclavian artery behind the head of the clavicle, as can be seen in Figure 1. The ITA delivers blood to the chest area; including the pericardium, phrenic nerve, sternum, anterior chest wall, the pectoralis major, the mammary gland, the anterior abdominal wall, and the diaphragm. There are two types of ITA, the left ITA (LITA) and the right ITA (RITA), passing downwards almost vertically and slightly laterally at a short distance from the margin of the sternum [6]. The length of the ITA varies between males and females, RITA and LITA. The average length of ITA is around 20.4±2.1cm while the mean diameter of proximal ITA is around 2.6±0.6mm. Normally, the LITA is slightly longer than the RITA [7, 8].

Although, there are varying arrangements of ITA for myocardial revascularization, the bilateral ITA (using both left and right internal thoracic arteries for the coronary bypass grafts surgery) has proven a high patency rate than single ITA [9, 10]. As indicated in the study at The Tel Aviv Sourasky Medical Center [11, 12], the goal of surgical method was attempted to use bilateral ITA as the cross arrangement (Figure 1). The findings also indicated a better long-term success rate and lower technical problems of the cross arrangement. This led to a higher demand in this surgical method and as the preferred method of choice if possible.

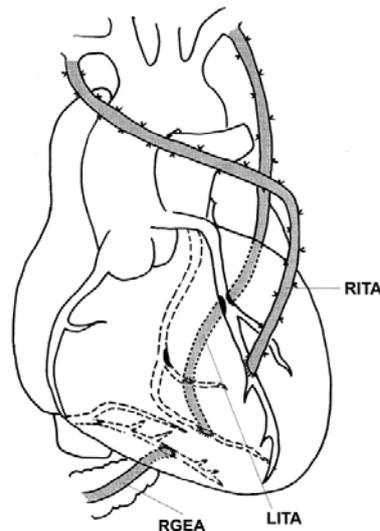


Figure 1 The cross arrangement RITA to LAD, LITA to circumflex artery and the right gastroepiploic artery (RGEA) to posterior descending artery (PDA) [12]

Although, the attempt of using both ITA as a bypass conduit have been made, the RITA in some cases was not long enough to reach the branches of the left or right coronary artery; this lead to the exhausted use of RITA as a free graft [11, 13]. The composite anastomosis of free RITA on the LITA can be performed in two ways, the first one is sequential grafting with diamond shaped and terminal T-shaped anastomosis, and the other is sequential graft with parallel side-to-side anastomosis [11].

From literature, there are several advance characteristics of ITA resistant to the development of intimal hyperplasia which provide high patency rates compared with the saphenous vein [2, 14, 15]. The endothelium of ITA seems to have a greater resistance to harvest injury as compared with the saphenous vein. Evident of the thrombogenic intimal defects, which are commonly detected in venous grafts, could not be found in ITA. The unique biological characteristics IMA such as: no fenestrated internal elastic lamina and lacks vaso vasorum might prevent cellular migration and the initiation of intimal hyperplasia [16]. Moreover, the medial of the ITA is formed by thin layer with limited smooth muscle cells which can provide a lesser proliferative such as: platelet-derived growth factor and pulsatile mechanical stretch [15]. As indicated by Del Campo [17], the endothelium of the ITA produces the vasodilators nitric oxide and prostacyclin which respond to pharmacologic agents commonly used after the surgical operation. The ITA exhibits the same characteristics as normal coronary arteries, which increase flow velocity and diameter through the endothelium to fulfil the requirements of flow on late postoperative.

In general, when the CABG is suggested with multiple stenosis, the composite graft and sequential grafting could be combined to perform a complete arterial revascularization. While the sequential anastomoses allow the most efficient use of precious arterial conduits by maximizing the number of distal anastomoses, the complete arterial grafting allow using the advantages of both ITAs as higher patency rates in complicate multiple stenosis patents. Although, the development of sequential or 'Y' grafting are based on three types of anastomosis to connect bypass graft to native artery such as, end-to-end, end-to-side and side-to-side anastomosis [18] as shown in figure 2, the connecting techniques are varieties in different patients.

Dobrin et al. [19] investigated the clinical impacts and hemodynamics of end-to-end artery to polytetrafluoroethylene graft and recommended the use of a larger diameter graft than host artery in order to provide less restrictive anastomosis compared with size-matched graft. The findings from this study also highlighted the importance of the rigidity of the grafts and the degree of compliance mismatch between the graft and the artery which could produce an adverse effect on the blood flow passing from the compliant artery into the rigid conduit. Moreover, it has been proposed that compliance mismatch may influence graft patency and the development of intimal hyperplasia. Nevertheless, it is likely that the thrombogenicity of the flow surface of the graft is more important than the effect of compliance on short-term patency.

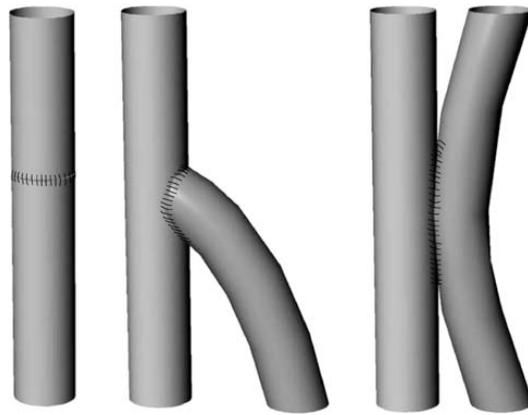


Figure 2. Illustration of End-to-end, End-to-side, Side-to-side anastomosis [18]

Kim et al. [20] have carried out a numerical simulation of flow through an anastomosis end-to-end model and compared the results with experimental data. At higher pressure difference between inside and outside the artery (transmural pressure), the authors observed a region of flow separation of 2 mm distal to the artery junction. In addition, the observations of low shear stress near the anastomosis junction in flow from the tubing to the graft were reported. Moreover, a correlation between regions of low wall shear stress and the development of anastomotic intimal hyperplasia was found. However, it must be pointed out that this study was carried out under various simplified assumptions, such as steady flow conditions, Newtonian fluid, axisymmetric geometry, and rigid wall at each pressure level which do not reflect the correct physiological conditions. Qiu and Tarbell [21] used a finite element model with transient flow and moving boundaries to simulate the oscillatory flow in the anastomotic region of vascular grafts. The study focused on the effects of radial artery wall motion and phase angle between pressure and flow waves and the behavior of near end-to-end vascular graft anastomoses models. The finding showed a significant decrease of the minimum distal mean wall shear rate on the deformable model with oscillatory flow compared with the rigid and steady flow. These results suggest the compliance mismatch induces lower mean WSR and more oscillatory WSR that could contribute to the initiation of intimal hyperplasia.

The hemodynamics investigations of these types of anastomoses have focused on the factors that may initiate the development of intimal hyperplasia in coronary revascularization. These factors include anastomosis angles (Figure 3), ratios of graft-host diameter and out of plane anastomosis [22-27]. In addition, it is well recognised that the flow within end-to-side anastomosis is three dimensional and the development of flow in various regions around the junctions is highly depended on the input boundary conditions. Other findings suggest that the highest fluid velocity was found in  $30^\circ$  of anastomosis while the lowest velocity was found in  $60^\circ$ . Moreover, the larger the anastomosis angle, the thicker intimal hyperplasia at the floor of host artery.

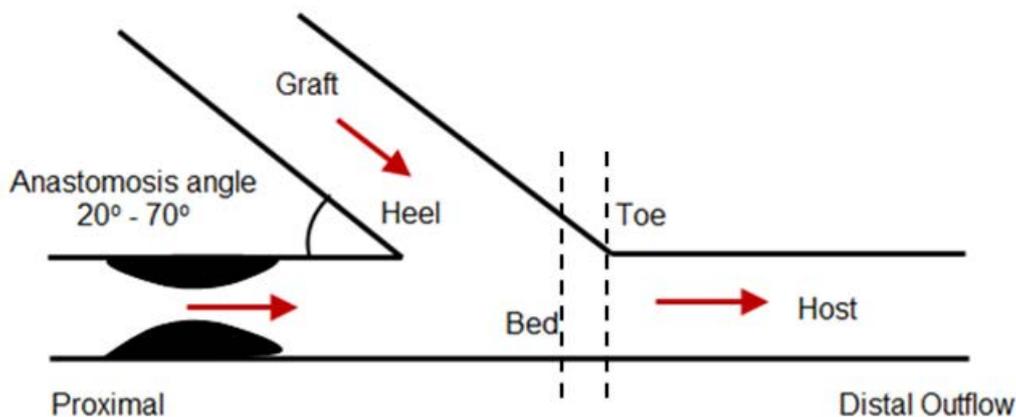


Figure 3. Illustration of the range of anastomosis angles of conventional end-to-side anastomosis

### Mathematical Model

Taking these assumptions into consideration, the *Navier-Stokes* equations for time dependent incompressible viscous fluid are given by [28]:

Continuity equation:

$$\frac{\partial \rho}{\partial t} + \frac{\partial}{\partial x}(\rho v_x) + \frac{\partial}{\partial y}(\rho v_y) + \frac{\partial}{\partial z}(\rho v_z) = 0 \quad (1)$$

Momentum Equations are as follow:

$$\begin{aligned} \frac{\partial \rho v_x}{\partial t} + \frac{\partial(\rho v_x v_x)}{\partial x} + \frac{\partial(\rho v_y v_x)}{\partial y} + \frac{\partial(\rho v_z v_x)}{\partial z} \\ = \rho g_x - \frac{\partial P}{\partial x} + R_x + \frac{\partial}{\partial x} \left( \mu_e \frac{\partial v_x}{\partial x} \right) + \frac{\partial}{\partial y} \left( \mu_e \frac{\partial v_x}{\partial y} \right) + \frac{\partial}{\partial z} \left( \mu_e \frac{\partial v_x}{\partial z} \right) \end{aligned} \quad (2)$$

$$\begin{aligned} \frac{\partial \rho v_y}{\partial t} + \frac{\partial(\rho v_x v_y)}{\partial x} + \frac{\partial(\rho v_y v_y)}{\partial y} + \frac{\partial(\rho v_z v_y)}{\partial z} \\ = \rho g_y - \frac{\partial P}{\partial y} + R_y + \frac{\partial}{\partial x} \left( \mu_e \frac{\partial v_y}{\partial x} \right) + \frac{\partial}{\partial y} \left( \mu_e \frac{\partial v_y}{\partial y} \right) + \frac{\partial}{\partial z} \left( \mu_e \frac{\partial v_y}{\partial z} \right) \end{aligned} \quad (3)$$

$$\begin{aligned} \frac{\partial \rho v_z}{\partial t} + \frac{\partial(\rho v_x v_z)}{\partial x} + \frac{\partial(\rho v_y v_z)}{\partial y} + \frac{\partial(\rho v_z v_z)}{\partial z} \\ = \rho g_z - \frac{\partial P}{\partial z} + R_z + \frac{\partial}{\partial x} \left( \mu_e \frac{\partial v_z}{\partial x} \right) + \frac{\partial}{\partial y} \left( \mu_e \frac{\partial v_z}{\partial y} \right) + \frac{\partial}{\partial z} \left( \mu_e \frac{\partial v_z}{\partial z} \right) \end{aligned} \quad (4)$$

Where  $\rho$  is the fluid density [ $\text{kg/m}^3$ ];  $\mu$  is the viscosity [ $\text{kg/m}\cdot\text{s}$ ]; and  $P$  is the pressure [ $\text{N/m}^2$ ];  $v_x$ ,  $v_y$  and  $v_z$  are components of the velocity vector in the  $x$ ,  $y$  and  $z$  directions, respectively [ $\text{m/s}$ ].

## Boundary Conditions

In the present study, the anastomosis models (as described in Figure 3) with three different anastomosis angles of 20, 40 and 60 degree and different graft and host diameter ratios are chosen to investigate. Here, the left interior descending coronary (LAD) is considered to have internal diameter of 3mm and 75% lumen axisymmetric stenosis. The distance from the stenosis to the heel of the graft was considered three time the internal diameters of the host (3 mm). In addition, the intermal mammary arteries (IMAs) are chosen as graft conduits. The inner diameters of the IMA are 2, 3 and 5mm which refereed as small, medium and large models, corresponding to the graft host diameter ratios of 0.67, 1 and 1.67 respectively.

The blood used in the analysis was assumed to be incompressible with Newtonian behaviour with a dynamic viscosity  $\mu$  of 0.00345 Pa-s and a density  $\rho$  of 1100  $\text{kg/m}^3$ . Furthermore, the blood vessel walls were assumed to be rigid and no-slip boundary condition. To ensure fully developed Womersley velocity profiles and WSS ahead of the entry an extension tube of  $L/D \geq 20$  diameter was added to all models investigated. These assumptions are in line with those of Freshwater and Morsi [22]. The inlet pulsatile boundary condition is shown in the following figure (Figure 4).

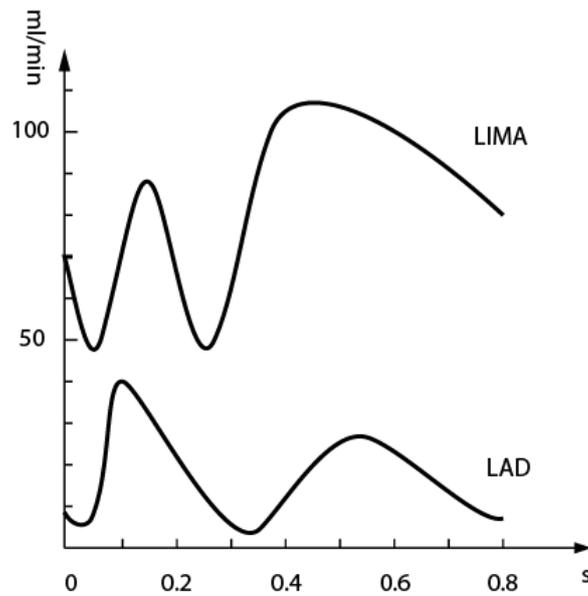


Figure 4 Pulsatile blood flow rate through LAD

## Numerical method

As stated above the solutions of the 3-D time-dependent Navier-Stokes equations were obtained by ANSYS Workbench package which is based on the finite volume method and the iterative coupled-equations solver. All the nine models of CABG were constructed and typically meshed from minimum number of 122,000 nodes and tetrahedral volume elements of 539,000 to a maximum 173,000 nodes and 885,000 tetrahedral volume elements. These were surrounded by a thick six-layer inflated boundary of triangular prisms. Furthermore, mesh controls were applied along the suture line and along the centre line of the inlet and outlet artery segments sufficiently to resolve the WSS and the velocity profiles at the junction. Note that the average velocities were taken to represent the average values over the artery cross-section and the maximum Reynolds Numbers ( $Re$ ) was 320, 220 and 130 for the graft and 75 for the proximal host segment (based on graft diameters of 2, 3, 5 mm and 3mm for the host artery diameter respectively). Furthermore, in all cases investigated the maximum number of iterations to achieve a solution with a convergence criterion of 0.0003 was 20. Moreover, the under-relaxation parameters used in the initial analysis varied from point 0.25 to 0.65 with a small fixed time step of 0.005s.

## Results and Discussion

In this section, the velocity vectors obtained at the cross section Y-Z plane and X-Z planes (Figure 3) are presented and discussed. Note that at each model, the host artery is constructed to fit exactly through the graft at one end. This created an elliptic cross section at the junction of the artery and the graft which is known to allow the maximum compliance between the host and the graft with minimum distortion to junction of the model [22]. Moreover, this method permits the maximum flow through the junction and minimizes the occurrence of recirculation that might lead to intimal thickening and restenosis at the junction.

Figures 5 to 8 show the velocity vectors and velocity contours of end-to-side coronary artery bypass graft with various anastomosis angles and grafts-host diameters at different time steps of the pulsatile, the results highlight the domination flows from graft conduits to the native conduits and the hemodynamics inside the end-to-side coronary artery bypass graft are sensitive with the changing of geometries. As it can be seen in these results, the reverse flow only observed at the distal of the junction areas, so the velocity vectors at the cross sections of Z-Y plane at the toe and the middle of the junction areas are presented and analysed.

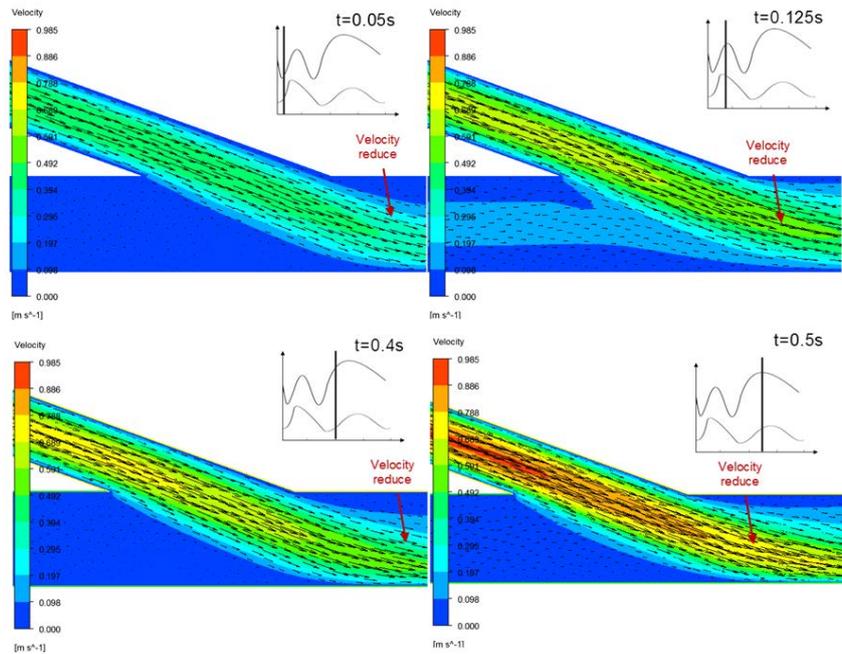


Figure 5. Velocity vectors of 20 degree anatomises angles and 0.6-1 ratio graft-host diameter at various time steps

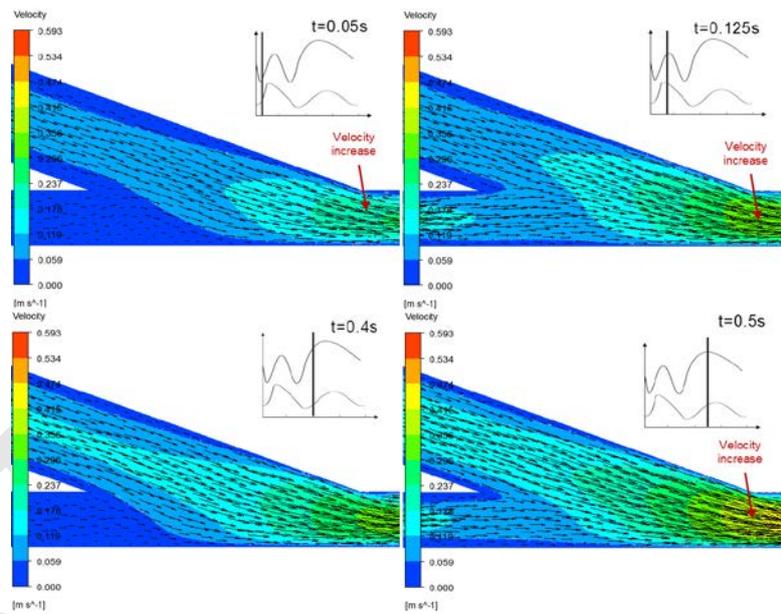


Figure 6. Velocity vectors of 20 degree anatomises angles and 1.6-1 ratio graft-host diameter at various time steps

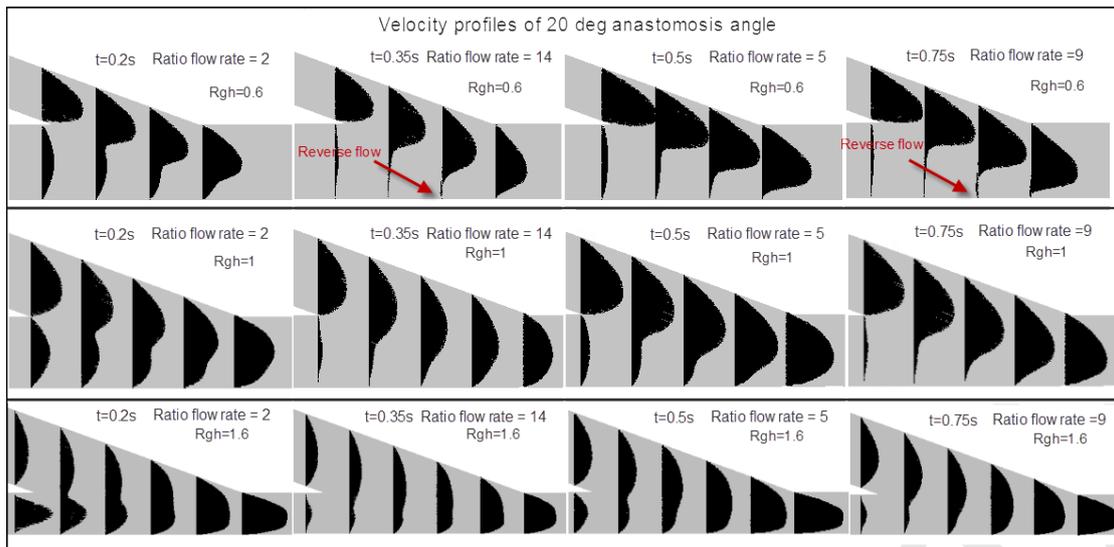


Figure 7. Velocity profiles of 20 degree anastomosis angles at various time steps

As it can be seen from the results of velocity vectors, in general the flow patterns are quite similar for all the investigated conditions in terms of recirculation zones near the heel and toe in the host artery. However, as predicted in figures 6 & 7 the reverse flow at the junction on the host conduit only present at small graft diameter with all anastomosis angles investigated. This is proven the existence of fluctuate flow in both direction (forward and backward) on the bed of the host conduit at the junction area over the whole pulsatile circle. When the small ratio graft-host diameter 0.6 are chosen, the velocity at the graft pick up a high magnitude comparing with 1.6 ratio host graft diameter (assume the same flow rate at the inlet of the graft for 3 investigated ratios). The flow then strongly influenced the flow pattern at the host conduit. This phenomenon can be seen less effective in large graft diameter, smaller blood velocity entering the end-to-side junction. In addition, the transient behaviour of the flow fields became apparent at the initial time step of 0.05 second as the bulk of graft velocity vectors accelerated toward the junction which in turn entrained the artery flow near the heel toward the artery floor. This pattern increased its intensity as time increased and reached maximum at 0.5 second.

Likewise, it should be noted that the feature of a disturbed velocity fields (secondary flow) around the native distal artery near the toe was found throughout the whole pulsatile circle and all of the configurations investigated. These phenomenon is formed when the dominated flow from the graft heading toward the junction area and hit the bed, this flow then skewing back toward the wall of the artery to the toe. However, the phenomenon is reduced with small anastomosis angles and big ratios graft host diameter.

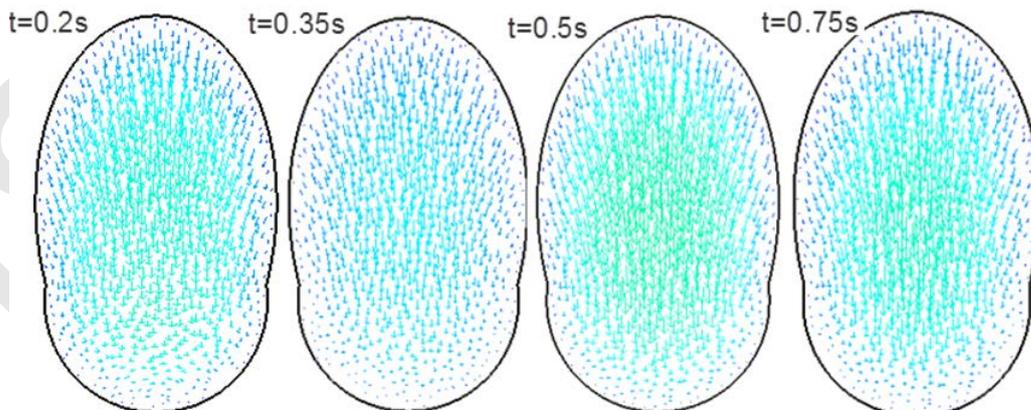


Figure 8. Velocity vectors of 20 degree anastomosis angles: 1 ratio graft host diameter at the cross section ZY at the junction

From literature, plaque rupture has been observed on the areas which are supposed to explore with high value of wall shear stress (WSS). To examine the relationship of this phenomenon to WSS, samples of WSS distributions at the peak systole and TAWSS overall the wall of the all investigated configurations are presented in Figure 9-10. Moreover, to compare the WSS values between all of the models, the line of WSS at the cross section Z-X plane are highlighted and presented (Figure 9 and 10).

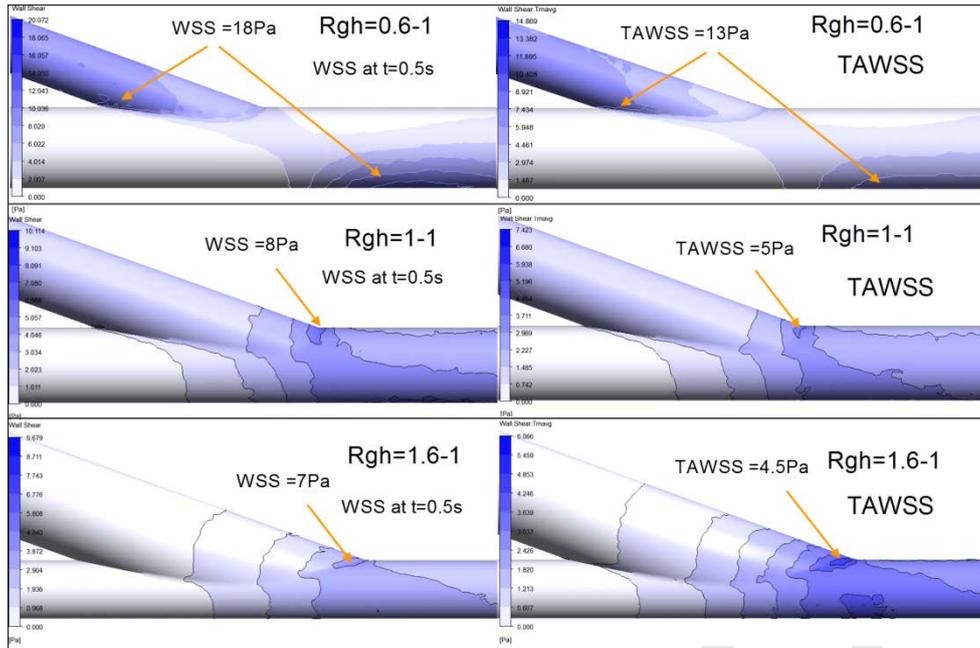


Figure 9 WSS at t=0.5s and TAWSS of 20 deg anastomosis angle

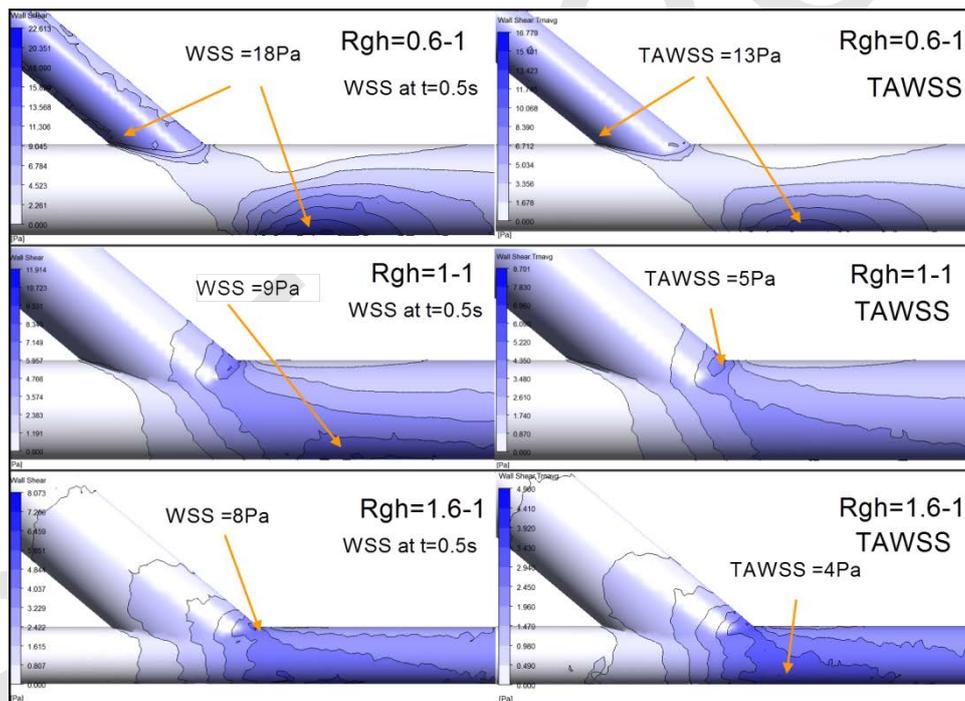


Figure 10 WSS at t=0.5s and TAWSS of 40 deg anastomosis angle

In general, results of high value of WSS are concentrated at the toe, the heel of the end-to-side CABG and the bed of native artery. However, the changing position of high WSS magnitude depends on different patterns such as angles and ratios of graft host diameter. For instance, the changing of angles will influence the position of high WSS on the bed of the host artery, while the ratios of diameter will affect the alternative of WSS at the heel or the toe.

Figure 11 shows the values of WSS on the line GH of the host artery at t = 0.5s. The results show a similar trend in all of the investigated configurations such as identical WSS at the inlet and outlet as all of the models have similar boundary conditions and the flow become fully develop at the distal of the host artery, and high value of WSS on the bed opposite the toe of the junction area. In addition, the 0.6 ratio host graft diameter pick up the highest value of WSS nearly 20 Pa, while the high ratio 1.6 got maximum 5 Pa at the same area.

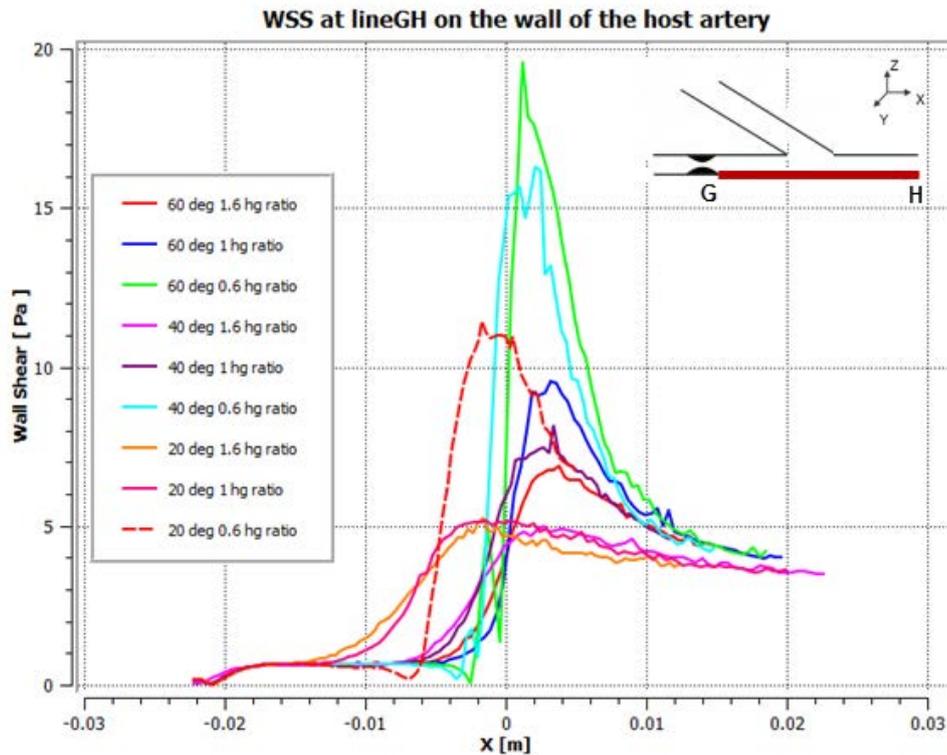


Figure 11 WSS at  $t=0.5s$  on GH line of all investigated configurations

## Conclusions

Although the hemodynamics results at the CABG junction might slightly be affected by the degree of stenosis, particularly in this investigation between 75 and 100%, the findings indicate that the hemodynamics parameters that dominated by the higher WSS values during the longer period of diastole are anastomotic angles and flow rates. The effects of stenosis with local hemodynamics inside of end-to-side CABG were quite obvious. When the degrees of stenosis increase, the flow rate at the host conduct reduces. This will increase the dominate effect of the flow from the graft conduct. As can be seen from the results of this Chapter, the circulation flow zone around the junction area of the end-to-side CABG configurations were clearly observed when the stenosis were 100% blockage.

On the effect of graft to artery diameter ratio, the differences between current flow simulations, with graft to artery ratio of 1.5 was most apparent at the beginning of the cycle following the sharp deceleration of the flow-rates at the end of the previous cycle. For graft to artery ratio of 1, (the simulation study of Freshwater, Morsi et al. [22] reverse flows along the surface of the host artery and the graft resulted in rapidly changing flow fields around the heel of the junction, along the bed of the anastomosis and in the proximal regions of the anastomotic domain were quite significant. However, in the current study of a ratio of 1:1.5 most of these adverse flow features were not found as significant and the values of shear stresses were significantly less than those found by others, implying less probability of occurrence of intimal hyperplasia. Hence, these configurations could be used for further analysis, especially in fluid structure interaction.

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# ORGANIC MATERIALS FOR APPLICATION AS THIN LAYERS IN MOLECULAR ELECTRONIC

H. Benamrani, B. Khaniche, F. Satour, A. Zegadi, K. Nehaoua, A. Zouaoui

Laboratoire de Croissance et Caractérisation de Nouveaux Semiconducteurs  
Faculté de Technologie, Université Ferhat Abbas – Sétif 1, Route de Béjaïa, Sétif 19000, Algeria.

E-mail : benamranihassen@yahoo.fr, khbr77c@yahoo.fr, fatima\_satour@yahoo.fr, ameur\_zegadi@yahoo.fr, k\_nehaoua2002@yahoo.fr, a\_zouaoui\_dz@yahoo.fr

**Abstract:** The objective of this work is the elaboration and the characterization of the composite materials p-Si/Poly (pyrrol benzoic acid)-Cu thin films for microelectronic and photovoltaic applications. The polymer film has been deposited on silicon substrate by electrochemical oxidation of the monomer. Metal copper particles were incorporated by electroreduction of copper complex formed by the polymer and  $\text{Cu}^{+2}$  ions. In the characterization, we have used cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and X rays diffraction (XRD).

**Keywords :** Conductive polymer, Modified electrode, Benzoic Polypyrrol, Silicon.

## Introduction

In the search to replace silicon and other semiconductor thin film technologies, and in order to develop a long term technology bearing in mind that this should be environmentally friendly, low cost and abundant an increasing research interest is nowadays given to organic materials [1].

The incorporation of small metal particles in organic matrices, in particular polymers, has resulted in numerous published works [2]. Studies on the incorporation by electrochemical reduction of metal particles with catalytic properties in polymer films have been mainly devoted to the incorporation of noble metals (Pt, Pd, Rh) [3]. However, only a few examples are found in the literature concerning the inclusion in polymer films of particles of transition metals such as nickel, copper or cobalt [4]. Recently, new electrode materials composite (carbon / polymer-metal) have been developed [5-6].

The aim of this work is to prepare polymeric layers containing metal particles deposited on a semiconductor material surface with better electrical properties which could be applied in nanotechnology fields as an attempt to offer an alternative to existing process involved in electronic circuit design.

## Experimental

Silicon substrates, p-type conducting, <100> oriented, of resistivity in the range 0.01 – 0.08  $\Omega$ .cm, and of active area of 0.32  $\text{cm}^2$  have been used as electrodes. Each electrode is cleaned with acetone and then ethanol, respectively, for 10 min and then washed thoroughly with distilled water. Thereafter, these were treated in a solution of 10% HF [7] for a short period of time in order to remove the oxide layer ( $\text{SiO}_2$ ) and other contaminants and finally activated in a hydrochloric acid solution (1M) for one minute.

The electrodeposition process of the polymer poly (PAB) was carried out in a Pyrex glass cell which has a double wall and a capacity of 5 ml with a glass lid in which there exist four holes that allows the easy passage of three electrodes. The counter electrode was a platinum wire and the reference electrode is an electrode  $\text{Ag}/\text{Ag}^+$  ( $10^{-2}$  M) which is a silver wire immersed in a solution of silver nitrate  $10^{-2}$  M in the acetonitrile with supporting electrolyte.

All of our electrochemical experiments was carried out with a Voltalab PGZ 301 that consists of a potentiostat-galvanostat, running under the software VOLTALAB Mastr 4.

The deposition of poly PAB is obtained in an organic solution of  $\text{CH}_3\text{CN}$  which contains  $4 \cdot 10^{-3}$  M of 4 - (pyrrol-1-yl-methyl) benzoic acid and  $10^{-1}$  M  $\text{LiClO}_4$ .

## Results and discussion

In order to determine the best processing time of the substrate with hydrofluoric acid to obtain more conductive surfaces, we dipped the substrate into the solution of the acid for different durations and then studied the conductivity of the substrates treated using impedance spectroscopy. The analysis was carried out in aqueous 0.1 M sodium sulphate on a range of frequencies between 10 mHz to 100 kHz. The impedance diagrams obtained are shown in Figure 1.

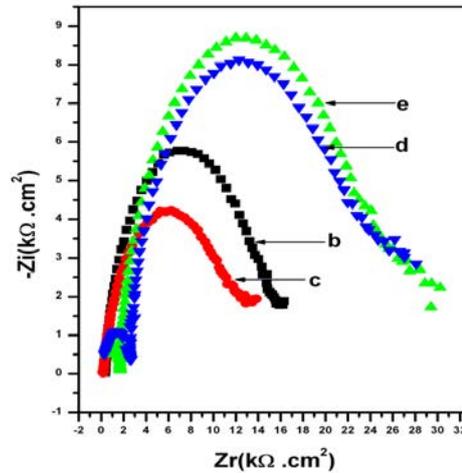


Figure 1: Impedance diagrams corresponding to different treatment times of p-silicon, in aqueous  $\text{Na}_2\text{SO}_4$  0.1M. (a) Before treatment; (b) and (c) 2 minutes; (d) 5 minutes; (e) 10 minutes; (f) 35 minutes.

We observe from this figure that the treatment of the substrate with hydrofluoric acid has a major influence on its conductivity. We have found that the best treatment time is obtained after five minutes of immersion, the resistance obtained is minimal, it is about  $15 \text{ k}\Omega\cdot\text{cm}^2$  (Figure 1(c)).

### Electropolymerization of PAB on p-Si by successive scans

Figure 2 shows the recording of successive voltamperograms (20 cycles), relating to a solution of  $10^{-1} \text{ M}$   $\text{CH}_3\text{CN}/\text{LiClO}_4$  containing  $4 \cdot 10^{-3} \text{ M}$  of (pyrrol-1-yl-methyl) benzoic acid on a p-silicon electrode (area =  $0.32 \text{ cm}^2$ ), recorded over a range of potentials between  $-0.2$  and  $1 \text{ V}/(\text{Ag}/\text{Ag}^+)$  at a scanning speed of  $0.1 \text{ V/s}$ . The voltamperograms show the appearance of two waves, one cathodic to  $0.05 \text{ V}/(\text{Ag}/\text{Ag}^+)$  corresponding to the reduction of the polymer previously obtained and another anodic towards  $0.7 \text{ V}/(\text{Ag}/\text{Ag}^+)$  corresponding to its oxidation. These processes increase in a regular manner, this translates into the growth of the polymer film deposited on the surface of the electrode.

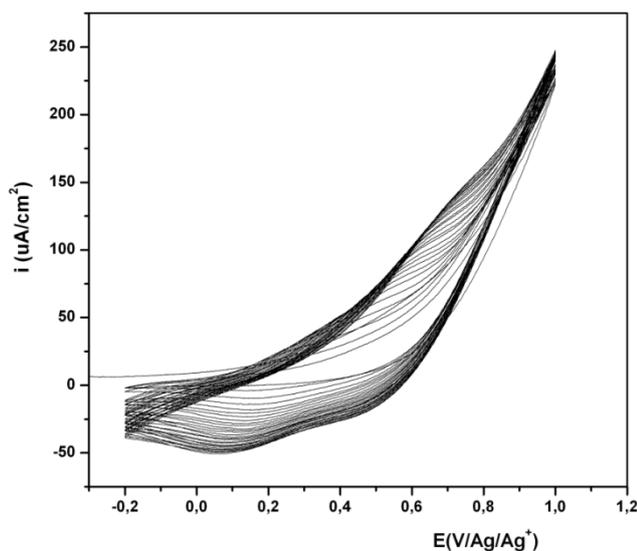


Figure 2: Electropolymerization of PAB/p-Si by repetitive scans.

### Elaboration technique of a modified electrode

After the deposition of the polymer on silicon by the electrochemical oxidation of the monomer (PAB) in a solution of acetonitrile  $10^{-1}$  M  $\text{LiClO}_4$ , the modified electrode is immersed in an aqueous metal salt (0.01 M  $\text{CuSO}_4$ ) at pH: 5 for a few minutes to exchange the  $\text{H}^+$  ions being in the film of the polymer and the cations  $\text{Cu}^{+2}$  of the aqueous solution. The electrode is then thoroughly washed with distilled water several times in order to remove the excess copper cations not related to the polymer, and then immersed in an aqueous solution of 0.1 M  $\text{Na}_2\text{SO}_4$ . It is then reduced in a potential range of: -1.7 to 0V/ECS for electroreduction of the metal in the polymer film. This process can be repeated several times to increase the amount of metal incorporated into the polymer.

### Electrochemical analysis of Cu on p-Si

The electrochemical behavior of copper was investigated on an electrode-of silicon in an aqueous solution less acidic (pH= 5) containing 0.1 M  $\text{Na}_2\text{SO}_4$  as a supporting electrolyte and the salt concentration of 0.01 M of  $\text{CuSO}_4$ . The cyclic voltamperograms recorded at a scan rate of 0.1V/s in a potential range between 0 to -1.6 V/SCE, see figure 3.

We note that the electrochemical reduction of copper on the new substrate is difficult compared to n-type substrates because the field of electroplating copper becomes large and the appearance of a reduction peak has reduced the potential to the value of -1.3V/ECS during the first cycle then we notice a shift of these peaks towards positive potentials with a steady increase in the intensity of the current showing the film formation of a metal deposit.

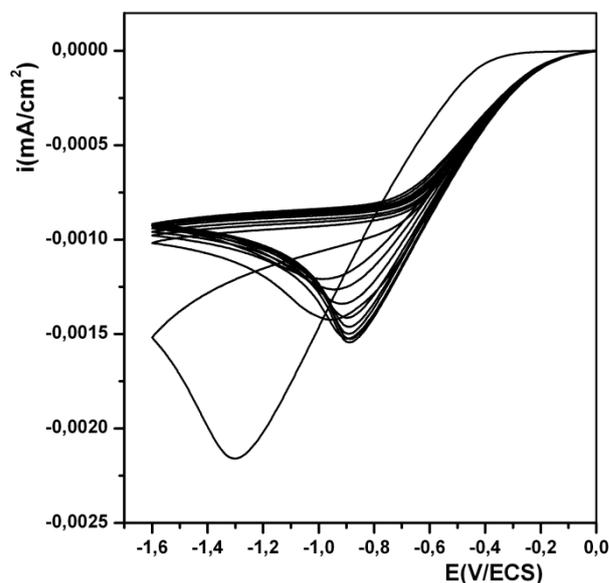


Figure 3: Electrodeposition of copper on p-Si.

### Characterization by impedance spectroscopy of p-Si/poly (PAB)-Cu

The impedance measurements were performed on films of poly (PAB) synthesized by galvanostatic coulometry at an imposed current of 0.2 mA on a silicon substrate during the elaboration of the polymer. The study is performed in the frequency range between 100 mHz to 100 kHz at equilibrium potentials. Figure 4 illustrates the results obtained.

The Nyquist diagrams obtained after the 1<sup>st</sup> and 2<sup>nd</sup> electrochemical reductions of copper on poly (PAB) show some differences in appearances, suggesting that the number of reduction affects the electrochemical behavior of the modified electrode p-Si/poly (PAB). Also, all the diagrams obtained do not start at the same value on the real axis indicating that the resistance of the electrolyte has changed. According to these diagrams, it is worth noting that when the copper incorporation number is increased our composite thin film becomes more conductive.

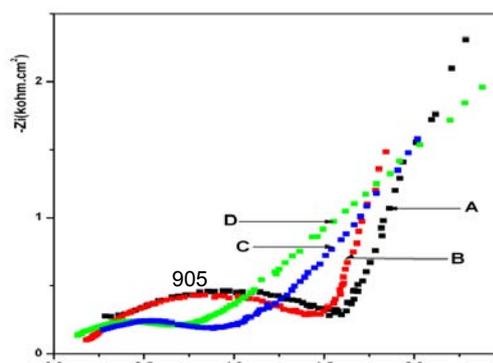


Figure 4: Nyquist diagrams for : A) p-Si, B) p-Si/poly (PAB), C) p-Si/poly (PAB)/Cu (1<sup>st</sup> incorporation) and D) p-Si/poly (PAB)/Cu (2<sup>nd</sup> incorporation).

## Structural analysis by XRD

In figure 8 are shown two spectra, the first XRD corresponding to the sample prepared by depositing a polymer film on silicon substrate (spectrum A), while the second is the spectrum of the composite material prepared by deposition a polymer film on silicon followed by the incorporation of copper complexation of cupric ions in the film by electroreduction of ions incorporated in the heart of the polymeric film (spectrum B). The spectrum (A) shows no peak. Indeed, our polymer is deposited on the surface of the electrode (silicon) electrochemically thus leading to an amorphous polymer. This result is in agreement with the literature. In contrast, the spectrum (B) shows well defined peaks. They are observed at angles of 43.28 and 73.95. These peaks are assigned to a crystalline structure of copper of a cubic shape, confirming the incorporation of copper particles in the polymer film. The results obtained by X-ray diffraction confirm those obtained by the electrochemical method.

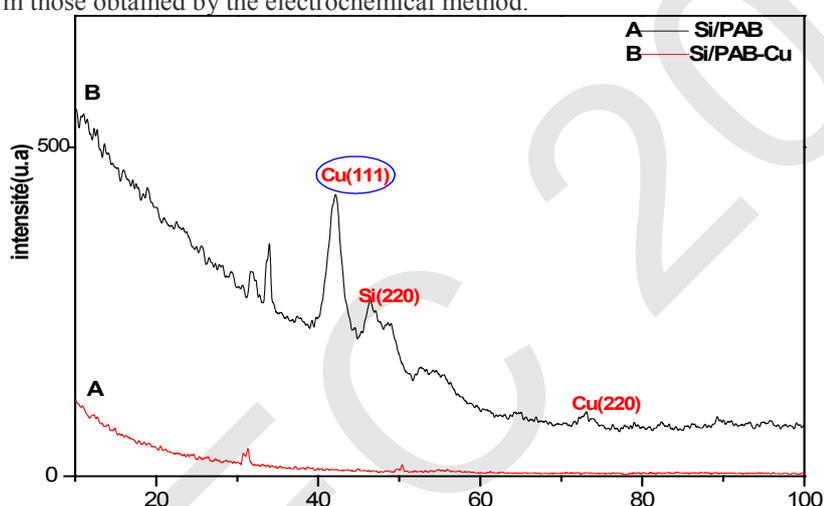


Figure 8: XRD spectra of two electrodes : (A) Si/PAB et (B) Si/PAB-Cu.

## Conclusion

This study demonstrated the feasibility of preparing n-Si electrodes modified by metal deposition of copper and p-Si modified by a polymer film containing metal particles obtained by complexation of copper and electroreduction. The electrodeposition of copper on the surface of n-silicon is produced by the electrochemical reduction of the ions of copper sulfate in an aqueous medium.

The scanning speed, the concentration of the reaction medium and the pH of the electrolyte have a very significant effect on the amount of copper deposited on the surface of n-silicon. The film deposition of pyrrole benzoic acid to the surface of p-silicon is obtained by electrochemical oxidation of the monomer in an organic medium. The incorporation of  $\text{Cu}^{+2}$  ions in the polymer film is obtained by the complexation of cupric ions in the polymer film followed by the electroreduction of the complex formed in a solution of  $\text{Na}_2\text{SO}_4$  to precipitate the metal particles in the polymer film. The electrodeposition process and characterization of the electrode material obtained were examined by cyclic voltammetry, impedance spectroscopy and XRD.

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# ORTAOKULDA DOĞRUDAN KAZANDIRILACAK DEĞERLERİN SOSYAL BİLGİLER KİTAPLARINA YANSIMA DÜZEYLERİ

Tekin ÇELİKKAYA

Ahi Evran Üniversitesi Eğitim Fakültesi Kırşehir, Türkiye, tcelikkaya@ahievran.edu.tr

Uğur BAŞARMAK

Ahi Evran Üniversitesi Eğitim Fakültesi Kırşehir, Türkiye, ugurbasarmak@gmail.com

Simge FİLOĞLU

Ahi Evran Üniversitesi Eğitim Fakültesi Kırşehir, Türkiye, simgefiloglu@hotmail.com

Bilge ŞAHİN

Vali Mithat İlköğretim Okulu, Kırşehir, Türkiye, bilgegomcu2008@hotmail.com

**Abstract:**Sosyal Bilgiler kitaplarında bu değerlerin hangilerinin yer aldığı, değerlere ne kadar yer verildiği, hangilerinin daha sık vurgulandığı büyük bir önem taşımaktadır. Ortaokul Sosyal Bilgiler kitaplarında değerlere yer verilme durumunu belirlemeye yönelik olarak gerçekleştirilen bu araştırma, nitel araştırma yöntemlerinden döküman incelemesi ile gerçekleştirilmiştir. Araştırmada ortaokul Sosyal Bilgiler öğretmen kılavuz kitaplarının hem Meb hem de özel yayınevi ne ait son baskıları incelenmiştir. Kitaplardan toplanan veriler 7 tema ve 26 alt temada altında incelenmiş olup temalara ait bulgular tablolarda gösterilmiş olup bu temalara ait alt temalar da tabloların altında açıklama olarak verilmiştir. Ortaokul sosyal bilgiler dersinde sorumluluk, dayanışma, estetik, bilimsellik, kültürel mirasa duyarlılık, hak ve özgürlüklere saygı değerlerine iyi şekilde yer verilirken, yardımlaşma, çalışkanlık, doğal çevreye duyarlılık, vatanseverlik, dürüstlük, adil olma, bayrağa ve İstiklal Marşı'na saygı ve barış değerlerine yeterince yer verildiği söylenemez. Yayın evi açısından değer ve değer eğitimi ilişkin bilgilere her sınıf düzeyinde yer vermesi ve değerlerin işlenmesi açısından Meb yayınlarının daha etkili olduğu söylenebilir.

**Key words:** Ortaokul, Sosyal Bilgiler kitabı, değer, yansımaya düzeyi

## Giriş

Devletler devamlılıklarını ve gelişmelerini, örf âdet, gelenek ve göreneklerinin yaşatılmasını eğitim ve öğretim sistemiyle gerçekleştirmektedir. Bir başka ifadeyle değerlerini eğitim sistemiyle aktarmaktadır. Bu aktarımda en önemli görevlerden biri de ilköğretim kurumlarına düşmektedir. İlköğretim kurumları da, bütün organlarıyla bu amaca hizmet etmektedir. İlköğretim programlarındaki değerlerin aktarılması için ortam hazırlayan kişiler ise öğretmenlerdir. Bu süreçte öğretmenlere yol gösterici olan ilköğretim okulu programları ve programın amaçlarına uygun içerik sunan ders kitapları da bu aktarımın en önemli öğelerinden birini oluşturmaktadır (Sezer, 2005, s.2-3).

Okulların temel amacı akademik açıdan başarılı bireyler yetiştirmenin yanında bireylere temel değerleri de kazandırmaktır. Bu amacı gerçekleştirmek için öğretmen, aile, çevre gibi faktörlerin yanında ders kitapları da önemli bir rol oynamaktadır. Çünkü, öğrenci okulda geçirdiği sürenin önemli bir kısmını ders kitabı ile geçirmektedir. Shannon'un (1982) yaptığı bir araştırmaya göre, öğrencilerin sınıf ortamında zamanlarının %70-95 arasındaki süreci ders kitaplarına dayalı etkinliklere harcamaktadır (Akt: Ho and Hsu, 2011, s.93). Türkiye'de de Adıgüzel (2010) ve Karaca (2011) tarafından yapılan çalışmalarda da öğretmenlerin, derslerinde genelde temel ders araç gereçleri olan ders kitaplarını kullandıkları belirlenmiştir.

Dünya üzerindeki çocuklar büyüyen sosyal problemlerden, şiddet ve hoşgörüsüzlükten giderek artan bir şekilde etkilenmektedir. Pek çok ülkede aileler ve eğitimciler toplumsal düzeni tehdit eden bu sorunlardan kurtulmanın yolunun etkili bir değerler eğitimi olduğunu vurgulamaktadırlar. (Tillman, 2000, s.IX). Değerlerin kazandırılmasında etkili bir programın hazırlanmasının yanı sıra ders kitapları da önemli bir yer tutmaktadır. Sanchez'e (1998, s.5) göre; ders kitaplarında tek boyutlu, geleneksel, gelişmiş seçilmiş okuma parçalarının mevcut olması, kahramanların seçilmesi ve özelliklerinin ortaya çıkarılmasında hikâyelerin kullanımını gündeme getirmektedir. İlk ve orta dereceli okullarda okutulan ders kitapları, nadiren kahramanların tüm özelliklerini anlatmasından dolayı (bireysel ve kültürel yansımaları açısından), istenilen değerlerin öğrencilere kazandırılmasını sağlayamamaktadır.

Ders kitapları, okuldaki eğitim-öğretim faaliyetlerinin temel materyallerindedir. İlköğretim müfredatı yenilenince, öğrencilere ders kitabı ve kazanımları içeren etkinliklerin bulunduğu çalışma kitabı hazırlanırken, öğretmenler için de ders esnasında kendilerine yardımcı olması amacıyla öğretmen kılavuz kitapları hazırlanmıştır. "Öğretmen Kılavuz Kitabı", öğretmenlere derste bilgiyi nasıl yapılandıracaklarını ve bu esnada izleyecekleri yolu göstermesinin yanında, öğrencilere derste sahip olmaları gereken kazanımları, beceri ve değerleri de göstermektedir. Ortaokul sosyal bilgiler programında doğrudan aktarılması planlanan değerler metinler, bilgiler, resimler, fotoğraflar, atasözleri, özdeyişler, diyalog konuşmaları, karikatürler, şiirler, kahramanlar, hikâyeler, etkinlik çalışmaları ve değerlendirme soruları ile kazandırılmaya çalışılmaktadır.

İlköğretim Sosyal Bilgiler Öğretimi Programında ise Özgüven (1999)'den alınan değer tanımı yer almaktadır. Bu tanıma göre değer, "bir sosyal grup veya toplumun kendi varlık, birlik, isleyiş ve devamını sağlamak ve sürdürmek için üyelerinin çoğunluğu tarafından doğru ve gerekli oldukları kabul edilen ortak düşünce, amaç, temel ahlakî ilke ya da inançlar"dır (MEB, 2005, s.89). Öğretim programlarının uygulayıcısı olan öğretmenler, değerlerin aktarılmasında etkin rol oynarlar. Öğretmenlerin değerler eğitiminde kullandığı çeşitli yöntem ve teknikler vardır. Tartışma temelli yaklaşım ve öğrenci merkezli aktif öğrenme stratejileri en yaygın olanlarıdır. Değer eğitiminde

kullanılan diğer yöntemler drama, proje çalışması, uygulamalı aktiviteler, işbirlikli öğrenme ve grup çalışması, öğrenciler tarafından yönetilen araştırmalar, eğitimsel oyunlar ve eğlence günlerini içerir. (Halstead ,1996,s.11) Öğretmenin, dersi işlerken kullandığı yöntem ve teknikler, istenilen değerlerin, öğrenciler tarafından özümsemesini kolaylaştırabilir.

Sosyal Bilgiler dersi bir değer eğitimi dersidir. 2004 yılında gerçekleştirilen köklü program değişikliklerinde dikkati çeken hususlardan biri de değer eğitimi konusunun programlar içinde vurgulanmasıdır. Sosyal Bilgiler Öğretim Programı incelendiğinde öğrencilere toplam 20 değer kazandırılması hedeflenmektedir (MEB, 2008; MEB, 2010). Bu değerler;“ *Adil olma, Aile birliğine önem verme, Barış, Bağımsızlık, Bilimsellik, Çalışkanlık, Dayanışma, Duyarlılık, Dürüstlük, Estetik, Hoşgörü, Misafirperverlik, Özgürlük, Saygı, Sağlıklı olmaya önem verme, Sevgi, Sorumluluk, Temizlik, Vatansızlık, Yardımseverlik*” olarak belirlenmiştir. Bu değerlerden bazıları sadece bir sınıf düzeyinde verilirken (örn: misafirperverlik 4.sınıf, estetik 7.sınıf), bazıları da aynı anda birkaç sınıf düzeyinde (örn: saygı 4-5-6 ve 7. sınıf) verilmektedir.

Sosyal Bilgiler dersinde, öğretmenlerin ve öğrencilerin birincil kaynak olarak kullandıkları ve takip ettikleri ders kitaplarında bu değerlerin hangilerinin yer aldığı, değerlere ne kadar yer verildiği, hangilerinin daha sık vurgulandığı büyük bir önem taşımaktadır. Bu nedenle, araştırmada ortaokul 5.,6. ve 7. sınıf Sosyal Bilgiler kitaplarında değerlere yer verilme durumunun belirlenmesi amaçlanmıştır. Bu amaç doğrultusunda aşağıdaki sorulara cevap aranmıştır.

1. Ortaokul 5.,6. ve 7. sınıf Meb ve özel yayın evi baskılı Sosyal Bilgiler kitaplarında doğrudan kazandırılacak değerlere hangi biçimde(görsel,bilgi,etkinlik,haber,söz,değerlendirme gibi) ne kadar sıklıkla yer verilmiştir?
2. Ortaokul 5.,6. ve 7. sınıf Meb ve özel yayın evi baskılı Sosyal Bilgiler kitaplarında hangi değerlere daha fazla yer verilmiştir?

### Araştırma Modeli

Ortaokul 5.,6. ve 7. Sınıf Sosyal Bilgiler kitaplarında değerlere yer verilme durumunu belirlemeye yönelik olarak gerçekleştirilen bu araştırma, nitel araştırma yöntemlerinden döküman incelemesi ile gerçekleştirilmiştir. Verilerin çözümlenmesinde tümevarım analizi yöntemi kullanılmıştır. Döküman incelemesi, araştırılması hedeflenen olgu ya da olgular hakkında bilgi içeren yazılı materyallerin analizini kapsar (Yıldırım ve Şimşek, 2003,s.140).

### Evren ve Örneklem

Bu araştırmada Ortaokul 5.,6. ve 7. Sınıf Sosyal Bilgiler öğretmen kılavuz kitaplarının hem Meb hem de özel yayınevi son baskıları incelenmek üzere ele alınmıştır. Araştırmada;

- ✓ 5.sınıf özel yayınevi (pasifik yay.) Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu'nun 18.12.2011 gün ve 244 sayılı kararı ile; 5.sınıf MEB yayın öğretmen kılavuz kitabı Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu'nun 18.12.2009 gün ve 290 sayılı kararı ile;
- ✓ 6.sınıf özel yayınevi (Altın yay.) Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu'nun 28.06.2006 gün ve 294 sayılı kararı ile; 6.sınıf MEB yayın öğretmen kılavuz kitabı Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu'nun 17.12.2010 gün ve 239 sayılı kararı ile;
- ✓ 7.sınıf özel yayınevi ( Anıttepe yay.) Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu'nun 20.12.2009 gün ve 309 sayılı kararı ile; 7.sınıf MEB yayın öğretmen kılavuz kitabı Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu'nun 08.12.2011 gün ve 258 sayılı kararı ile kabul edilen ortaokul 5.,6. ve 7. Sınıf Sosyal Bilgiler öğretmen kılavuz kitapları kullanılmıştır.

### Verilerin Toplanması ve Çözümlemesi

Araştırma verileri nitel araştırma yöntemlerinden döküman incelemesi yoluyla toplanmıştır.Bu bağlamda inceleme, Milli Eğitim Bakanlığı(MEB) ve özel yayınevleri tarafından basılan Ortaokul Sosyal Bilgiler 5., 6. Ve 7 sınıf öğretmen kılavuz kitapları üzerinden yapılmış olup kılavuz kitabın içinde ayrıca hem öğrenci ders kitabı ve hem öğrenci çalışma kitabı da incelenmiştir. Bulgular bu kitabın içinde yer alan verilerden oluşmaktadır. Verilen örnekler kılavuz,ders ve çalışma kitaplarının tamamını kapsamaktadır. Örneğin; “Hak ve Özgürlüklere Saygı” değerine ait verilerden biri kılavuz kitabında sayfa 193'te yer alırken, ders kitabında sayfa 159, öğrenci çalışma kitabında ise sayfa 109'da yer almaktadır. Sayfa numaraları her kitapta farklı olduğu elde edilen verilere ilişkin sunulan örnek alıntılarının sayfa numaraları öğretmen kılavuz kitabında bulunduğu yeri göstermektedir. Kitaplar üzerinde araştırmacılar ayrı ayrı kodlamalar yapmış ve kodlamalar karşılaştırılarak tutarlık oranı hesaplanmıştır. İçerik analizinde güvenilirliğin belirlenmesi amacıyla kodlayıcılar arası tutarlılık hesaplanmaktadır. Bu çalışmada bu amaçla uyuşum yüzdesi formülü kullanılmıştır (Türnüklü,2000,s.551). Çalışmada, bu formül kullanılarak kodlamalardaki uyuşum yüzdesi; 5.sınıf özel yayın evi için 0,87; 5.sınıf meb yayını için 0,88; 6.sınıf özel yayın evi için 0,93; 6.sınıf meb yayını için 0,90; 7.sınıf özel yayın evi için 0,88; 7.sınıf meb yayını için 0,96 olarak hesaplanmıştır. Uyuşum yüzdesinin % 70 veya daha üstü olması yeterli görüldüğünden veri analizi açısından güvenilirlik sağlanmıştır. Kitaplardan toplanan veriler Tablo 1 de gösterildiği gibi 7 tema ve 26 alt temada altında incelenmiş olup temalara ait bulgular tablolarda gösterilmiş olup bu temalara ait alt temalar da tabloların altında açıklama olarak verilmiştir.

**Tablo 1.**Veri analizinde kullanılan Tema ve Alt temalar

| Temalar   | Alt temalar  |
|-----------|--|
| 1. GÖRSEL | Resim ,fotoğraf, karikatür,afiş,şema                   |
| 2. BİLGİ  | Diyalog,açıklama,kılavuz kitap bilgisi,şiir,türkü,marş |

|                  |   |
|------------------|---|
| 3. OLAY          | Hikaye,destan, yazıt,örnek olay   |
| 4. SÖZ           | Deyim,atasözü, özdeyiş  |
| 5. ETKİNLİK      | Konuya hazırlık soru, konu içi soru,öğrenci çalışma kitabı soru ve faaliyetleri, Öğretmen kılavuz kitabı soru ve faaliyetleri |
| 6. HABER         | Gazete,internet ve dergi haberleri  |
| 7. DEĞERLENDİRME | Ünite sonu değerlendirme soruları   |

## Bulgular

Ortaokulda doğrudan kazandırılacak değerlerin Sosyal Bilgiler kitaplarına yansıma düzeylerinin incelendiği bu çalışmada elde edilen bulgular tablolar halinde verilmiştir.

### Beşinci Sınıf Sosyal Bilgiler Ders Kitaplarına İlişkin Bulgular

Tablo2. MEB ve Özel yayın evi 5.Sınıf Sosyal Bilgiler Kitaplarında Doğrudan Kazandırılacak Değerlerin Yansıma Düzeylerine İlişkin Bulgular

| TEMALAR                                      | GÖRSEL |      | BİLGİ |      | OLAY |      | SÖZ |      | ETKİNLİK |      | HABER |      | DEĞERLENDİRME |      |
|--|--------|------|-------|------|------|------|-----|------|----------|------|-------|------|---------------|------|
|  | MEB    | ÖZEL | MEB   | ÖZEL | MEB  | ÖZEL | MEB | ÖZEL | MEB      | ÖZEL | MEB   | ÖZEL | MEB           | ÖZEL |
| Yayın evi<br>Değer                           |        |      |       |      |      |      |     |      |          |      |       |      |               |      |
| Sorumluluk                                   | 8      | 24   | 24    | 64   | 2    | 2    | -   | -    | 14       | 59   | 2     | -    | 8             | 11   |
| Estetik                                      | 48     | 72   | 23    | 17   | -    | -    | -   | -    | -        | 21   | 2     | -    | 10            | 1    |
| Doğal Çevreye Duyarlılık                     | 3      | -    | 3     | 3    | 1    | -    | -   | -    | 2        | -    | 2     | 3    | -             | -    |
| Çalışkanlık                                  | 11     | 6    | 15    | 2    | 1    | 1    | -   | -    | 4        | 2    | 4     | 2    | 2             | -    |
| Akademik Dürüstlük                           | 4      | -    | 20    | 3    | -    | -    | -   | -    | 3        | 1    | -     | -    | 2             | 1    |
| Dayanışma                                    | 20     | 23   | 23    | 18   | 2    | 1    | -   | 2    | 13       | 14   | 8     | 4    | 10            | 15   |
| Adil Olma, Bayrağa Ve İstiklal Marşına Saygı | 3      | -    | 10    | 11   | -    | -    | 1   | -    | 14       | -    | -     | -    | 7             | -    |
| Tarihsel Mirasa Duyarlılık                   | 17     | 24   | 6     | 5    | -    | -    | -   | -    | 8        | -    | 4     | -    | 3             | 1    |

**Sorumluluk** değerine **MEB** yayınında **görsel** tema olarak öğrencilerin sorumluluklarını yerine getirdiğini gösteren fotoğraflarla(8);**bilgi** temasında açıklama(13), öğretmen kılavuz kitabı (2), diyalog(9) şeklinde bilgilerle, örneğin “...herkes üzerine düşen görevi yerine getiriyor...(s.78);...çevreye karşı sorumluluklarını yerine getirmeleri gerekiyor.(s.87);ilköğretime devam etmek aynı zamanda sorumluluğumuzdur (s.90)” şeklinde; **olay** temasında Ayşe'nin bir günü(1) ile herhangi birine çağrı(1) adlı örnek olaylara;**etkinlik** temasında konuya hazırlık (2), konu içi (6), öğrenci çalışma kitabı soru ve faaliyetleriyle(6),örneğin “Sizin okulunuzdaki hak ve sorumluluklarınız nelerdir? (s.84);Ayşe'nin listesinde yer alan ifadelerden hangilerinin hak,hangilerinin sorumluluk olduğunu belirleyiniz.(s.85)” şeklinde ;**değerlendirme** temasında ise doğru-yanlış(1), boşluk doldurma(2), çoktan seçmeli(5) soru tipleriyle örneğin “ üstlenilen her rol bazı hak ve sorumluluklar gerektirir,eğer bunlar olmazsa....(s.92)” şeklinde yer verilmiştir. **Özel** yayın evinde ise **görsel** temada sorumlulukla ilgili bilgiler hem fotoğraf (13) hem de resimlerle (11); **bilgi** temasında, çocuğun okul, çevre, aile ve devlete karşı sorumlulukları açıklama (10), öğretmen kılavuz kitap(37), diyalog (17) bilgileriyle örneğin “... çocukların ödevlerini yapmak,odalarını temiz tutmak ve ...gibi görevleri olduğunu belirtiniz.(s.59); bireysel sorumlulukların yerine getirilmesi...(s.63);ülkemize olan sorumluluklarımızın...(s.66);okuldaki sorumluluklarımız şunlardır (s.67)” şeklinde; **olay** temasında bireyin vazifesini yerine getirmeme (1) ve getirmesi (1) ile ilgili örnek olaylarla;**etkinlikler** temasında konuya hazırlık soruları (4), konu içi soruları (36), öğrenci çalışma kitabındaki ödevler (18) ve proje (1) çalışmalarıyla örneğin “...rollerin getirdiği sorumlulukları söyleyiniz.(s.54)” şeklinde;**değerlendirme** temasında, çoktan seçmeli (2), doğru-yanlış (1), eşleştirme (7) ve klasik (1) soru tipleriyle örneğin “ ... ilgili hak ve sorumlulukları eşleştiriniz.(s.73)” şeklinde yer verilmiştir.

**Estetik** değerine **MEB** yayınında **görsel** temada harita(1),tarihi eser (14), doğal güzellik(10), kültürel zenginliklerimizin (kıyafet, halk oyunları, el sanatları, fıkra gibi) fotoğraflarıyla (23);**bilgi** temasında açıklama(12),diyalog(7) kılavuz kitap (4) bilgileriyle örneğin “el sanatlarımızın estetik değer taşıdığını,her birinin zarif,ayrıntılı,incelikli eserler olduğunu,motiflerin farklı anlamlar taşıdığını vurgulayınız.s.104”; **haber** temasında doğal güzellik (1) ve kültürel zenginliklerimiz(1) ilişkin internet haberleriyle ; **değerlendirme** temasında doğru-yanlış(1), klasik(4), çoktan seçmeli(5) soru tipleriyle yer verilmiştir.**Özel** yayın evinde ise **görsel** temada, tarihi eser (23), doğal güzellik (12), kültürel zenginliklerimize ait (kıyafet, yemek, türkü, el sanatları, bayram ve düğünler gibi) fotoğraflarla(37);**bilgi** temasında eserlerin güzellikleri, eşsizlikleri, zarafetlerine yer verilen açıklama (1), diyalog (15), kılavuz kitap (1) bilgileriyle; **etkinlik** temasında konuya hazırlık (2), konu içi (10), öğrenci çalışma kitabı (9) soru ve faaliyetleriyle ;**değerlendirme** temasında ise sadece doğru-yanlış(1) sorusuyla yer verilmiştir.

**Doğal çevreye duyarlılık** değerine **Meb** Yayınında **görsel** temada gazete haberi ve etkinlik çalışmada verilen fotoğraflarla(3);**bilgi** temasında açıklamalarla(3) örneğin “...*bu da ancak doğal çevreye duyarlı insanlar sayesinde olacaktır. (s.135)*” şeklinde;**olay** temasında çalışma kitabında yer alan örnek olayla(1); **etkinlik** temasında konu içi (1) ve öğrenci çalışma kitabı(1) soru ve faaliyetleriyle örneğin “*çevre kirliliğini önlemek ve insanların doğaya verdikleri zararları azaltmak için neler yapılabilir? (s.135); doğal çevreyi korumaya neden duyarlı olmalıyız? (s.135)*” şeklinde; **haber** temasında internet (1) ve gazete haberleriyle (1) yer verilmiştir. **Özel** yayınevinde ise **bilgi** temasında açıklama(2) ve kılavuz kitabı (1) bilgileriyle örneğin “... *doğal dengesinin zarar görmemesi ... (s.125)*” şeklinde ;**olay** temasında internet haberine (3) yer verilmiştir.

**Çalışkanlık** değerine **Meb** yayınında **görsel** temada çalışan ve üreten insanların fotoğraflarıyla (11) ;**bilgi** temasında insanların mesleklerini ve ürettiklerini ifade eden açıklama(6) ve diyaloglarla(9) örneğin, “...*kömür madenlerinde çalışırız...emek veririz...işçilerin emeğiyle çeliğe dönüşür.(s.149)*” şeklinde ; **olay** temasında öğrencilerin bir proje çalışmasında başından geçenlerin anlatıldığı örnek olayla (1);**etkinlik** temasında konu içi (2), öğretmen kılavuz kitabı(1) öğrenci çalışma kitabı(1) soru ve faaliyetleriyle ;**haber** temasında internet (3) ve gazete haberleriyle(1); **değerlendirme** temasında klasik sorularla(2) örneğin “*çalışkan ve girişimci olmak ...ekonomiye nasıl katkı sağlar?(s.167)*” şeklinde yer verilmiştir. **Özel** yayınevinde ise **görsel** temada başarılı insanların resmi(4), üretkenlik ile ilgili resim(1) ve girişimcilik şemasıyla (1); **bilgi** temasında diyaloglarla(2); **olay** temasında girişimci bir ev kadınının nasıl başarılı olduğuna dair örnek olayla (1); **etkinlik** temasında konu içi soru(1), öğrenci çalışma kitabı(1) soru ve faaliyetleriyle; **haber** temasında ise başarılı çalışma(1) ve girişimcilikle ilgili(1) internet haberleriyle; yer verilmiştir.

**Akademik dürüstlük** değerine **Meb** yayınında **görsel** temada öğrencilerin çalışma durumlarını ve nasıl araştırma yaptıklarını gösteren fotoğraflarla(4); **bilgi** temasında ünitenin son konusu olan “*Bilgi Kaynaklarımız*” adlı konu içerisinde bilimsel araştırma yaparken işlenecek yolları anlatan açıklamalarla(20) örneğin “...*bir plan yaptı. (S.184); araştırma konum ile ilgili bilgi toplamak için, ... (s.185); ..... bilgiyi hangi kaynaklardan aldığını özellikle yazdım s.185.*” şeklinde; **etkinlik** temasında konu içi (1) ve öğrenci çalışma kitabı(2) soru ve faaliyetlerle örneğin “*sizce araştırmalarda kaynak göstermek neden önemlidir? s.185; bir konuda araştırma yaparken doğru kaynaklardan yararlanmalıyız. Çünkü... (s.185)*” şeklinde;**değerlendirme** temasında klasik(1) ve çoktan seçmeli(1) soru tiplerine örneğin “*Bir konu hakkında araştırma yaparken hangi kurallara uyulmalıdır?Neden? (s.187)*” yer verilmiştir. **Özel** yayın evinde ise **bilgi** temasında açıklama(2) ve öğretmen kılavuz kitap (1) bilgileriyle örneğin “...  *faydalandığımız kaynakları aşağıdaki gibi belirtmelisiniz.(s.191)*” şeklinde;**etkinlik** temasında sadece öğrenci çalışma kitabındaki öz değerlendirme formunda yer alan ifadeyle (1) örneğin “*yaptığım çalışmalarda yararlandığım kaynakları gösterebilirim (s.193)*” şeklinde;**değerlendirme** temasında doğru- yanlış sorusu (1) ile “*Araştırma yapmak, akademik dürüstlüktür (s.192)*” şeklinde yer verilmiştir.

**Dayanışma** değerine **Meb** yayınında **görsel** temada fotoğraf (16) ve afişlerle(4); **bilgi** temasında açıklama(19), öğretmen kılavuz kitabı bilgisi (3) ve şiirle(1) örneğin “... *yardımlaşma ve dayanışmanın toplum için öneminden kısaca bahsediniz. (s.198); bazı sivil toplum kuruluşları çocukların haklarını korumak ve onları geleceğe hazırlamak için kurulmuştur.(s.197);... etkin yurttaş olan insanlar yardımlaşmaya ve dayanışmaya önem verirler.(s.205)*” şeklinde;**olay** temasında Otash Kampı ziyaretini ve öğrenci masrafının karşılanması ile ilgili örnek olaylarla(2);**etkinlik** temasında konuya hazırlık (5), konu içi (5), öğrenci çalışma kitabı(3) soru ve faaliyetleriyle; **haber** temasında sivil toplum kuruluşlarının faaliyetlerini gösteren internet(3) ve gazete(5) haberleriyle; **değerlendirme** temasında doğru-yanlış(1), boşluk doldurma(1), kavram haritası(1), klasik(2), çoktan seçmeli(5) soru tipleriyle yer verilmiştir. **Özel** yayın evinde ise **görsel** temada resmi ve sivil toplum kuruluşlarının faaliyetlerini gösteren fotoğraflarla(23);**bilgi** temasında açıklama(14), diyalog(3) ve şiirle(1) örneğin “*Birey olarak ihtiyaçlarımızın karşılanması için birbirimizle yardımlaşırız (s.198);... çocuklara yardım eli uzatmıştır s.200*” şeklinde;**olay** temasında hastane çalışanlarının LÖSEV için yaptığı yardımın anlatıldığı örnek olayla (1); **söz** temasına öğrenci çalışma kitabı geçen Mevlana'nın “*Bir mum,diğerini tutuşturmakla ışığından bir şey kaybetmez*” sözü ile (1) ve değerlendirme sorularında sorulan çoktan seçmeli testin cevabı olan “*Bir elin nesi var,iki elin sesi var.(s.214)*” atasözüyle (1);**etkinlik** temasında konu içi (7), öğrenci çalışma kitabı soru ve faaliyetleriyle (6), proje ödeviyle(1) örneğin “*doğal afetlerde insanların yardımına koşan Türk Kızılayı hakkında gazete haberleri bularak aşağıdaki boş bırakılan alana yapıdırınız.(s.206);LÖSEV'in yaptığı çalışmalara katkı sağlamak için neler yapabilirsiniz?(s.208)*” şeklinde; **haber** temasında resmi ve sivil toplum kuruluşların yanı sıra bireysel olarak yapılan yardım faaliyetlerini gösteren internet haberleriyle(4) **değerlendirme** temasında çoktan seçmeli test(3), boşluk doldurma(5) doğru- yanlış(6), kavram bulmaca(2) sorularıyla yer verilmiştir.

**Adil olma, bayrağa ve İstiklal marşına saygı** değerine **Meb** yayınında **görsel** temada bayrağa ve İstiklal Marşı'na saygıyı yansıtan fotoğraflarla(3);**bilgi** temasında açıklama (6), şiir(1), marş(1) ve öğretmen kılavuz kitap bilgisiyle(2) örneğin;“*bu senin en temel hakkındır...(s.210); Bayrağın Türk milleti için anlam ve öneminin büyük olduğunu vurgu yapınız (s.223); .... M. Akif Ersoy'un vatanseverliğini, bağımsızlık aşkını, bayrağa olan sevgi ve saygısını...(s.225)*” şeklinde;**söz** temasına Atatürk'ün sözüyle (1) örneğin “*Adalet yasalarla yerine getirilir. (s.210)*” şeklinde; **etkinlik** temasında konu içi (4), öğretmen kılavuz kitabı(1) ve öğrenci çalışma kitabı(9) soru ve faaliyetleriyle örneğin, burada özellikle yöneticinin adil olması ile ilgili “*Bir vali yada kaymakamın karar yada faaliyetlerinde adil olmaması durumunda neler yaşanabilir? (s.221) ve ... yönetecek olsaydınız adil bir yönetici olarak neler yapardınız? (s.221)*” şeklinde; **değerlendirme** temasında boşluk doldurma(2), klasik (2), çoktan seçmeli(3) sorularla yer verilmiştir.**Özel** yayınevinde ise **bilgi** temasında diyalog(3), açıklama(7) ve şiirle(1) adil olma değeri

örneğin “... vatandaşların haklarını korur (s.232); Adalet Bakanlığı ... görevlerini yerine getirir.(s.233)” şeklinde; bayrağa saygı “29 Mayıs 1936 çıkarılan bayrak kanunu (s.236)” şeklinde yer verilmiştir.

**Tarihsel mirasa duyarlılık** değerine **Meb** yayınında **görsel** temada tarihi eser fotoğraflarıyla (17), **bilgi** temasında açıklama(4) ve öğretmen kitabı kılavuzu bilgisiyle (2) örneğin; “ Öğrencilerinize, daha önce örnek olarak verilen tarihi eser, doğal güzellik vb. hepsinin birer ortak miras öğesi olduğunu söyleyiniz (s.240); ... tarihi mirasın korunması ve turizme kazandırılması konusunda duyarlı olunması gerekir. (S.245)” şeklinde; **etkinlik** temasına konuya hazırlık soru(1), konu içi soru(3) ve öğrenci çalışma kitabı (2) soru ve faaliyetleriyle(2) örneğin “... tarihi eser ve doğal güzellikler bulunmaktadır. Bunların korunması neden önemlidir? (s.240); ... doğal ve kültürel varlıkların korunması için neler yapardınız? (s.241)” şeklinde; **haber** temasında internet(3) ve gazete (1) haberleriyle; **değerlendirme** temasında klasik(1), çoktan seçmeli(2) soru tipleriyle yer verilmiştir. **Özel** yayinevinde ise **görsel** temada tarihi eser fotoğraflarıyla(24); **bilgi** temasında açıklama(1), öğretmen kılavuz kitap bilgisiyle(4) örneğin “ UNESCO’nun amacının dünya miraslarını korumak ve gelecek nesillere aktarmak olduğunu vurgulayınız.(s.252)” şeklinde; **değerlendirme** teması adına sadece doğru-yanlış (1) sorusuyla örneğin “ Kültür Bakanlığı, ülkemizdeki tarihi eserlerin korunmasını sağlar. (s.261)” şeklinde yer verilmiştir.

### Altıncı Sınıf Sosyal Bilgiler Kitaplarına İlişkin Bulgular

Tablo3. Meb ve Özel yayın evi 6.Sınıf Sosyal Bilgiler Kitaplarında Doğrudan Kazandırılacak Değerlerin Yansıma Düzeylerine İlişkin Bulgular

| TEMALAR                    | GÖRSEL |      | BİLGİ |      | OLAY |      | SÖZ |      | ETKİNLİK |      | HABER |      | DEĞERLENDİRME |      |
|----------------------------|--------|------|-------|------|------|------|-----|------|----------|------|-------|------|---------------|------|
|                            | MEB    | ÖZEL | MEB   | ÖZEL | MEB  | ÖZEL | MEB | ÖZEL | MEB      | ÖZEL | MEB   | ÖZEL | MEB           | ÖZEL |
| Yayın evi                  |        |      |       |      |      |      |     |      |          |      |       |      |               |      |
| Değer                      |        |      |       |      |      |      |     |      |          |      |       |      |               |      |
| Bilimsellik                | 5      | 3    | 13    | 25   | -    | -    | 3   | 1    | 10       | 20   | -     | -    | 6             | 6    |
| Doğal Çevreye Duyarlılık   | -      | 5    | 2     | 6    | -    | -    | -   | -    | 1        | 8    | -     | 1    | -             | -    |
| Kültürel Mirasa Duyarlılık | 8      | 29   | 20    | 31   | -    | -    | -   | -    | 10       | 12   | 1     | 1    | 2             | 6    |
| Sorumluluk                 | 6      | 1    | 6     | 1    | -    | 1    | -   | 1    | 4        | 2    | 1     | -    | 1             | 2    |
| Yardımseverlik             | 3      | 3    | 4     | 1    | -    | 2    | 1   | -    | 3        | 7    | -     | 1    | 1             | 1    |
| Hak ve Özgürlüklere Saygı  | 6      | 7    | 46    | 41   | -    | 1    | 5   | -    | 22       | 28   | 6     | 2    | 5             | 14   |
| Çalışkanlık                | 4      | -    | 1     | -    | -    | 2    | 1   | -    | -        | 4    | 14    | 4    | -             | 2    |

**Bilimsellik** değerine **Meb** yayınında **görsel** temada öğrencilerin araştırma yaptıklarını gösteren fotoğraflarla (5); **bilgi** temasında öncelik olgu ve görüş kavramları ile başlayıp sonrasında bilimsel araştırmanın basamaklarını içeren açıklama (10) ve öğretmen kılavuz kitabı (3) bilgileriyle, örneğin: “Kendi görüşlerimizden başka doğruluğu bilimsel olarak kanıtlanabilen ifadeleri de günlük hayatımızda da kullanırız. (s.52); bilimsel araştırma basamakları konusunda öğretmenleri, onları bilgilendirdi. (s.64)” şeklinde; **söz** temasında Atatürk’ün sözleriyle (3) örneğin “...bilimsel bir şekilde korunmaları ve sınıflandırılması...(s.62)” şeklinde; **etkinlik** temasında konuya hazırlık(1), konu içi 3) öğrenci çalışma kitabı (5) ve öğretmen kılavuz kitabı (1) soru ve faaliyetleriyle örneğin “Araştırma yaparken bilimsel araştırma basamaklarını uygulamak neden önemlidir? (s.64)”; **değerlendirme** temasında klasik (3) çoktan seçmeli (3) soru tipleriyle yer verilmiştir. **Özel** yayinevinde ise **görsel** temada kütüphane ve tarama katalog fotoğraflarıyla (3); **bilgi** temasında açıklama (21), öğretmen kılavuz kitap (4) bilgileriyle örneğin “...dipnot olarak gösterilmeden başkasının bilgilerinin alınmasının bilimsellikte bağdaşmayacağını...(s.28)”; **söz** temasında Atatürk’ün sözüyle (1); **etkinlik** temasında konuya hazırlık (3), konu içi (9), öğrenci çalışma kitabı (7) ve öğretmen kılavuz kitabı (1) soru ve faaliyetleriyle örneğin “Bilimsel araştırma basamaklarını kullanarak istediğiniz, merak ettiğiniz herhangi bir konuda araştırma yapınız.(s.43)” şeklinde; **değerlendirme** temasında eşleştirme (1), çoktan seçmeli (2) ve klasik (3) soru tipleriyle örneğin “ bu konuşmada hangi bilimsel araştırma basamağından söz edilmemiştir? (s.67)” şeklinde yer verilmiştir.

**Doğal çevreye duyarlılık** değerine **Meb** yayınında **bilgi** temasında sadece açıklamalarla (2) örneğin “Yağmur ormanlarının bulunduğu ülkelerdeki bilinçsizlik ve gelişmiş ülkelerin kereste talepleri de bu yıkımı artırıyor.(s.76); ancak fazla kesim nedeniyle teak ağaçları ve ormanlarımız yok olma tehlikesiyle karşı karşıyadır. (s.77)” şeklinde; **etkinlik** temasında ise yapılan açıklama bilgilerinin peşine sorulan konu içi (1) örneğin, “Bu yok oluşu durdurmak için sizce neler yapılabilir? (s.76)” şeklinde yer verilmiştir. **Özel** yayinevinde ise **görsel** temada nesli tükenmekte olan canlıların (3) ve ormanların yok edildiğini (2) gösteren fotoğraflarla; **bilgi** temasında açıklama (5) ve öğretmen kılavuz kitabı (1) bilgileriyle örneğin “ünitenin bu bölümü doğal çevreye duyarlılık değerine ayrıldığı için konu ile ilgili hikayeler bularak sınıfa getirebilirsiniz.(s.74)” şeklinde; **etkinlik** temasında konuya hazırlık (1), konu içi (3), öğrenci çalışma kitabı soru ve faaliyetleriyle (4) örneğin “sizce, ormanları korumak için neler yapmalıyız?(s.74); onlara da yaşam hakkı tanıyalım faaliyeti (s.83)” şeklinde; **haber** temasında doğal çevre tehdidi ve alınan tedbirleri konu alan internet haberiyle (1) yer verilmiştir.

**Kültürel mirasa duyarlılık** değerine **Meb** yayınında **görsel** temada örf, adet ve gelenekleri gösteren resim (4), minyatür (3) ve fotoğraflarla(1);**bilgi** temasında destanlar, kitaplar, kitabeler, alim ve devlet büyüklerinin yaşantıları ve örf adet, gelenekleri ifade eden açıklama (15), öğretmen kılavuz kitap bilgisi (4)ve diyaloglarla (1)örneğin “ *kültürel mirasımızın korunmasına önem veren Türkiye... (s.103);Kısa adı TİKA olan Türk İşbirliği ve Kalkınma İdaresi'nin çalışmaları sayesinde Kök Türk dönemine ait eserlerin gün yüzüne ait eserlerin gün yüzüne çıkarılarak müzelerde sergilenmeye başlandığını... (s.103);Kültürel öğelerimizden biri de düğünlerimizdir.(s.127);... kültürel mirasın korunmasında ülkemizin bu şekilde katkıda bulunduğunu söyleyiniz.(s.130)* ” şeklinde ;**etkinlik** temasında konu içi soru (1), öğretmen kılavuz kitabı (2) ve öğrenci çalışma kitabı (7) soru ve faaliyetleriyle örneğin “ *günümüzde bu el sanatlarının hangileri yaşatılmaktadır?(s.131)* ” ;**haber** temasında Nevruz Bayram faaliyetlerini içeren gazete haberiyle (1); **değerlendirme** temasında doğru-yanlış (1) ve klasik (1) soru tipleriyle yer verilmiştir. **Özel** yayinevinde ise **görsel** temada tarihi eser (9), minyatür ve resim (11), kültürel zenginlikleri (9) gösteren fotoğraflarla;**olay** temasında destan (3) ve yazıtlarla (1); **bilgi** temasında kültürel zenginliklerimize, bilim adamı ve devlet büyüklerinin bırakmış oldukları eserlere ait açıklamalarla (31) örneğin “ *...Bayramlar,nevruz kutlamaları,düğünler ve Mesir macunu şenlikleri gibi kutlamalarımız kültürel zenginliğimizin birer göstergesidir.Bunlar dil,din,müzik,edebiyat vb. kanallarla kültürümüzü oluşturan,yaşatan ve geliştiren değerlerimizdir.(s.116)* ” şeklinde;**etkinlik** temasında konuya hazırlık (2), konu içi (5) ve öğrenci çalışma kitabı (5) soru ve faaliyetleriyle örneğin “*Bayramlar,törenler ve kutlamaların Türk kültüründeki yeri nedir?(s.113);Selçuklular Döneminden kalan eserlerin Türk kültür,sanat ve estetik anlayışına katkıları nelerdir?(s.130)*”şeklinde ;**haber** temasında kültürel zenginliği gösteren internet (1) haberiyle;**değerlendirme** temasında doğru-yanlış (1), eşleştirme (1),çoktan seçmeli (2), klasik (2) soru tipleriyle yer verilmiştir.

**Sorumluluk** değerine **Meb** yayınında **görsel** temada vergi verme ile ilgili afişlerle (6); **bilgi** temasında vatandaşlık sorumluluğu olarak vergi vermenin gerektirdiği ile ilgili açıklama (5) ve şiirle (1) örneğin, “*Vatandaşlık sorumluluğu ve ülke ekonomisine katkısı açısından vergi vermenin gereğini ve önemini savunur.(s.148)* kazanımıyla;**olay** temasında öğrenci çalışma kitabında yer alan öyküyle(1); **etkinlik** temasında konu içi (1) ve öğrenci çalışma kitabı (3) soru ve faaliyetleriyle; “*Atatürk, vatandaşlık görevlerine neden önem vermektedir? (s.149); Bir vatandaşlık sorumluluğu olarak ... (s.149)*” şeklinde;**haber** temasında vergi verme ile ilgili gazete haberleriyle (1); **değerlendirme** temasında ise sadece(1) çoktan seçmeli soru tipiyle yer verilmiştir.**Özel** yayinevinde ise **görsel** temada vatandaşlık sorumluluklarından biri olan vergi vermenin önemini anlatan çizgi karikatür hikayeye (1);**bilgi** temasında görsel temada verilen bilgiler dışında sadece açıklamayla (1),örneğin “*...çevremize ve doğal kaynaklara olan yaklaşımımızı yeniden gözden geçirmemizi gerektirmektedir.(s.151)*”şeklinde; **olay** temasında iki öğrencinin kendilerine verilen ödevi yaparken ki sorumluluklarından bahseden örnek olayla (1);**söz** temasında Atatürk'ün “*vatanımı en çok seven görevini en iyi yapandır.(s.149)*” sözüyle (1);**etkinlik** temasında konu içi soru(1), öğrenci çalışma kitabında vergi vermenin sorumluluğu ile ilgili afiş hazırlanmasının istendiği ödevle (1); **değerlendirme** temasında eşleştirme (1) ve çoktan seçmeli (1) soru tipleriyle yer verilmiştir.

**Yardımsızlık** değerine **Meb** yayınında **görsel** temada gazete haberleri ve öğrenci çalışma kitabında yer alan fotoğraflarla (3); **bilgi** temasında yardımlaşma ve işbirliği konusunda açıklamalar (3) ve şiirle (1);**söz** temasında “*Birlikten kuvvet doğar.(s.176)*” atasözünü (1); **etkinlik** temasında konu içi soru (2) ve öğrenci çalışma kitabı faaliyetleriyle (1);**değerlendirme** temasında çoktan seçmeli (1) soru tipiyle yer verilmiştir.**Özel** yayinevinde ise **görsel** temada örnek olay içinde fotoğraflarla (3);**bilgi** temasında örnek olayda geçen açıklamaların dışında sadece zorluklar birlikte aşılar konusunun “*Ülkemizin diğer ülkelerle doğal afetlerde ve çevre sorunlarında dayanışma ve iş birliği içinde olmasının önemini fark eder.(s.180)*” kazanımı ile (1);**olay** temasında bir öğrencinin başından geçen deprem sonrası yapılan yardımın anlatıldığı örnek olayla (1) ve öğrenci çalışma kitabında yer alan hikayeye (1);**etkinlik** temasında konuya hazırlık (1) konu içi (2), öğretmen kılavuz (2) ve öğrenci çalışma kitabında (2) yer alan sorularla örneğin “*Doğal afetler ve çevre sorunları karşısında uluslararası iş birliği ve dayanışma neden önemlidir?(s.181)*” şeklinde; **haber** temasında gazete haberiyle(1) ;**değerlendirme** temasında sadece “*Dünyanın herhangi bir yerinde, bir çevre sorununa ya da doğal afete maruz kalan insanları gördüğünüzde neler hissediyorsunuz?İnsanların böyle sorunlar yaşamasına engel olabilecek bir çözüm üretmeniz istense,nasıl bir çözüm düşündünüz?(s.187).*” şeklindeki klasik (1) soru tipiyle yer verilmiştir.

**Hak ve özgürlüklere saygı** değerine **Meb** yayınında **görsel** temada hak ve özgürlükleri gösteren şema (1) ve kadınlara verilen hakları gösteren fotoğraflarla (5);**bilgi** temasında diyalog (2), açıklama (37), öğretmen kılavuz kitabı (7) bilgileriyle örneğin “*...Türkiye Cumhuriyeti'nin en temel özelliklerinden birinin insan haklarına saygılı ve laik devlet olma özelliği olduğunu söyleyiniz.(s.192)*” şeklinde;**söz** temasında Hz. Muhammed (S.A.S) “*Sizin kadınlarınız üzerinde haklarınız, kadınların da sizin üzerinde hakları vardır.(s.192)*”sözüyle(1) ve Atatürk'ün sözleriyle (4) örneğin, “*...kısaca herhangi bir sosyal kurumda çalışan bir vatandaşın hak, çıkar ve özgürlükleri eşittir.s.199;...herhangi bir ayırım gözetilmeksizin,bu bildirgeyle ilan edilen bütün haklardan ve bütün özgürlüklerden yararlanabilir. (s.198);Cumhuriyet yönetimi insana verdiği değer,insan hak ve özgürlüklerine gösterdiği saygı nedeniyle diğer yönetim biçimiyle ayrılır.(s.199)* ” şeklinde;**etkinlik** temasında konuya hazırlık (2), konu içi (9) öğretmen kılavuz kitabı (3) ve öğrenci çalışma kitabı (8) soru ve faaliyetleriyle örneğin “*Mustafa Kemal Atatürk'ün cumhuriyetle birlikte Türk milletine kazandırdığı hak ve özgürlükler nelerdir?(s.199)*” şeklinde;**haber** temasında internet (2) ve gazete (4) haberleriyle;**değerlendirme** temasında doğru-yanlış (2) çoktan seçmeli (3) soru tipleriyle yer verilmiştir. **Özel yayinevinde** ise **görsel** temada insanın yaşama, eğitim, bakım hakkı ile ilgili fotoğraf (5), resim (1) ve karikatürlerle (1); **bilgi** temasında insanlara ve hatta hayvanlara bile verilen hakların geçmişten günümüze yansımalarını aktaran açıklamalarla (41); Örneğin, “*tarihsel metinler olarak Hammurabi yasaları,veda hutbesi,Magna Carta ve Kanuni Sultan Süleyman'ın ilgili yasaları,1789 İnsan Hakları Bildirgesi,Kanun-i Esasi,1948 İnsan Hakları Evrensel*

*Bildirgesi ve Avrupa İnsan Hakları Sözleşmesi (s.210-214)*” verilerek tarih içindeki hak kavramının ele alınması şeklinde;**olay** temasında haksızlığa uğrayan bir kişinin haksızlığının giderilmesi konusunun ele alındığı tiyatro oyunu metniyle (1);**etkinlik** temasında konuya hazırlık (7) konu içi (10) öğretmen kılavuz kitabı (3) öğrenci çalışma kitabı (8) soru ve faaliyetleriyle ;**haber** temasında gazete haberiyle (2);**değerlendirme** temasında doğru–yanlış (3), eşleştirme (6), çoktan seçmeli (3), klasik (2) soru tipleriyle yer verilmiştir.

**Çalışkanlık** değerine **Meb** yayınında **görsel** temada çalışmanın ve azmin sonunda ortaya çıkan ürünleri gösteren fotoğraflarla (4);**bilgi** temasında sadece “...çalışkan ve özverili bilim insanları yetiştiren ....s.220” şeklindeki açıklamayla (1);**söz** temasında Atatürk’ün “Hayatta en hakiki mürşit ilimdir.(s.220)”sözüyle(1); **haber** temasında çalışkanlığın ve azmin sonucunda ortaya çıkan ürünlerin yer aldığı dergi (4), gazete (6) ve, internet (4) haberleriyle yer verilmiştir.**Özel** yayinevinde ise **olay** temasında bunlardan biri ders kitabında “Hayal Hırsızı” diğeri ise öğrenci çalışma kitabında “Bir Basketçinin Bilinmeyen Tarihi” başlıklı hikayelerle (2);**etkinlik** temasında konu içi (1) ve öğrenci çalışma kitabı (3) soru ve faaliyetleriyle;**haber** temasında dergi haberiyle (2);**değerlendirme** temasında doğru-yanlış (2) soru tipiyle yer verilmiştir.

### Yedinci Sınıf Sosyal Bilgiler Ders Kitaplarına İlişkin Bulgular

Tablo4.Meb ve Özel yayin evi 7.Sınıf Sosyal Bilgiler Kitaplarında Doğrudan Kazandırılacak Değerlerin Yansıma Düzeylerine İlişkin Bulgular

| TEMALAR             | GÖRSEL |      | BİLGİ |      | OLAY |      | SÖZ |      | ETKİNLİK |      | HABER |      | DEĞERLENDİRME |      |
|---------------------|--------|------|-------|------|------|------|-----|------|----------|------|-------|------|---------------|------|
|                     | MEB    | ÖZEL | MEB   | ÖZEL | MEB  | ÖZEL | MEB | ÖZEL | MEB      | ÖZEL | MEB   | ÖZEL | MEB           | ÖZEL |
| Farklılıklara Saygı | 2      | 2    | 4     | 4    | 2    | 1    | 1   | -    | -        | 4    | -     | -    | 1             | 1    |
| Vatanseverlik       | -      | -    | -     | -    | -    | -    | -   | -    | -        | 2    | -     | -    | -             | -    |
| Estetik             | 81     | 24   | 40    | 24   | -    | 5    | -   | -    | -        | 2    | 2     | -    | 1             | 1    |
| Bilimsellik         | -      | -    | 8     | 2    | -    | -    | -   | -    | -        | -    | -     | -    | -             | -    |
| Dürüstlük           | -      | -    | 7     | -    | -    | -    | -   | -    | -        | -    | -     | -    | -             | -    |
| Adil Olma           | 1      | -    | 20    | 5    | -    | -    | -   | -    | 2        | 1    | -     | -    | 3             | -    |
| Barış               | 7      | -    | 15    | 2    | -    | 1    | -   | -    | 7        | 5    | 4     | -    | 2             | -    |

**Farklılıklara saygı** değerine **Meb** yayınında **görsel** temada iletişim konusu ile ilgili olarak fotoğraflarla (2);**bilgi** temasında özellikle düşünce farklılıklarına saygıyı ifade eden açıklamalarla (4) örneğin “Arkadaşlarımız bizden farklı düşündüğünde ..... saygıyı göstermek ..... (s.74); Konuşmacıların duygu ve düşüncelerini anlamaya çalışır. (s.76)” şeklinde; **olay** temasında öğretmen kılavuz kitabı (1) ve öğrenci ders kitabı bölümünde (1) yer alan öykülerle; **söz** temasında Atatürk’ün sözüne (1) “Neticede kendi fikrimi uygulayacak bile olsam, herkesi ayrı ayrı dinlemekten zevk alırım (s.86)” şeklinde; **değerlendirme** temasında cevabı farklılıklara saygı olan (s.89) çoktan seçmeli soru (1) tipiyle yer verilmiştir. **Özel** yayinevinde ise **görsel** temada, resimlerle (2); **bilgi** temasında açıklama (3), öğretmen kılavuz kitabı (1) bilgileriyle örneğin “görselde yer alan çocukların birbirlerinden hangi farklılıklar olduğunu belirleyin. Hepimiz farklı birçok özelliği var. Bu farklılıklara hepimizin saygı duyması gerekir. (s.34) ve ...farklı düşüncelere saygı gösterme...(s.38)” şeklinde;**olay** temasında özel hayatın gizliliği hakkı konusu altında Efe’nin Günlüğü adlı örnek olayla (1);**etkinlik** temasında konuya hazırlık (1), konu içi (3) sorularıyla örneğin “ Farklılıklara saygı duymak veya duymamak iletişimi nasıl etkiler? (s.34)” şeklinde;**değerlendirme** temasında sadece “Kişi hak ve özgürlüklerine kasıtlı olarak dokunulması, çiğnenmesi (s.54)” şeklindeki eşleştirme sorusu (1) ile yer verilmiştir.

**Vatanseverlik** değerine **Meb** yayınında hiçbir temaya yer verilmemiştir. Ünitede vatandaşlık haklarından bahsedilmektedir. **Özel** yayinevinde ise **etkinlik** temasında öğrenci çalışma kitabında (2) ülkenin geleceği adına yapılabilecekler adlı bir çalışma ile “ Memleketim (s.78) ” adlı şarkı sözlerine yer verilmiştir.

**Estetik** değerine **Meb** yayınında **görsel** temada Osmanlı döneminde yapılan tarihi eser fotoğraflarıyla (35), olayları canlandıran minyatürlerle (17), kıyafet, yemek, gelenek gibi kültürel zenginliği gösteren fotoğraflarla (20) ve resimlerle (9); **bilgi** temasında özellikle “Osmanlı –Avrupa ilişkileri çerçevesinde kültür, sanat ve estetik anlayışındaki etkilerinin fark edilmesi.(s.140)” kazanımı doğrultusunda o döneme ait eser ve kültürel zenginliklerin “eşsiz örneği, en güzel örneği, sanat ve estetiği yansıtan, uyumlu” gibi ifadelerin aktarıldığı açıklamalarla (40);**haber** temasında “çivisiz camii (s.119)ve Avrupalı Besteciler Mehterden Etkilendi (s.140)” başlıklı gazete haberleriyle (2);**değerlendirme** temasında kültürel zenginliğe çoktan seçmeli soru tipi (1) ile yer verilmiştir. **Özel** yayinevinde ise **görsel** temada tarihi eser (13), kültürel zenginlik (5) fotoğraflarıyla ve minyatür (6) resimleriyle; **bilgi** temasında açıklama (10) alıntı (11) ve öğretmen kılavuz (3) bilgileriyle;örneğin “... eserlerdeki muhteşem taş işçiliğine dikkat çekebilirsiniz (s.86); klasik Türk evlerinin hem kullanım rahatlığı hem de estetik bir boyuta sahip olduğunu vurgulayabilirsiniz (s.114); Süleymaniye Cami....birçok teknik özellikleriyle de,eser erişilmez boyutlardadır (s.118) ” şeklinde;**olay** temasında

efsane (2) ve hikâyelerle (3); **etkinlik** temasında konu içi (2) soruyla; **değerlendirme** temasında sadece araştırma ödevine (1) “ *çeşitli dökümanlardan yararlanarak bulduğunuz ilin tarihi ve kültürel özelliklerini yansıtan bir tanıtım dosyası hazırlayınız. Hazırladığınız dosyayı sınıftaki arkadaşlarınızla paylaşınız. (s.127)* ” şeklinde yer verilmiştir.

**Bilimsellik** değerine **Meb** yayınında **bilgi** temasında sadece alıntılar altında bilginin kaynağının belirtilmesi (8) ile yer verilmiştir. **Özel** yayınevinde ise **bilgi** temasında bilim kavramının üzerinde durulduğu “*merak etmek, bilmek ve öğrenmek insanlığın en önemli özelliğidir (s.142)*” şeklindeki açıklamalarla (2) yer verilmiştir.

**Dürüstlük** değerine **Meb** yayınında **bilgi** temasında dürüstlük, doğruluk, adil olma gibi ifadelerin geçtiği açıklamalarla (7) örneğin “*...va’ dinde doğru, ... (s.194); dürüst olacağıma ... (s.84); Her şeyin gerçeğini söyle. (s.195)*” şeklinde yer verilmiştir. **Özel** yayınevinde ise hiçbir temaya yer verilmemiştir.

**Adil olma** değerine **Meb** yayınında **görsel** temada mahkeme salonunun içini gösteren fotoğrafla (1); **bilgi** temasında devletin, yöneticilerin ve yargı organlarının adaleti nasıl sağladıklarını ifade eden açıklamalarla (18) ve öğretim kılavuz kitabı bilgisiyle (2) örneğin “*Mısır firavunları güçlerini göstermek için insanları öldürürken, Türk Hakanları sadece kendi milletinin refahını düşünürlerdi. (s.204); Divan, din ve millet farkı gözetmeksizin bütün halkın istek ve şikayetlerine açıktı. (s.205); Herkesin eşit oy hakkı vardı. (s.207)*” şeklinde; **etkinlik** temasında öğretmen kılavuz kitabı (1) ve öğrenci çalışma kitabında yer alan soru ve faaliyetlerle (1), örneğin “*Sınıf başkanı nasıl seçilmelidir? (s.207)*” şeklinde; **değerlendirme** temasında çoktan seçmeli soru tipiyle (3) yer verilmiştir. **Özel** yayınevinde ise **bilgi** temasında açıklamalarla (5) örneğin “*Türkiye Cumhuriyeti’nde vatandaşlar arasında herhangi bir ayırım ve ayrıcalık söz konusu değildir. (s.193); Haklıyı haksızı ayırmada, yeni adaleti sağlamada devletin yargı organları en yetkili kurumlardır. (s.197); devlet hükümlerinin zalim olmaması ile ilgili olarak da Kutadgu Bilig’de geçen “Zalim olma; zulmü kötülere karşı ... et, bütün memleketi kötülerden temizle (s.185)”*” şeklinde; **etkinlik** temasında öğrenci çalışma kitabı faaliyetiyle (1) yer verilmiştir.

**Barış** değerine **Meb** yayınında **görsel** temada savaşın meydana getirdiği tahribatı gösteren fotoğrafla (1) ve öğrenci çalışma kitabında küresel sorunlara konu olan karikatürlerle (6); **bilgi** temasında savaşların sona ermesi için imzalanan barış anlaşmalarını, küresel sorunlar için imzalanan protokol ve sözleşmelere ait açıklamalarla (15), örneğin “*...Mondros Ateşkes Anlaşması’nı imzalayarak savaştan çekildi. (s.233), ...Dünya Çevre Sözleşmesi katılımcı devletlerin bir kısmı tarafından imzalanmıştır. (s.239)*” şeklinde; **etkinlik** temasında konu içi soru (1), öğrenci çalışma kitabı soru ve faaliyetleriyle (6), örneğin özellikle öğrenci çalışma kitabındaki verilen resimler doğrultusunda “*... barışın önemini anlatan bir kompozisyon yazınız. (s.233); ...barışın sağlanması ve korunmasına yönelik düşüncelerinizi içeren bir kompozisyon yazınız. (s.241)*” şeklinde; **haber** temasında küresel sorunların çözümüne yönelik internet (3) ve gazete (1) haberleriyle; **değerlendirme** temasında doğru-yanlış (1) ve çoktan seçmeli soru tipleriyle (1) yer verilmiştir. **Özel** yayınevinde ise **bilgi** temasında açıklamayla (2) örneğin “*... Mustafa Kemal, yurttan ve dünyada barışa önem vermiş eşsiz bir dehadır. (s.217); Eğer sürekli bir barış istiyorsa insan topluluklarının durumlarını iyileştirecek uluslararası önlemler alınmaktadır. (s.217)*” şeklinde; **olay** temasında Einstein’ın barışa sağladığı katkıdan bahseden hikâyeyle (1); **etkinlik** temasında konu içi (2), öğretmen kılavuz kitabı (1) ve öğrenci çalışma kitabı (2) soru ve faaliyetiyle örneğin “*... terörün barışa verdiği zararları tartışınız. (s.223), Barış için neler yapılabilir? (s.219) ve ... dünya barışının sağlanması için neler yapılabilir? (s.218)*” şeklinde yer verilmiştir.

## Sonuç

Milli Eğitim Bakanlığı tarafından bazı bölgelerde özel yayınevi baskılı kitaplar okutulurken bazı bölgelerde de Meb yayını kitaplar okutulmaktadır. Değer ve değer eğitimi ilişkin bilgi aktarımı 5,6 ve 7.sınıf meb yayınlı sosyal bilgiler öğretmen kılavuz kitabında yer alırken özel yayınevi baskılarında sadece 6.sınıf öğretmen kılavuz kitabında ilgili değer tanımı yer verilmiştir. Bu durum özel yayınevi baskılı kitaplar için olumsuz bir durumdur. Çünkü kitapta verilen bu bilgiler öğretmenlere değer ve değer eğitimi konusunda önemli bilgiler aktararak öğretmenlere bu süreçte yardımcı olmaktadır.

5.sınıf meb ve özel yayınevi kitaplarında **sorumluluk ve dayanışma** değerleri hemen hemen tüm temalarda en iyi en etkin şekilde ele alınmıştır. Verilen bilgilerin yanı sıra bu bilgilerin kazanılıp kazanılmadığı da ünite sonu değerlendirme sorularıyla da ölçülmeye çalışılmıştır. Meb yayını ile kıyaslandığında özel yayınevinde sorumluluk ve dayanışma değerine daha iyi bir şekilde yer verilmiştir. **Sorumluluk** öncelikle kişilerin sahip oldukları rollere ait görevler olarak verilmiştir. Özellikle **sorumluluk (s.62)** konusu ile öğrencilere sorumlulukları doğrudan verilerek, sorumluluk sahibi olmaları gerektiği belirtilmektedir. **Dayanışma** değerine ise resmi ve sivil toplum kuruluşlarının toplumsal ve bireysel sorunları çözmek için yapmış oldukları faaliyetler anlatılarak aktarılmaya çalışılmıştır. **Estetik** değeri Meb yayınında ve özel yayınevinde ülkemizin çeşitli yerlerindeki doğal varlıklar ile tarihi mekanlar, kültürel zenginliklerimiz, oyunlarımız ve kıyafetlerimiz, evlerimiz, yemeklerimiz, el sanatlarımız, düşünlerimiz, milli ve dini bayramlarımız ile estetik değeri kazandırmaya çalışılmıştır. Verilen bilgilerde özellikle eşsiz, güzellik, büyüleyici, sanat harikası, doğa harikası, mimarlık harikası gibi sözcüklerle estetik değeri vurgulanmaya çalışılmıştır. **Doğal çevreye duyarlılık** değerine Meb ve özel yayınevi baskılarının her ikisinde de tam olarak yer verildiği söylenemez. Verilen bilgilerde de doğaya verilen zarar önleme olarak verilmiş olup doğa sevgisinden bahsedilmemiştir. **Çalışkanlık** değerine Meb yayının da bir meslek grubunun çalışması, insanların düşüncelerini üretmeye dönüştürmesi olarak verilmişken özel yayınevinde ise istenilen düzeyde yer verilmemiş olup sadece girişimci insanın özelliklerinden biri olarak verilmiştir. **Akademik dürüstlük değeri** 5.sınıf meb yayınında bilgi kaynaklarının konusu ile bilimsel bir çalışmanın basamakları ve kaynak göstermeye hem görsel hem de bilgi temasında vurgu yapılarak aktarılmaya çalışılmışken özel yayınevinde ise, sadece kaynak gösterme şeklinde verilmiş olup değer yeterince kazandırıldığı söylenemez. **Adil olma, bayrağa ve İstiklal Marşına saygı** 5.sınıf meb yayınevinde yöneticilerin adil olup olmaması ile ilgili sorulara

yer verilirken bayrağa ve İstiklal Marşı'na saygı hem etkinliklerle hem de şiir ve marşlarla verilmiştir. Ancak özel yayınevinde ise bu değerlere bilgi teması dışında hiç yer verilmemiştir. **Tarihsel mirasa duyarlılık** değerine meb yayınevinde resimleri verilen neden ve niçin korunması adına herhangi bir etkinliğe yer verilmemişken özel yayınevinde ise tarihi eserler, nesnelere tanıtılarak bunların korunması ve gelecek kuşaklara aktarılmasına vurgu yapılmaktadır. Bu eserleri korunması ve tamamlanması ile turizme katkı sağlayarak ülke ekonomisine getirisinden bahsedilmiştir.

6.sınıf Meb yayını evinde **bilimsellik** değerine hem görsel hem de açıklayıcı bilgi ile öğrencilere bilimsel bir çalışmanın nasıl yapılacağına yer verilirken, özel yayınevinde ise sadece teorik bilgi olarak verilmiş. Bilimsellik değerine en açık ve net şekilde Meb yayını evinde yer verildiği söylenebilir. **Doğal çevreye duyarlılık değerine** her iki yayınevi de çok az tema altında doğada meydana gelen olumsuz durumlar ile etkileri ortaya konularak kazandırılmaya çalışılmış. Ayrıca değerini tanıyarak ifade edildiği gibi bu değeri kazandırırken doğa sevgisini kazandırmaya hiç yer verilmemiştir. Her iki yayınevini de değeri aktarmada yetersiz oldukları söylenebilir. **Kültürel mirasa duyarlılık** değerine her iki yayınevinde de kültürümüzün yaşayan değerleri kutlamalar konusu altında hemen hemen her tema ile ilgili etkinlikler yer verilmenin yanında kültürel mirasın korunması ifadesine yer verilmiştir. **Sorumluluk değeri** 5.sınıfta her iki yayınevinde de en iyi şekilde yer verildiği için 6.sınıfta sadece vatandaşlık sorumluluğu olarak vergi vermenin gerekliliği üzerinde durulmuştur. **Yardımseverlik** değeri 5.sınıfta dayanışma değeri olarak her iki yayını evinde etkili şekilde verilmişti. 6.sınıfta bu değere özellikle ülkeler arasındaki ilişkilerde bir ülkenin başına gelen bir felaketten dolayı diğer ülkelerin o ülkeye ağırlıklı olarak maddi anlamda yardım etmesi gerektiğine yer verilmiştir. 6.sınıf Meb yayınevinde (2012a,s.35) "*Yardımseverlik değerini sadece maddi olarak algılamamak gerekir. Bazen bir söz ile üzüntüyü paylaşmak, bir problemi dinlemek, umut vermek de yardımsever olmanın ifadesidir. Dolayısıyla yardım etmek için zengin olmak gerekmez*" ifadesi geçmesine rağmen yardımlaşma sadece maddiyat olarak verilmiştir. Bu durum yardımlaşma değerinin sosyal bilgiler programında tam olarak verilmediğini ortaya koymaktadır. **Hak ve özgürlüklere saygı** her iki yayınevinde genel olarak hak ve özgürlüklere saygının tarihsel gelişiminden bahsedilmiş olup saygı kavramına özellikle farklı inanç, kültüre saygı olarak yer verilmiştir. Ayrıca insanların hakkı olan durumların kendilerine verilmesi hak ve özgürlüklere saygı olarak ifade edilmiştir. En fazla değerlendirme sorusuna (Meb,5;Özel,s.14) burada yer verilmiştir. **Çalışkanlık** değeri her iki yayınevinde de bilim dünyasındaki son teknolojik gelişmelerin meydana gelmesinde insanların planlı, disiplinli çalışmalarının rolü olduğu vurgulanarak kazandırılmaya çalışılmıştır. Özel yayınevinde ise buna ek olarak *Hayal Hırsız (s.174)* ile *Bir Basketçinin Bilinmeyen Tarihi (s.247-248)* hikayeleri ile bir işi başarmak için pes etmeden çok çalışmak ve azimli olmak gerektiği vurgulanıyor.

7.sınıf kitaplarında 5 ve 6.sınıflarda olduğu gibi değerlere tam olarak yer verildiği söylenemez. 7.sınıf sosyal bilgiler kitaplarında her iki yayınevi en fazla **estetik** değerine vurgu yaparken başta milli duyguların aşılanması ve birçok değeri içine alabilecek olan **vatanseverlik** olmak üzere **bilimsellik** ve **dürüstlük** değerlerine hemen hemen hiç yer verilmemiştir. **Farklılıklara saygı** değerine her iki yayınında da özellikle iletişim konusu ile aktarılmaya çalışılmıştır. Bu değere yeterince yer verildiği söylenemez. **Estetik** değeri, "Osmanlı Avrupa ilişkileri çerçevesinde kültür, sanat ve estetik anlayışındaki etkileşimi fark eder." kazanım ile verilmeye çalışılmıştır. **Dürüstlük** değerine özel yayını evinde hiç yer verilmezken meb yayınında Ahilik ile meslek etiği konularında birkaç sözle değinilmiştir. Adil olma değerine, Meb yayınında eski Türk devletlerinde ve şu an ki Türkiye Cumhuriyeti Devletinde devlet ve yöneticilerin adalet anlayışı hakkında açıklayıcı bilgilere yer verilirken özel yayınevinde anayasada geçen hükümler ve mahkemelerin varlığı ile ifade edilmeye çalışılmıştır. **Barış** değeri her iki yayınevinde de savaş ve savaşın doğurduğu kötü sonuçlar verilerek aktarılmaya çalışılmış. 7.sınıf meb yayınında (2012,s.30) barış değeri için "*Kişiler arası ve ülkeler arası ilişkileri geliştirmek için olumlu iletişim kurmanın yolları aranmalıdır. Sanat, spor, kültürel etkinlikler insanların birbirlerini daha iyi tanımalarına, dostluklarını geliştirmelerine yardımcı olacaktır. Böylece barış ortamı oluşacaktır.*" ifadesinde yer alan etkilere ise hiç yer verilmemiştir.

Sonuç olarak ortaokul sosyal bilgiler dersinde sorumluluk, dayanışma, estetik, bilimsellik, kültürel mirasa duyarlılık, hak ve özgürlüklere saygı değerlerine iyi şekilde yer verilirken, yardımlaşma, çalışkanlık, doğal çevreye duyarlılık, vatanseverlik, dürüstlük, adil olma, bayrağa ve İstiklal Marşı'na saygı ve barış değerlerine yeterince yer verildiği söylenemez. Yayını evi açısından değer ve değer eğitime ilişkin bilgilere her sınıf düzeyinde yer vermesi ve değerlerin işlenmesi açısından Meb yayınlarnın daha etkili olduğu söylenebilir.

#### Öneriler

- ✓ Bir ülkenin geleceği olan genç nesillerin yetiştirilmesinde öğretimden ziyade eğitime özellikle de değer eğitime önem verilmesi iyi bir gelişme olarak değerlendirilebilir. Sosyal Bilgiler programında sadece bu değerlerin ismini yazmak yeterli değildir. Bu sebeple programda yer verilen bu değerler yeniden gözden geçirilerek eksik ve yetersiz olarak aktarılan değerlere daha fazla yer verilebilir.
- ✓ Meb ve özel yayını evi baskılı kitaplarda değerlerle ilgili etkinlik türleri çeşitlendirilebilir.

#### Teşekkür

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# ÖRGÜT KÜLTÜRÜNÜN DEĞİŞİMİNDE YÖNETİCİLERİN ROLÜ

Yrd.Doç.Dr. Filiz Kantek  
Akdeniz Üniversitesi  
Antalya Sağlık Yüksekokulu,  
Türkiye  
fkantek@akdeniz.edu.tr

**Özet:** Bu çalışmada, kurumlar için örgüt kültürünün önemi açıklanarak kültürel değişimde yöneticilerin rollerine açıklık getirilmesi amaçlanmıştır. Örgüt kültürü örgütte işlerin yapılış tarzları ile ilgili olduğundan örgütte uygulamaya konulacak herhangi bir değişim planı işlerin yapılış tarzını etkileyeceğinden, çalışanların örgüt kültürü bağlamındaki temel değer ve inançlarını da etkileyecektir. Bu nedenle, örgütteki değişim uygulamaları aynı zamanda kültürel bir değişim planlamasını da gerektirmektedir. Yöneticiler kültürel değişimi tasarlamadan önce “kültürel değişime neden ihtiyaç duyulmaktadır?” ve “yeni kültürün şekli ne olacaktır?” sorularının cevaplandırılması gerekmektedir. Ayrıca, başarılı bir kültürel değişim için yöneticilerin kültürel değişimin yönetimiyle uğraşmaya istekli olmaları ve kültürel değişiminin kolay bir süreç olmadığının fakat değiştirilebileceğinin bilincinde olmalıdır. Sonuç olarak; yöneticilerin, kurumlarındaki değişim politikasını çok iyi belirlemesi, kurum içi ve kurum dışı karşılaşabilecekleri kültürel, sosyal, ekonomik engelleri önceden kestirebilmesi ve gerekli önlemleri alabilmesi, kurumsal etkililik ve başarı için büyük önem taşımaktadır.

**Anahtar kelimeler:** Değişim, örgüt kültürü, kültürel değişim, yönetici.

## Giriş

Son yirmi yılda, örgüt kültürünün örgütsel etkililik ve başarı için öneminin anlaşılması örgütlerin bu konuya olan ilgisinin artmasına neden olmuştur (Marcoulides ve ark., 2005, Sayılar, 2003). Örgüt kültürü kavramının, organizasyonları anlamak, özellikle de örgütsel performansı ve örgütsel davranışı açıklamak konusunda birçok farklı çözümlenmeye temel oluşturduğu görülmektedir (Sayılar, 2003). Örgüt kültürü konusunda yürütülen çalışmalar örgüt kültürü ile iş doyumu, işte kalma niyeti, personel devir hızı, örgütsel bağlılık ve örgütsel etkililik arasında ilişki olduğunu göstermektedir (Sikorska-simmons, 2006, Way ve ark, 2007, Tzeng ve ark, 2002). Bununla birlikte, örgüt kültürünün örgüt üzerindeki etkisinin ve kültürel değişim sürecinin yeterince anlaşılmasının örgütsel değişimlerde başarısızlığa neden olduğu sık sık ifade edilmektedir (Stotler, 2007)

Örgüt kültürü örgütte işlerin yapılış tarzları ile ilgili olduğundan örgütte uygulamaya konulacak herhangi bir değişim planı işlerin yapılış tarzını etkileyeceğinden, çalışanların örgüt kültürü bağlamındaki temel değer ve inançlarını da etkileyecektir. Bu nedenle, örgütteki değişim uygulamaları aynı zamanda kültürel değişim planlamasında gerektirmektedir (Terzi, 2000, Karşlı, 1998, Pınar, 1999). Örgüt kültürü değişiminde yöneticiler kilit role sahip kişilerdir. Onların kültürel değer sistemleri ve kişilik özellikleri kurumlarda örgütlenme biçimini etkileyen başlıca etmenlerden biridir. Örneğin yönetici, insanlara güvenmeyen ve otokratik bir kişiliğe sahip ise, personele yetki dağıtma konusunda hasis davranacak ve böylece merkezi-otokratik bir örgüt biçimi ortaya çıkacaktır (Öztürk, 2012). Bununla birlikte, örgüt kültürü yöneticiler için seçilen stratejinin yürütülmesini kolaylaştıran ya da zorlaştıran bir etkiye sahiptir (Eren, 1998, Pınar, 1999).

Örgütlerdeki değişimlerin örgüte katkı sağlayacak şekilde yönlendirilmesi ve kontrol edilebilmesi örgüt yöneticisinin bilgi ve becerisi ölçüsünde mümkün olabilmektedir (Argon, Özçelik, 2008). Bu noktadan hareketle, bu çalışmada, kurumlar için örgüt kültürünün önemi açıklanarak, kültürel değişimde yöneticilerin rollerine açıklık getirilmesi amaçlanmıştır.

## Örgüt kültürü

Örgüt kültürü, bir işyerinde oluşan kültür çeşitidir (Crow, Hartman, 2002). Örgüt kültürü genel kültüre göre bir alt kültür olarak düşünülebileceği gibi, işletme içindeki çeşitli grupların kültürlerine göre de bir genel kültür olarak da görülebilir. Ancak genel kültür, alt kültürlerin bir toplamı olmadığı gibi, örgüt kültürü de bir örgütteki değişik kültürlerin bir toplamı değildir (Köse, Ünal, 2000, Sabuncuoğlu, Tüz 2001).

Örgüt kültürü, örgütsel davranışa bakmanın ve hakkında düşünmenin bir yolu ve örgütte ne olduğunu anlamının bir perspektifidir (Karşlı, 1998). Schein’ e göre örgüt kültürü; bir grubun kendi içinde bütünleşme ve dış çevreye uyum sorunlarını çözerken yarattığı ve geliştirdiği, yeni üyelerine algılama, düşünme ve hissetme yolu olarak aktardığı varsayımlar ve inançlar bütünüdür (Schein 1992). Killmann ve diğerleri de, örgüt kültürünü, “bir grubu birbirine bağlayan ve grupça paylaşılan normlar, tutumlar, beklentiler, inançlar, sayıtlılar, değerler, ideolojiler ve felsefeler” biçiminde tanımlayarak, kültürü, herhangi bir örgütte gözlemlenen, elle tutulabilen tüm durumların arkasındaki gizli güç ve örgütte yapılan işlerde temel ölçüt olarak görmektedir (Killman, Saxton, Serpa, 1986). Bir

örgütün mevcut kültürü, örgütün geçmişteki ve bugünkü yönetsel planlama, örgütlenme, yöneltme ve kontrol etme aktivitelerini yansıtır. Bununla birlikte, örgüt kültürü zaman içerisinde dış çevrede meydana gelen değişimlerden de etkilenen dinamik bir süreçtir (Greenberg, 2002, Sabuncuoğlu, Tüz, 2001).

Her örgütün ve çalışanların kendine özgü tutum, değer ve davranışları bulunmaktadır ve tüm bu özelliklerin toplamı örgüt kültürünü oluşturmaktadır (Crow, Hartman 2002). Örgütün içinde bulunduğu sektörün belirgin özelliklerinden olan; ürünü, müşterileri, büyüklüğü ve yerleşim yeri, rekabet koşulları, finans ve insan kaynakları, biçimsel örgüt yapısı, yönetim sistemleri, bilgi sistemleri, karar verme biçimleri, haberleşme sistemleri, fonksiyonel politikalar, ahlaksal faktörler vb. özellikler olup, kültürün oluşması için gerekli olan, inançlar, değerler ve varsayımlar bütünü oluşturur (Greenberg, 2002, Şimşek, Akgemci, 2001).

Örgüt kültürünün incelenmesi, kurumsal yapının-işleyişin temellerini anlama, değişim gereksinimini belirleme, kurumsal problemlerin çözümü, personel gelişiminin ve doyumunun sağlanması gibi birçok açıdan yararlar sağlar (Şişman, 2002, Terzi, 2000). Örgüt kültürünün incelenmesinde, kullanılacak kültürel öğeler ve araştırma yöntemleri konusunda araştırmacılar arasında tam bir görüş birliği bulunmamaktadır. Bazı araştırmacılar, kültürün özünü temel sayıtların (varsayımlar) oluşturduğunu, bazıları ise değerlerin oluşturduğunu ileri sürerek değerlerin açıklanması ile örgüt kültürünün de açıklanmış olacağını belirtmektedirler. Bir grup araştırmacı ise, örgüt kültürünün temelini normların oluşturduğunu ileri sürmektedir (Şişman, 2002, Terzi, 2000). Schein, örgüt kültürünün temelini, temel sayıtların (inançların) oluşturduğunu, kültürün ancak söz konusu sayıtların açıklanması ile anlaşılabilirliğini; değerlerin ve sembollerin ise, bu kültürün yüzeysel kısmını oluşturduğunu belirterek, bir örgüt kültürü öğeleri modelini geliştirmiştir (Schein 1992). Schein bu modelde; *temel sayıtları*; örgüt üyelerinin çevre ile ilişkileri, gerçek, zaman, mekan, insan, insan eylemleri ve insan ilişkilerinin doğası konularında paylaştıkları temel inançlar, *temel değerleri*; örgüt üyelerinin olay, durum ve davranışları değerlendirme ve yargılamada benimsedikleri ölçütler, *artifaktları ise*; kültürün gözle görülen yönü olup teknoloji, üyelerce gerçekleştirilen sanat-mitler, semboller, hikayeler, efsaneler, görülen ve işitilen davranış örüntüleri olarak tanımlanmaktadır (Erdem, 1996, Şişman, 2002).

Örgüt kültürünün incelenmesinde kullanılacak araştırma yöntemi konusunda bazı araştırmacılar, kültürün sadece kalitatif yöntemler kullanılarak araştırılabileceğini, bazıları da kantitatif yöntemlerle daha objektif değerlendirme yapılabileceğini savunmaktadırlar. Bununla birlikte, bir grup araştırmacı da hem kalitatif hemde kantitatif yöntemlerin birlikte kullanılması gerektiğini belirtmektedir (Hofstede ve ark., 1990, Hon, 2002, Locatelli, West, 1996). Kültür analizinde anket, katılımcı gözlem, yapılandırılmış görüşme, derinlemesine görüşme, grup tartışmaları, doküman analizi, işletme ziyaretleri gibi yöntemler kullanılmaktadır (Angelides, Ainscow 2000, Haris 2003, Hofstede 1998).

## Örgüt Kültürü Değişimi

Örgütlerin yaşamları ve rekabet avantajı sağlamaları, onların strateji, yapı ve süreçlerinin içinde buldukları çevreye uyumları ile mümkündür (Awal ve ark, 2006). Bu nedenle, örgütler amaçlarını çevrenin isteklerine göre yeniden düzenlemek ya da değiştirmek durumundadırlar. (Argon, Özçelik, 2008). Değişime uyum sağlamanın günlük rutinin bir parçası olduğu bir çevre içinde bulunan örgütlerin karşı karşıya kaldıkları değişimlerden muhtemelen en zor, en riskli ve en rahatsız edici olanı örgüt kültüründeki değişimdir (Brubakk, Wilkinson, 1996). Bir kültürde değişimin genel olarak anlamı örgütün değerleri, inançları ve işleri yapmanın alışılmış yollarından bazılarının değişmesidir (Awal ve ark, 2006).

Örgütün dış çevresinde meydana gelen kültürel, teknolojik, bilimsel ve ekonomik değişimler ile birlikte, örgüt kurucularının amaçlarında görülen değişimler, örgüt üyelerinin değer ve amaçlarında oluşan değişimler, örgüt başarısındaki yetersizlik, benzer örgütlerde değişim programlarının başlaması, örgüt içi geliştirilen teknolojik ilerlemeler, lider değişimi, örgütün yaşam eğrisindeki (doğuş, büyüme, olgunluk, çöküş) dönem ve durumlarındaki değişimler kültürü yaratan varsayımların zaman içinde değişmesine neden olabilmektedir (Koçel 1993). Kilmann'a göre örgüt kültürü, örgütün temel amaçlarını destekler nitelikte değilse, örgütün başarısını itici bir güç olarak harekete geçiremiyorsa, örgütteki çıkar gruplarının örgüt çıkarları ile örtüşmesini ve örgütteki diğer çıkar grupları arasındaki uyumu sağlayamıyorsa, çalışanlara örgütün karmaşık sorunlarını ele almaya ve çözüm üretmeye yönlendirici katılımcı bir ortam oluşturmuyorsa, örgüt kültürünün değişimi kaçınılmaz hale gelir (Polat, 2003). Anahtar konumdaki çalışanları değiştirmek, çalışanların yerlerini, tutum ve inançlarını ve davranışlarını değiştirmek, örgütsel sembol, yapı ve sistemleri değiştirmek, örgüt içindeki teknolojiyi değiştirmek yoluyla örgüt kültüründe değişim yaratmak mümkündür (Williams ve ark, 1993).

Kültürel değişimde örgütsel değişimde olduğu gibi, değişimin planlı olup olmamasına göre planlı ve plansız değişim, mevcut sorunlara yönelik olup olmamasına göre reaktif ve proaktif değişim, kapsamına göre makro ve mikro değişim, zamana bağlı olarak birdenbire ve çok kısa süreli değişim, kısa süreli değişim ve uzun süreli değişimden bahsetmek mümkündür (koçel, 1993, Polat, 2003). Örgüt kültürü değişim sürecinde mevcut yapının analizi, değişim hedef ve stratejilerinin hazırlanması, değişim planının uygulanması, sonuçların izlenmesi ve değerlendirilmesi adımlarını içermektedir (Polat, 2003, Terzi, 2000, Awal ve ark, 2006). Geleneksel olarak, örgüt kültürünün değişiminde, öncelikle örgüt felsefesinden başlanır, ardından ona uygun örgüt yapısı oluşturulur, çalışanların inançlarında ve değerlerinde değişim gerçekleştirilir ve son olarak felsefeye uygun gelecek davranışların uyumunun sağlanmasına çalışılır (Polat, 2003)

Bir örgütte dramatik krizin yaşanması, lider/ yönetici değişikliğinin olması, örgütün zayıf kültüre sahip olması ve örgütün genç ve küçük olması örgütsel değişimi kolaylaştırabilmekte (Robbins, 1993) iken, örgütün güçlü kültüre sahip olması, örgütte birden çok kültürün var olması, kültür değişiminin arzu edildiği katmanın derin olması durumunda, kültür değişim süreci zor ve zaman alıcı olabilmektedir (Polat, 2003, Terzi, 2000).

## Kültürel Değişimde Yöneticinin Rolü

Örgüt kültürü, bir organizasyonda yer alan bireylerin iletişim ve etkileşimi ile oluşmakta ve şekillenmektedir (Greenberg, 2002, Şişman, 2002). Bu sürece birçok faktör etki etmekle birlikte, örgütsel-yönetimsel uygulama ve kararlar, yöneticilerin bir takım konularda benimsedikleri temel değer ve inançlar üzerine kurulduğundan yöneticilerin rolü daha baskındır. Özellikle kurucuların başlangıç dönemlerinde işe aldığı yöneticiler, örgüt kültürünün oluşması ve şekillenmesinde önemli bir etkiye sahiptir (Erkmen, Ordun, 2001, Örcü, Ayhan, 2001). Yöneticiler, örgüte personel seçerken, bazı kültürel ölçütleri göz önünde bulundurabilmekte, örgütsel sosyalleşmeyi gerçekleştirmek amacıyla düzenlenecek eğitim etkinliklerinde benimsenen değerleri vurgulayıp güçlendirebilmektedir. Yöneticinin yenilik ve risk yanlısı olup-olmaması, yeni görüş ve önerileri destekleyip-desteklememesi, ödül-ceza uygulamaları, kriz anındaki tavırları vb. etkenler, örgüt kültürünün oluşumu ve biçimini etkilemektedir (Erdem, İşbaşı, 2001, Hofstede ve ark., 1990).

Örgütlerde başta tepe yöneticiler olmak üzere, her kademedeki yöneticilerin önemli görevlerinden biri örgüt kültürünü yönetmektir (Terzi, 2000, Öztürk, 2012). Kültürel değişimin yönetimiyle uğraşmak için yöneticilerin/liderlerin istekli olmaları, çatışmaları yönetebilmeleri ve ortaya çıkacak sonuçlardan tarafların memnun olmayacaklarını, bazı değerli çalışanların işten ayrılacaklarını bazılarının ise teşvik edilebileceğini bilmeleri gerekir (Dyer, 1988). Bununla birlikte, yöneticiler kültürel değişimin başarısının buldukları örgütün kültürel özelliklerini iyi bilmesine ve sahip oldukları bilgi ve beceriye bağlı olarak mümkün olabileceğinin farkında olmalıdır. Ayrıca, kültür değişiminde güçlü liderliğe ihtiyaç olduğu, bu liderlik olmaksızın değişim sürecinin son derece zor olacağı bilinmelidir (Brubakk, Wilkinson, 1996, Argon, Özçelik, 2008, Öztürk, 2012)

Başarılı bir kültürel değişim için kültürel değişimi tasarlamadan önce “kültürel değişime neden ihtiyaç duyulmaktadır?”, “yeni kültürün şekli ne olacaktır?” ve “değişim stratejileri kimin tarafından ve nasıl kontrol edilecektir?” soruları yöneticiler tarafından cevaplandırılmalıdır (Brubakk, Wilkinson, 1996, Terzi 2000). Kültürel değişim ihtiyacını ifade edebilmek için kültürel ölçümlerin kullanılması, mevcut ve arzulan durumun değerlendirilmesine katkı sağlayacaktır (Awal ve ark., 2006). Değişim sürecinde yöneticilerin davranışları ile olumlu rol modelleri olması, yeni semboller ve hikayeler yaratması, eski ritüeller yerine başka ritüelleri yerleştirilmesi, sosyalizasyon sürecini değiştirerek yeni değerlere yer vermesi, yeni değerlerin kabulünü kolaylaştırmak için ödül sistemlerini değiştirmesi, yazılı olmayan normlar yerine yeni kurallar ve yöntemler geliştirmesi ve güçlü bir şekilde uygulaması değişimi güçlendirecektir (Terzi 2000). Ayrıca çalışanların değişime karşı dirençlerini azaltmak ve katılımlarını artırmak için bilgi ve konsensus sağlama, olumlu davranışları güçlendirme ve ölçümlere ilişkin mesajları kullanma stratejilerinin kullanılması yararlı olacaktır (Brubakk, Wilkinson, 1996)

## Sonuç

Örgüt kültürünün değişiminde yöneticiler kilit role sahip kişilerdir. Yöneticilerin, kurumlarındaki değişim politikasını çok iyi belirlemesi, kurum içi ve kurum dışı karşılaşılabilecekleri kültürel, sosyal, ekonomik engelleri önceden kestirebilmesi ve gerekli önlemleri alabilmesi kurumsal etkililik ve başarı için büyük önem taşımaktadır.

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# PERFORMANCE ANALYSIS OF GAS TURBINE ENGINES USING VARIOUS GREENING TECHNOLOGIES FOR INLET AIR COOLING

Yousef S.H. Najjar, Mechanical Engineering Department-Jordan University of Science and Technology-Irbid-Jordan,

Email [ysnajjar@just.edu.jo](mailto:ysnajjar@just.edu.jo)

Yazan M.A. Al-Zoghool, Korea Southern Power Co., Ltd./ Jordan L.L.C.

**Abstract:** This paper studies the different greening techniques of inlet air cooling and compares their effects on performance especially power, efficiency, fuel consumption and condensable water. A comparison between three air cooling techniques, namely mechanical chillers, evaporative cooling and fogging systems was performed on a gas turbine. The performance characteristics were examined for a set of design and operational variables including ambient temperature, relative humidity, compressor pressure ratio and turbine inlet temperature. Calculations were made and graphs were drawn using Microsoft Excel.

The analysis showed that the evaporative cooling enhanced the power by up to 8.7% and efficiency by up to 3.3%.

On the other hand the fogging system enhanced the power by up to 9.5% and the efficiency by up to 3.5%.

The mechanical chiller reduced the temperature by 20 to 45 °C; enhancing the net power by 7 to 24.3% and improving the efficiency by 2.4 to 18.8%.

**Keywords:** Gas turbines, Greening technologies, Inlet air cooling, Performance improvement.

## Nomenclature

### Symbols

|                 |  |         |
|-----------------|--|---------|
| $C_{pa}$        | air specific heat at constant pressure                               | kJ/kg K |
| $C_{pg}$        | flue gases specific heat at constant pressure                        | kJ/kg K |
| COP             | coefficient of performance of chiller                                |         |
| $f$             | fuel-air ratio   |         |
| GT              | gas turbine  |         |
| $h_{fg}$        | specific enthalpy of vaporization                                    | kJ/kg   |
| $h_g$           | specific enthalpy of saturated vapor                                 | kJ/kg   |
| $h_{ref}$       | enthalpy of refrigerant around the cycle (point 1: compressor inlet) |         |
| IAC             | inlet air cooling  |         |
| $m_a$           | mass flow rate of air  | kg/s    |
| $m_f$           | mass flow rate of fuel   | kg/s    |
| $m_{ref}$       | mass flow rate of refrigerant  | kg/s    |
| $m_w$           | mass flow rate of water vapor  | kg/s    |
| $m_{tot}$       | total mass flow rate   | kg/s    |
| $m_w$           | mass flow rate of water  | kg/s    |
| $MM_f$          | molar mass of fuel   | g/mol   |
| $P_0$           | stagnation pressure  | Pa      |
| $\square_{net}$ | net power output   | kW      |
| $Q$             | heat load on the chiller cooling coil                                | kW      |
| $r_c$           | total compression ratio  |         |
| $r_t$           | total turbine pressure ratio   |         |
| SFC             | specific fuel consumption  | kg/kJ   |
| $T_a$           | ambient temperature  | K       |
| $T_{db}$        | dry-bulb temperature   | K       |
| TIT             | turbine inlet temperature  | K       |
| $T_{wb}$        | wet-bulb temperature   | K       |

|       |  |       |
|-------|--|-------|
| $T_0$ | stagnation temperature                     | K     |
| VAR   | vapor absorption cooling                   |       |
| VCR   | vapor Compression cooling                  |       |
| $w_c$ | specific compressor work                   | kJ/kg |
| $w_t$ | specific turbine work                      | kJ/kg |
| $w_n$ | net specific work                          | kJ/kg |
| W     | power consumed by the chiller cooling coil | kW    |

### Greek Letters

|              |                                   |                                  |
|--------------|-----------------------------------|----------------------------------|
| $\Delta h_f$ | enthalpy of combustion            | kJ/kg <sub>f</sub>               |
| $\eta_c$     | combustion efficiency             |                                  |
| $\eta_{c,p}$ | compressor polytropic efficiency  |                                  |
| $\eta_{t,p}$ | turbine polytropic efficiency     |                                  |
| $\eta_{th}$  | thermal efficiency                |                                  |
| $\omega$     | humidity ratio                    | kg <sub>w</sub> /kg <sub>a</sub> |
| $\phi$       | relative humidity                 |                                  |
| $\gamma_a$   | specific heat ratio of air        |                                  |
| $\gamma_g$   | specific heat ratio of flue gases |                                  |

### Subscripts

|     |                |
|-----|----------------|
| 0   | stagnation     |
| a   | air or ambient |
| c   | compressor     |
| f   | fuel           |
| g   | flue gases     |
| m   | mechanical     |
| n   | net            |
| t   | turbine        |
| th  | thermal        |
| tot | total          |
| v   | vapor          |
| w   | water          |

### Introduction

A major drawback of the gas turbine engine is its low efficiency especially at part load (hence higher fuel usage); forcing the use of different techniques to increase its efficiency using inexpensive greening technologies.

Many research works were done on boosting the net output and the overall efficiency. The main aims were to have gas turbines with high efficiency, low emissions and high availability.

Gas turbine inlet air cooling IAC has always been suggested to increase performance of simple and combined cycles especially in hot day operation.

The main factors that play a great role in maximization of gas turbine power output and overall efficiency are:

1. Inlet air cooling technology
2. Gas turbine design
3. Ambient air conditions.

These factors had led to a variety of green cooling techniques; some of them are [1]:

- 1- **Wetted media:** this method is highly sensitive to relative humidity. In low humidity areas, the evaporative cooling can boost power output by up to 15%, while in high humidity areas the increase is more likely to be under 10%, approaching zero at the point of saturation (100% relative humidity).

- 2- **Fogging:** droplets of water in various sizes, depending on inlet air temperature and humidity conditions, are sprayed into the warm inlet air stream where the droplets evaporate to cool the air. This method is similar to wetted media systems, but it is a bit more effective.
- 3- **Wet compression:** more fogging is added than can be evaporated in the inlet (sometimes referred to as high fogging or overspray). The excess water fog is carried over by the air stream and evaporates for compressor inlet-cooling and mass flow enhancement. This method can boost power output by 25% independent of ambient temperature conditions.
- 4- **Chilling:** ambient intake air is cooled by chilled fluid circulating through cooling coils. In this method, electrically driven mechanical chillers or absorption chillers may be used. Also this method is not limited by humidity and can lead to more than 25% increase in power output. However, it consumes relatively high power.

Alhazmy and Najjar [4] presented an analysis that showed real benefits of inlet air cooling, however the net power generated drops when chillers are used.

Hurlbert [5] pointed that the gas turbine output depends significantly on ambient temperature which impacts every gas turbine, some more than others, in the range of 10-40% of the rated output capacity. He also added that the total impact over the global installed base of gas turbines equated to tens of thousands of megawatts and called it “the biggest miss in the history of power generation”.

John Kraft [6] mentioned that chillers could be thought of as a virtual peakers. But he also mentioned that water use maybe an issue in some areas, particularly if a chiller package with wet cooling is specified and air-cooled condensers might not work financially.

Punwani, et al. [7] presented an analysis performed for a 316.8 MW cogeneration plant showing the effect of cooling technology on the net power capacity enhancement.

Dos Santos et al [8] presented a numerical simulation of a single shaft gas turbine utilizing two different inlet cooling techniques with evaporative cooling resulting in less improvement than absorption chilling

Jaber, and Khawaldah [9] performed a computer simulation model for a power plant in Jordan, using evaporative and cooling coil system.

They concluded that cooling coil gives a full control of the compressor inlet conditions regardless of ambient conditions; however, it demands a quite large operational power.

Chaker et al. [10] presented a detailed climatic analysis for 122 locations in the US to provide the hours of cooling that can be obtained by direct evaporative cooling. Hosseini et al [11] presented a model for a media evaporative cooling system installed with the gas turbines of combined cycle power plant (Iran). They mentioned that the payback period obtained is about four years.

Ibrahim, Rahman and Abdalla [12] reviewed three inlet air cooling techniques including the mechanical chillers, media type evaporative coolers and absorption chillers. They concluded that the success of evaporative cooling in reducing the high air temperature depends on relative humidity of the ambient air. The absorption cooling technique produced higher gain in power and efficiency than evaporative cooling.

Al- Ibrahim and Varnham [13] made an extensive review related to Saudi Electric Company. The preferred option is refrigeration cooling with chilled water or ice thermal storage. This requires a smaller storage volume compared this o chilled water.

Al-Tobi [14] presented the performance of two gas turbines; single shaft engine and two shafts engine, when two methods of inlet cooling are applied to them. These two methods are vapor compression refrigeration VCR and vapor absorption refrigeration VAR. The simulation results obtained using the VCR system showed a 27% increase in output power for the single shaft engine and about 20% increase in power for the two- shaft engine at an ambient temperature of 50 °C. Both methods of cooling were technically feasible.

The objectives of this work are to study the different techniques of inlet air cooling and compare their effects on performance especially power, efficiency, fuel consumption and water recovery. So this study is a follow-up of the work previously performed by Alhazmy and Najjar [4] but with some modifications, namely:

- 1- Using more realistic TIT.
- 2- Extending the study to cover three methods of IAC; mechanical chillers, evaporative cooling and fogging.
- 3- Using more accurate equations to calculate the compressor and turbine efficiency of the gas turbine.
- 4- Using a variable speed refrigeration compressor instead of a constant COP<sub>R</sub> compressor.

## 2. Theoretical Analysis

### 2.1 Assumptions:

- Mechanical chillers having a variable cooling capacity that can reduce the inlet air temperature to 5 °C even at extremely high ambient temperature (50 °C) [15].
- Wet-bulb temperature is kept constant when cooling the inlet air using evaporative cooling or fogging techniques.
- Evaporative cooling technique (wetted media) can cool the inlet air to around 90% of the difference between ambient dry-bulb and wet-bulb temperatures [1].
- Fogging can cool inlet air to around 97% of the difference between ambient dry-bulb and wet-bulb temperatures [1].
- Compressor inlet pressure  $P_{o1}$  is equal to 0.1 M Pa.
- Combustion chamber pressure loss is assumed to be 2% of  $P_{o2}$  and the GT exhaust pressure is assumed to be 1.02 bar [16].
- Diesel fuel is used in the combustion process. It is assumed to have a fixed formula of  $C_{12}H_{23}$ , with enthalpy of combustion value of 42,000 kJ/kg<sub>f</sub>.
- Complete combustion with no CO in the reaction products.
- For Mechanical chillers a variable speed compressor with 134a refrigerant was used.
- Fogging system consumes 10 kW of electricity to cool 300,000 cfm (141 m<sup>3</sup>/s) of air by 10 °F (5.6 °C) [3].
- Evaporative cooling technique is assumed to have negligible pumping cost.

### 2.2 Gas turbine cycle analysis:

Following the notations of Çengel and Boles [17] the values were obtained using the following equations:

$\omega_1$  (the humidity ratio after the cooler) was obtained using psychrometric calculator [18] and can be also calculated using:

$$\omega_1 = \frac{P_{g1} \omega_2}{P_{o1} - P_{g1} \omega_2} \quad (1)$$

Where  $P_{o1}$  is the ambient pressure at the intake and  $P_{g1}$  the saturation pressure of water at the intake temperature.

The cooling load (Q) is:

$$\dot{Q} = \dot{m}_a c_p (T_{o1} - T_{o2}) = \dot{m}_a (h_{o1} - h_{o2}) \quad (2)$$

The power needed to operate the refrigeration machine is estimated from the following relation:

$$\dot{W}_{ref} = \dot{m}_a (h_{o1} - h_{o2}) = \frac{\dot{Q}}{COP_R} \quad (3)$$

The air pressure at the compressor exit can be calculated as:

$$P_{o2} = P_{o1} \times P_{r2} \quad (4)$$

Where,  $P_{o1}$  and  $P_{o2}$  are the total pressures of moist air at the compressor inlet and exit, respectively.

The air temperature at the compressor exit  $T_{o2}$  can be evaluated using the following equation:

$$T_{o2} = T_{o1} \left[ \frac{P_{o2}}{P_{o1}} \right]^{\frac{\gamma-1}{\gamma}} \quad (5)$$

Where,  $[(p - 1)/\gamma]_c = [(p - 1)/\gamma_{\infty}]_c$ , and

$$\gamma_{\infty} = \gamma - \left[ \gamma \cdot \gamma + \left[ \frac{(\gamma - 1)}{\gamma} \right] \right] \quad (6)$$

Where,  $\gamma_a$  is the air specific heat ratio,  $\gamma_{\infty}$  is the compressor polytropic efficiency and can be evaluated using the relations suggested by Korakianitis and Wilson [19], and used by Alhazmy and Najjar [4].

The adiabatic specific compression work  $w_c$  per unit mass of air:

$$w_c = \gamma_{\infty} (p_{02} - p_{01}) + \gamma_{\infty} (p_{02} - p_{01}) \quad (7)$$

The energy balance for the combustor is:

$$m_a h_{a,03} + m_f h_{f,03} + m_o h_{o,03} = m_a h_{a,04} + m_o h_{o,04} \quad (8)$$

$$m_a (h_{a,03} - h_{a,04}) + m_f \Delta h_{f,03} = m_a (h_{a,04} - h_{a,03}) + (m_a + m_f) \times C_{pg} \times (T_{04} - T_{03}) \quad (9)$$

Where,  $C_{pg}$  is the specific heat of the flue gas at constant pressure,  $f$  is the fuel to air ratio defined as  $f = m_f / m_a$  and  $\Delta h_{f,03}$  is the enthalpy of combustion of fuel.

Rearranging the variables:

$$\eta_c = \left[ \frac{m_a (h_{a,03} - h_{a,04}) + m_f \Delta h_{f,03} - m_o (h_{o,03} - h_{o,04})}{m_a (h_{a,04} - h_{a,03})} \right] / \gamma_{\infty} \quad (10)$$

Where  $\eta_c$  is the combustion efficiency and it is assumed to be 0.98.

The temperature of the gas leaving the turbine is derived from:

$$T_{04} = T_{03} \left[ \left( \frac{p_{04}}{p_{03}} \right)^{(\gamma - 1)/\gamma} \right] \quad (11)$$

Where  $[(p - 1)/\gamma]_t = \gamma_{\infty} [(p - 1)/\gamma]_t$ , and

$$\gamma_{\infty} = \gamma - \left[ \gamma \cdot \gamma + \left[ \frac{(\gamma - 1)}{\gamma} \right] \right] \quad (12)$$

Where  $\gamma_{\infty}$  is the polytropic efficiency of the turbine and it was estimated using the relation given by Korakianitis and Wilson [19].

The adiabatic specific power of the turbine is:

$$w_t = (m_a + m_f + m_o) \times [\gamma_{\infty} (T_{04} - T_{03})] \quad (13)$$

Hence, the net specific power obtained from the gas turbine engine is:

$$w_{net} = w_t - w_c - w_{compressor} - w_{generator} \quad (14)$$

The thermal efficiency is:

$$\eta_{th} = \frac{w_{net}}{w_{fuel}} \quad (15)$$

The net power output is then:

$$P_{net} = w_{net} \times \dot{m}_a \quad (16)$$

Hence, the specific fuel consumption SFC is:

$$SFC = \frac{\dot{m}_f}{P_{net}} = \frac{(\dot{m}_f \times 1000)}{P_{net}} \quad (17)$$

The knowledge of the mole fraction of water vapour and the total pressure are sufficient to evaluate the amount of water vapor in the exhaust gas as follows [4]:

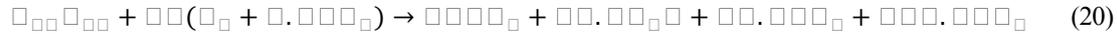
$$n_{H_2O} = n_{C_{12}H_{23}} \left[ \frac{n_{H_2O} \times n_{C_{12}H_{23}}}{n_{C_{12}H_{23}}} \right] \quad (18)$$

Where, 18 is the molar mass of H<sub>2</sub>O and 167 is the molar mass of C<sub>12</sub>H<sub>23</sub>.

The complete combustion equation of 1 mole of diesel fuel:



But with a 400% excess air, which is usually the case for gas turbines, the combustion equation becomes:



To find the condensable amount of water vapor as the products were cooled to 25 °C at 100 kPa .

$$\frac{n_{H_2O} - P_v}{P_{atm} - P_v} = \frac{n_{H_2O}}{P_{atm}} \quad (21)$$

Where,  $\alpha$  is the number of moles of water coming from moisture and combustion process and it is equal to ( $N_{v,air} + 11.5$ ),  $N_w$  is the number of kmol of H<sub>2</sub>O condensable,  $N_{prod,f}$  is the number of kmol of products formed and is equal to ( $N_{v,air} + 11.5 + 12 + 53.25 + 266.96$ ),  $P_v$  is the saturation pressure of water at 25 °C and  $P_{atm}$  is the atmospheric pressure.

Finally, we can estimate the total component cost of the gas turbine in US dollars (\$) using the following equation [20]:

$$C_{GT} = \{ -C_{GT} \times n_{H_2O} + C_{H_2O} \} \times n_{H_2O} \quad (22)$$

Where,  $C_{GT}$  is the total component cost of a gas turbine in US dollars (\$).

### Results

The gas turbine specifications as ISO rating were obtained from “Gas Turbine World” manual [22 - 23] ( $T_a = 15^\circ C$ ,  $\Phi = 60\%$  and  $P_a$  at sea level). Taking pressure ratio  $r_c$  equal to 12 and exhaust temperature  $T_{04}$  equal to 448 °C then the turbine inlet temperature TIT is calculated to be equal to 1050 °C and to be used in the design point calculations.

The design point conditions are chosen to meet extreme operating conditions, namely:

$$T_a = 45^\circ C, \Phi_a = 80\%, T_{03} = 1050^\circ C, r_c = 12$$

In comparison between the effects of the three cooling techniques, the performance of the gas turbine power plant is examined as shown in Table (1) .

The design point is fixed at the ambient conditions of 45 °C, 80% relative humidity,  $T_{03} = 1050^\circ C$  and pressure ratio of 12 (nearest to GE LM600 PD). The off -design points are selected in the vicinity of these values as listed in Table (1). Figs (5-14) show the performance characteristics resulting from the systematic change of one design variable and keeping the rest fixed at the design point conditions.

## 3. Discussion of Results

### Evaporative Cooling and Fogging

The net power output increases when using evaporative cooling or fogging systems because they increase the density of air by reducing its temperature and increasing its moisture content. The temperature drop across evaporative cooling and fogging systems become very small when the ambient air as high humidity and may reach zero if the incoming air is saturated.

The power output improves as the relative humidity decreases for evaporative cooling and fogging systems, because as the relative humidity decreases, the amount of moisture that can be added to the system increases, hence greater temperature drop.

### Vapor Compression Cooling

Mechanical chillers are independent of the ambient conditions and can increase the power output, however, the power needed to operate the chiller must be considered.

### Collectable Condensable Water

The mass of condensable water increases with the ambient temperature for all cooling configurations. This is because the mass of water vapor contained originally within the ambient air increases with temperature for the same relative humidity level.

Increasing the ambient relative humidity increases the mass of condensable water.

Also increasing the turbine inlet temperature means more fuel should be burned and more water vapor may be expected in the flue gases due to combustion of hydrocarbon fuels. On the other hand, increasing the pressure ratio leads to less fuel consumption due to the increase in the temperature of air entering the combustion chamber, hence fewer mass of water vapor in the exhaust gases.

The results were as follows:

Fig (5) shows the relative change in net power generated  $w/w_a$  from the four technologies with ambient temperature whereas other variables remain at the design point.

Similarly Fig (6) shows the relative change in the plant efficiency  $\eta/\eta_d$  with the ambient temperature for the four technologies. Similarly Figs (7-8) show the relative variation with  $\Phi$ ; Figs 9-10) show the variation with TIT; Figs.11-12) show the relative variation with  $r_c$  and Figs. (13-15) show the relative variation of relative condensable water with  $T_a$ ,  $\Phi_a$  and TIT.

The evaporative cooling technique reduces the air inlet temperature by 12 °C for hot and dry ambient conditions (45 °C and 40% relative humidity), 3.6°C for hot and humid conditions (50 °C & 80%) and also by 2.4 °C for cold and humid conditions (25 °C and 80% relative humidity).

On the other hand, the fogging system cooling technique reduces the air inlet temperature by 13 °C for hot and dry ambient conditions (45 °C and 40% relative humidity), 3.9 °C for hot and humid conditions (50 °C & 80%) and also by 2.6°C for cold and humid conditions (25 °C and 80% relative humidity).

Furthermore, the mechanical chiller cooling technique fixes the air inlet temperature to the desired value of 5 °C making a temperature drop of 20-45 °C and demanding an operational power that varies with ambient conditions.

The percentage change in the GT net power output, efficiency and specific fuel consumption were studied for three different operational conditions and are shown in Table (2).

The percentage change per 1 °C for different parameters and operating conditions was studied and shown in Table (3).

Also a comparison between traditional evaporative cooling and fog cooling is shown in Table (4):

#### 4. Conclusions

1. The performance of the gas turbines is particularly sensitive to the ambient temperature.
2. For TIT = 1050°C, 80% relative humidity and a pressure ratio near the optimum, an increase in  $T_{01}$  from 25 °C to 50°C reduces the thermal efficiency of the gas turbine cycle without an air cooler by about 18.3% and the specific output by nearly 18.4 % which emphasizes the importance of designing a gas turbine to give the required power output at the highest ambient temperature likely to be encountered.
3. Without an air cooler the net power output typically drops by about 0.7% for each °C rise in ambient temperature while the thermal efficiency drops by about 0.73% for each °C rise in ambient temperature.
4. Evaporative and fog cooling are more effective when the relative humidity of the ambient air is low; mechanical chilling is much less dependent on humidity.
5. Evaporative and fog cooling are capable of boosting the power and enhancing the efficiency of the gas turbine power plant in a way that is less expensive than mechanical chillers.
6. Providing the water needed for the operation of evaporative and fog coolers may be a challenge in some areas, however, condensing the water from the exhaust system is a method for recovering partially the make-up water for evaporative and fog coolers in dry climates.

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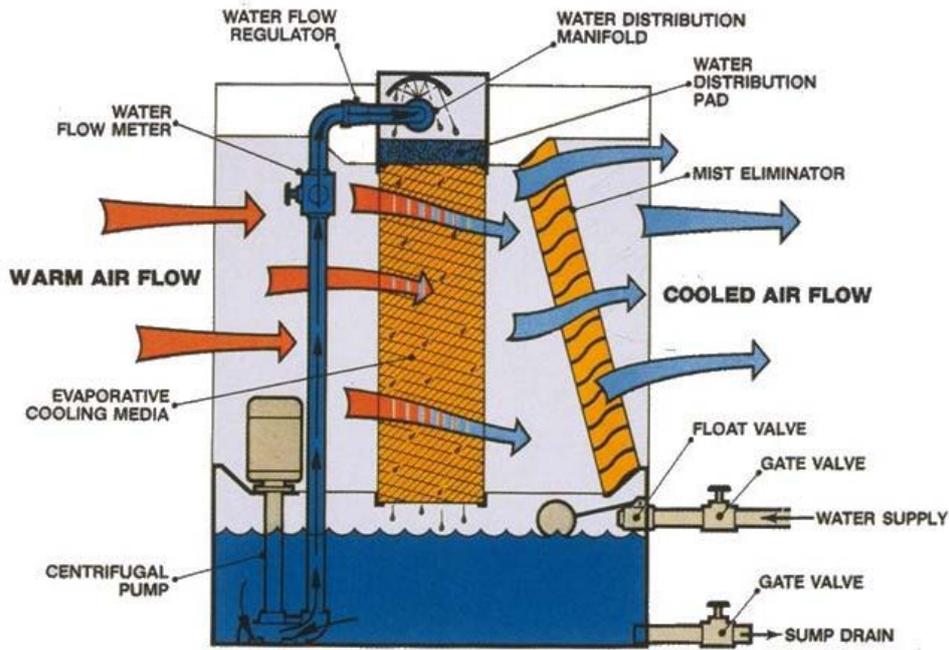


Figure (1): Wetted media (evaporative air cooling) [2].

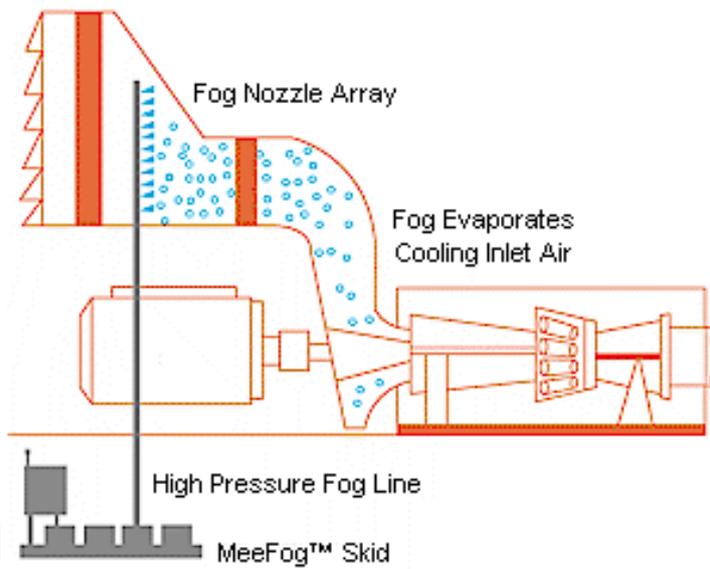


Figure (2): Fogging system air cooler [3].

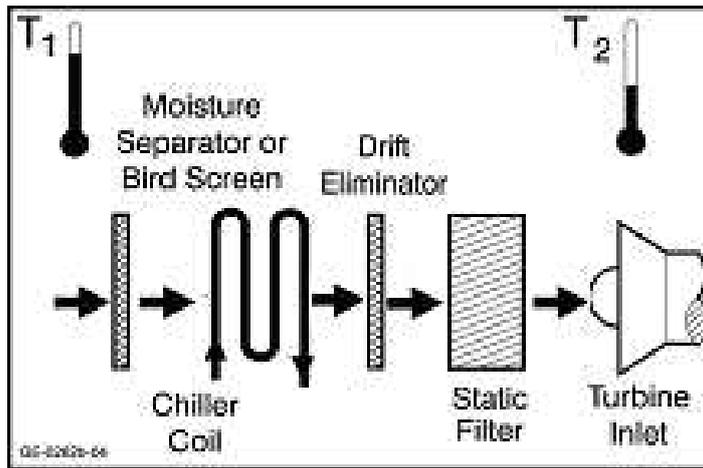


Figure (3): Inlet air chiller coil.

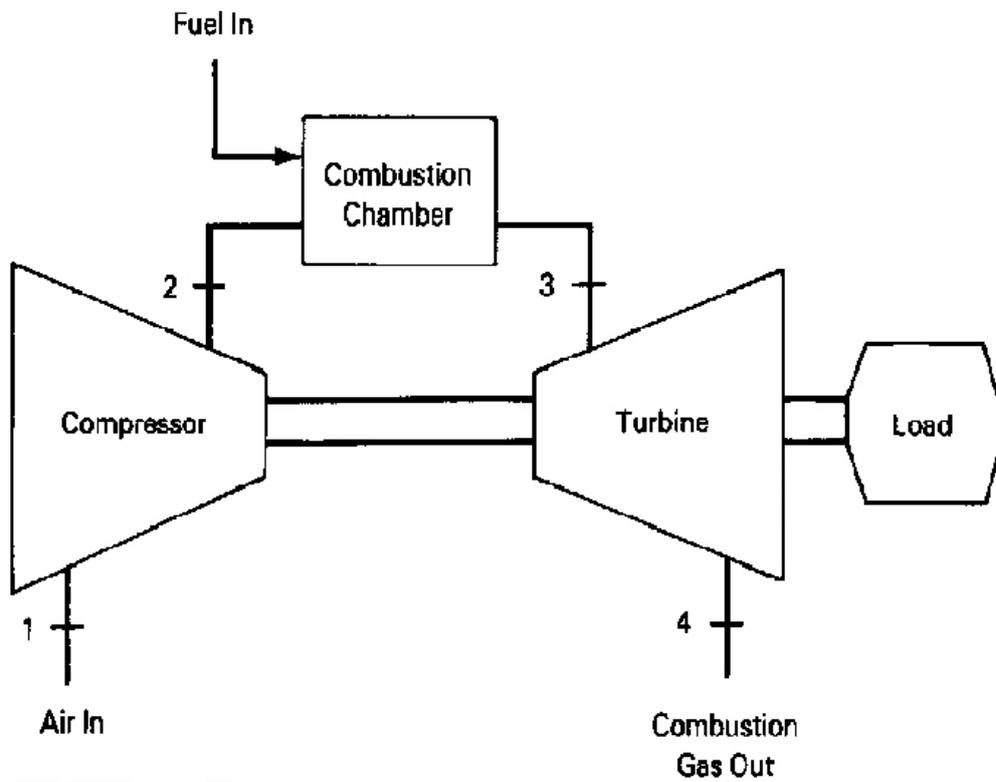


Figure (4): Gas turbine diagram

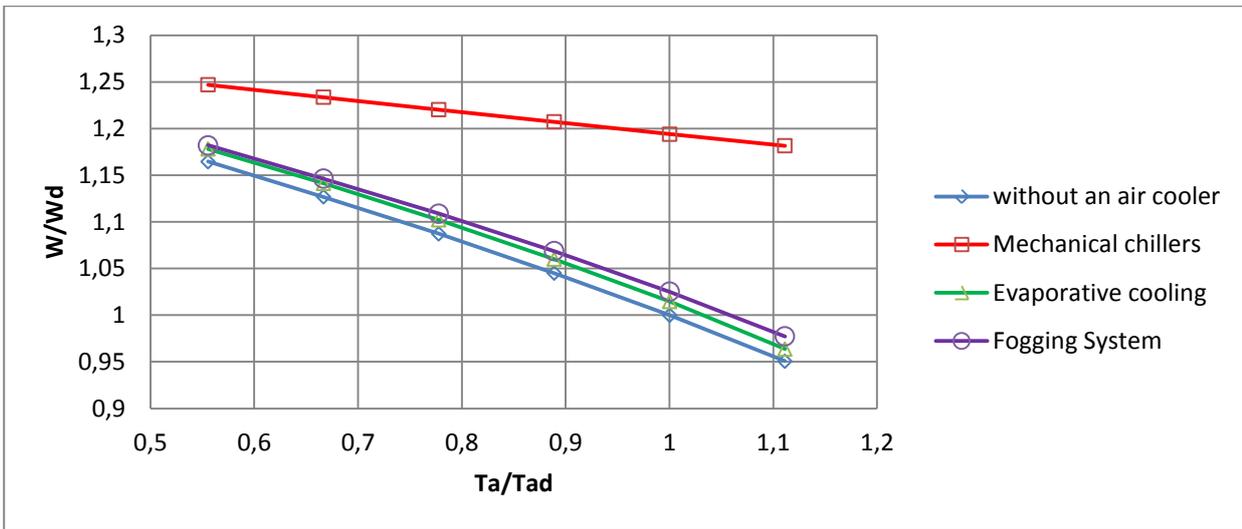


Figure (5): Relative change in power with ambient temperature.

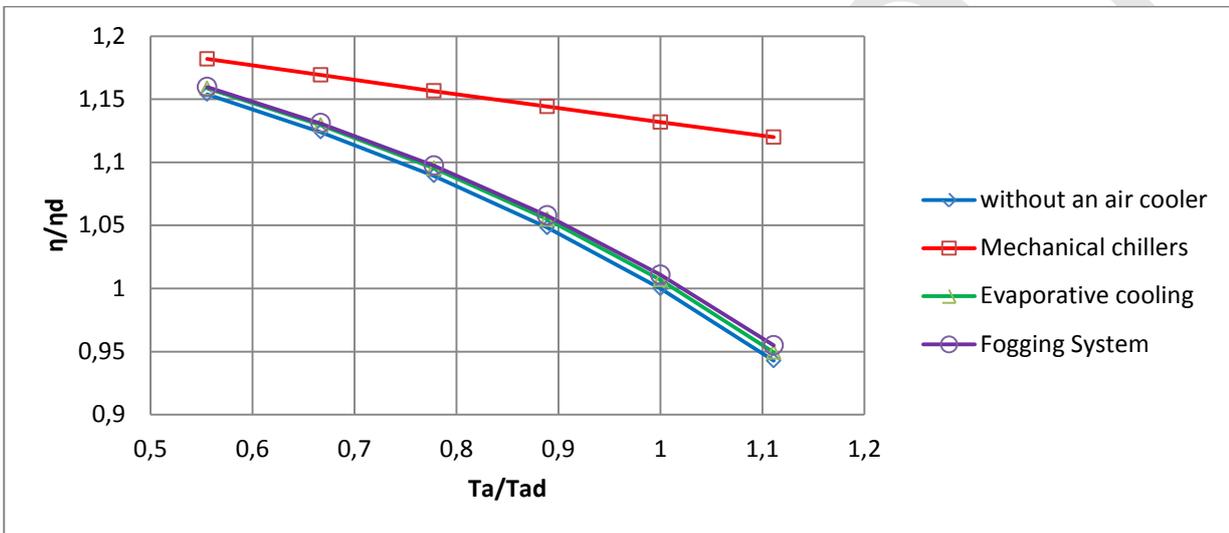


Figure (6): Relative change in efficiency with ambient temperature.

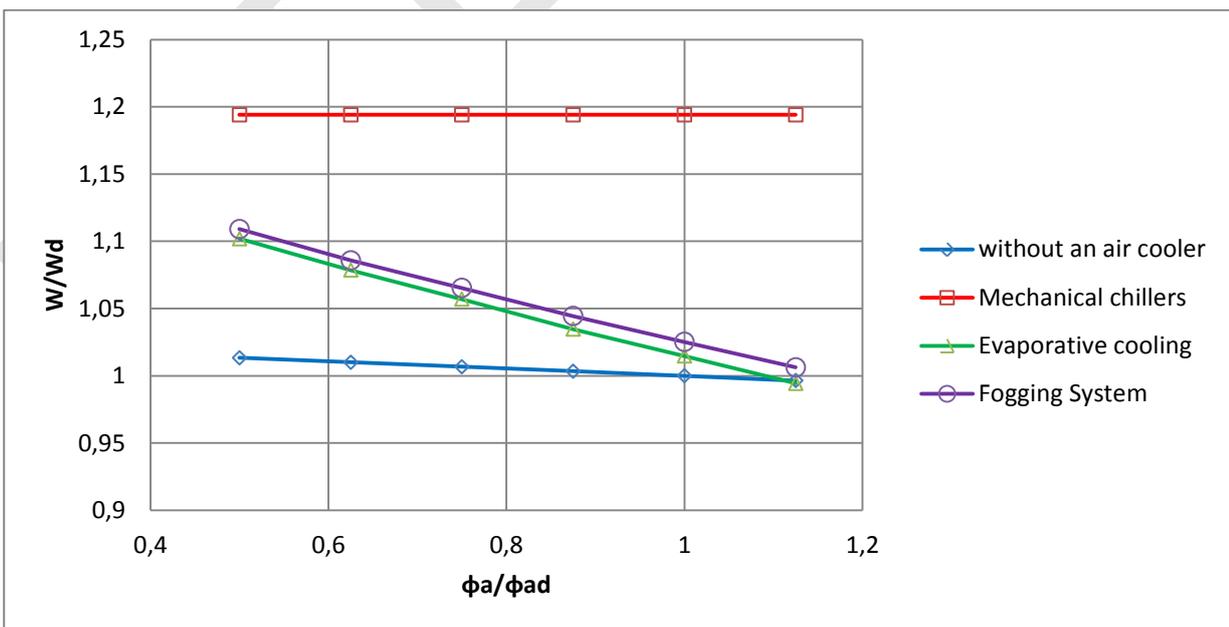


Figure (7): Relative change in power with relative humidity.

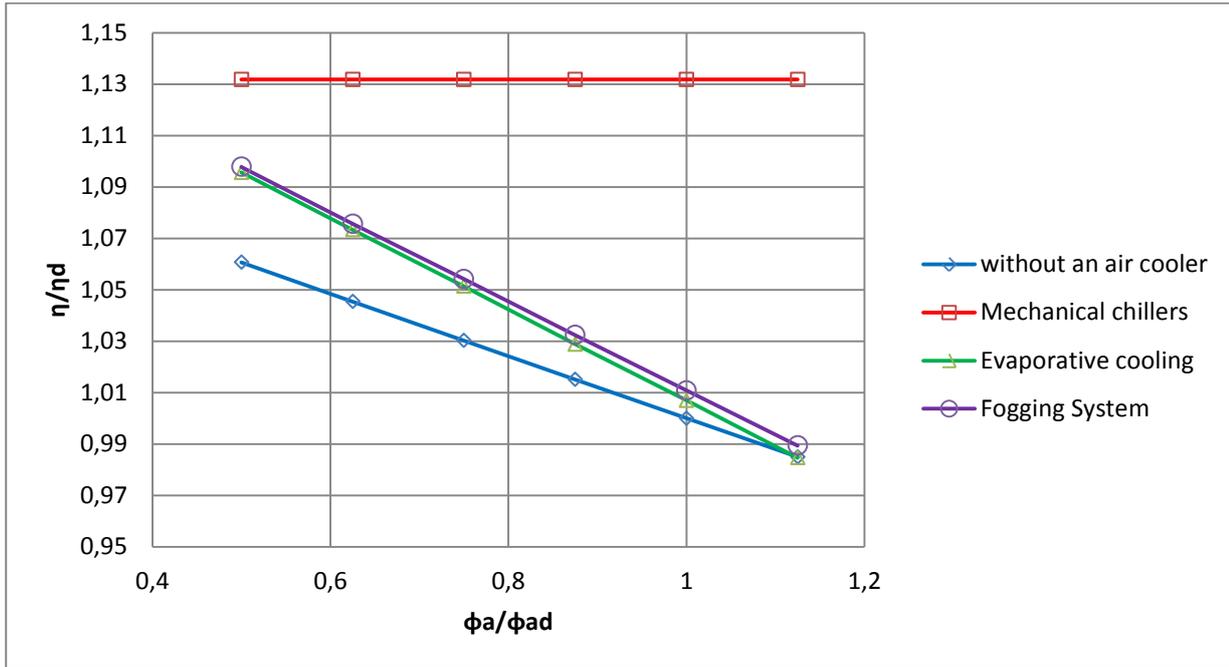


Figure (8): Relative change in efficiency with relative humidity.

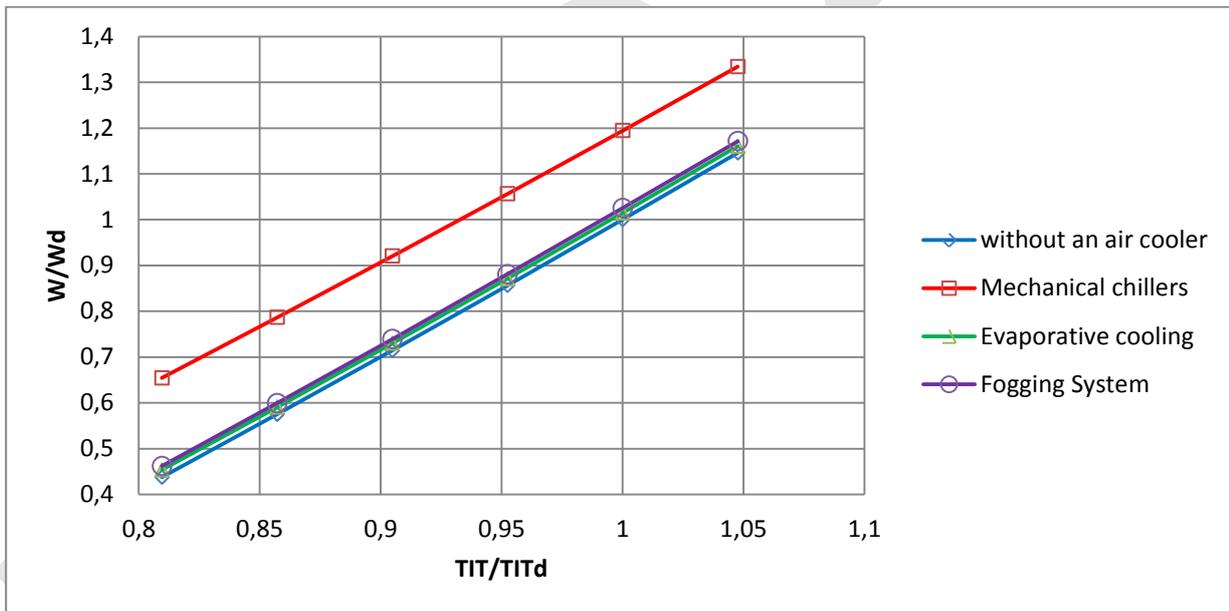


Figure (9): Relative change in power with TIT.

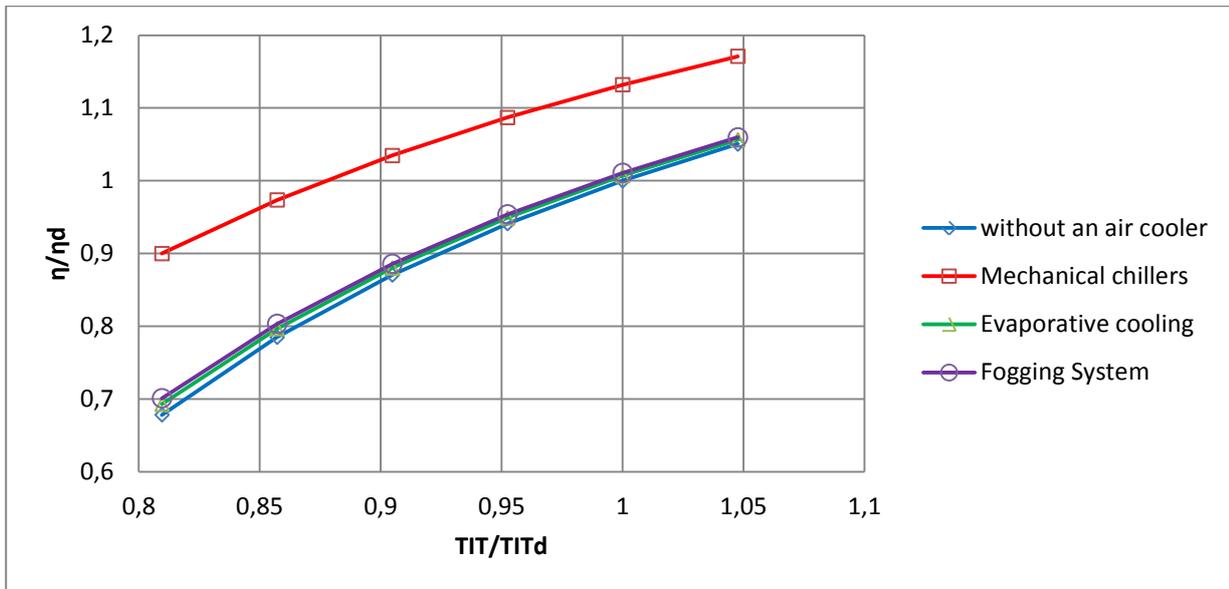
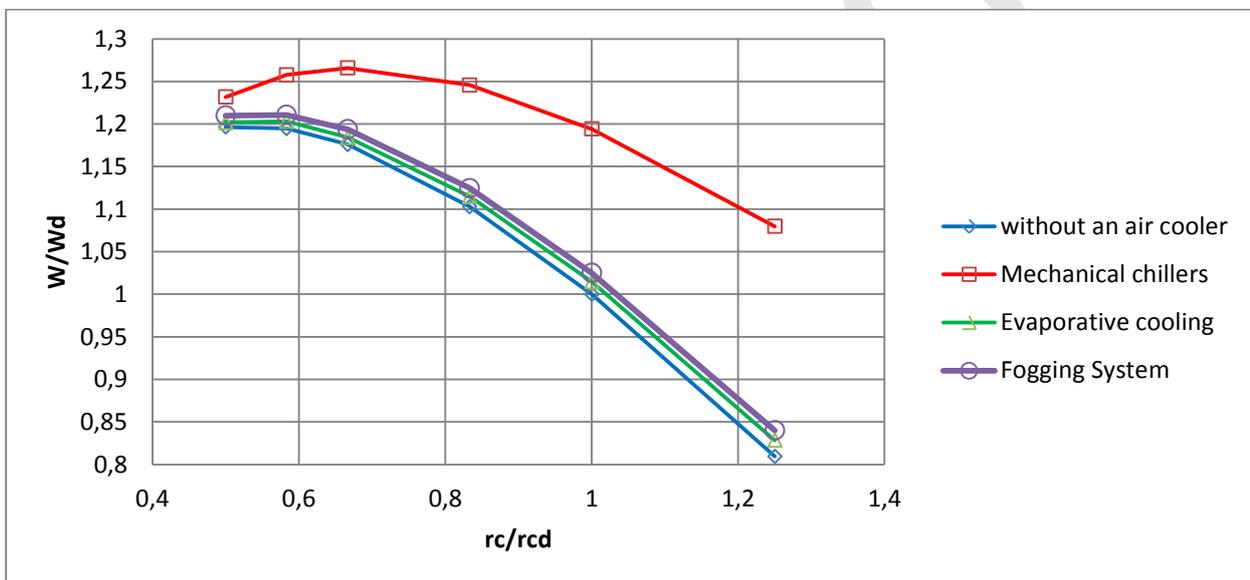


Figure (10): Relative change in efficiency with TIT.


 Figure (11): Relative change in power with the pressure ratio  $r_c$ .

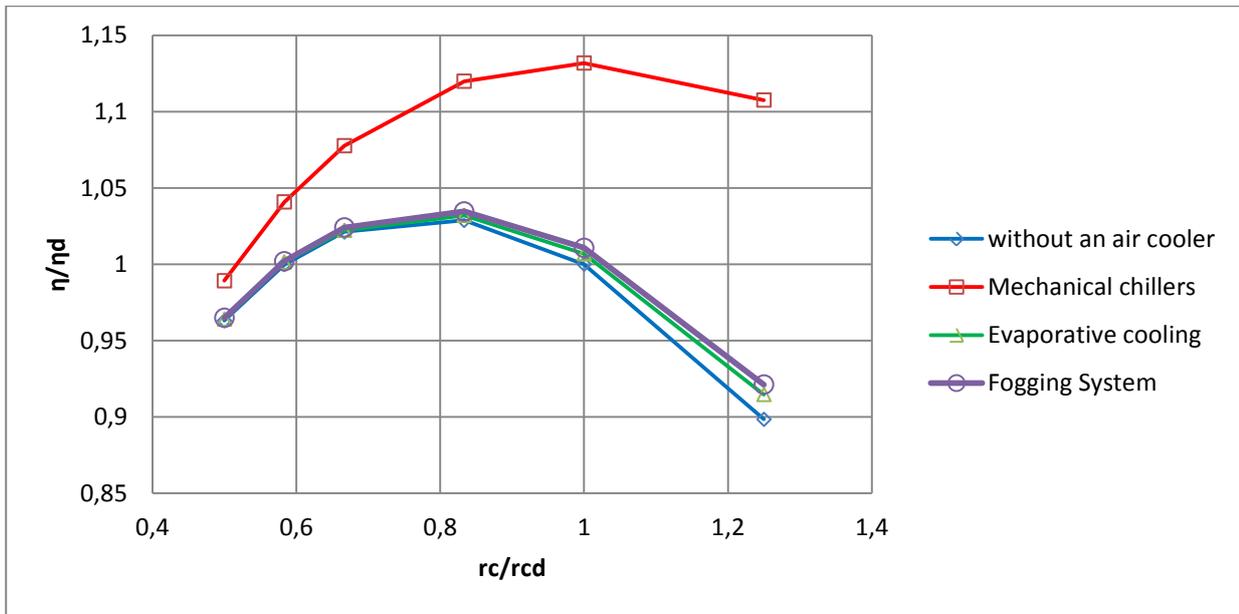


Figure (12): Relative change in efficiency with the pressure ratio  $r_c$ .

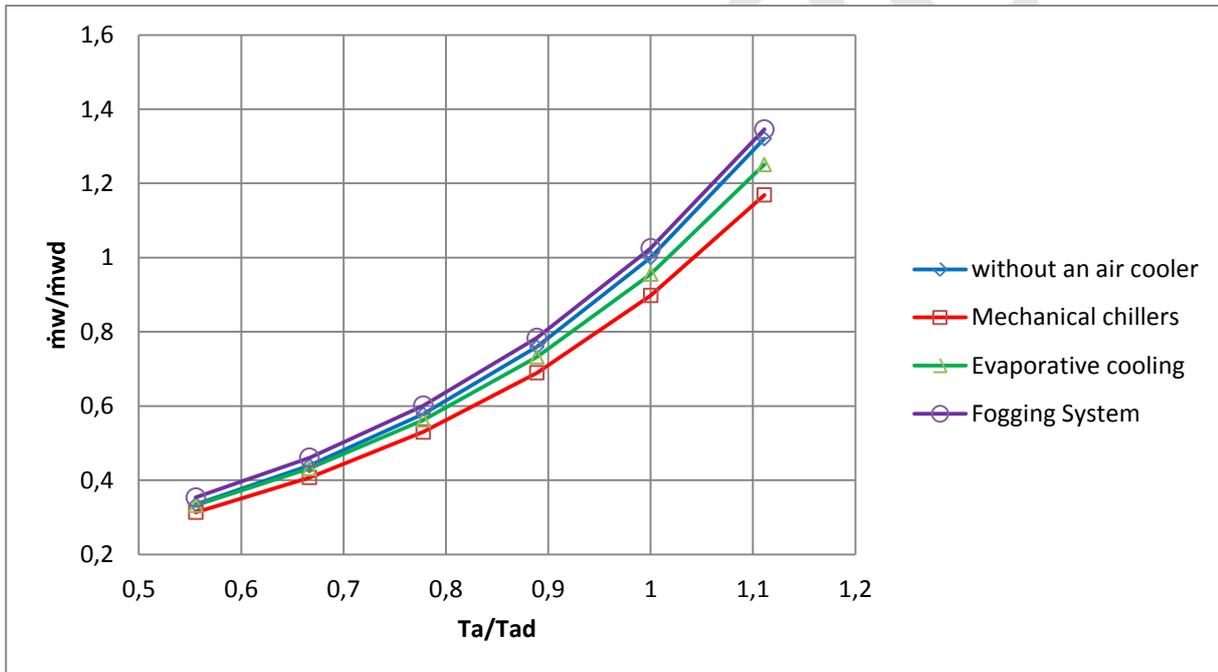


Figure (13): Relative variations of condensable mass of water with ambient temperature.

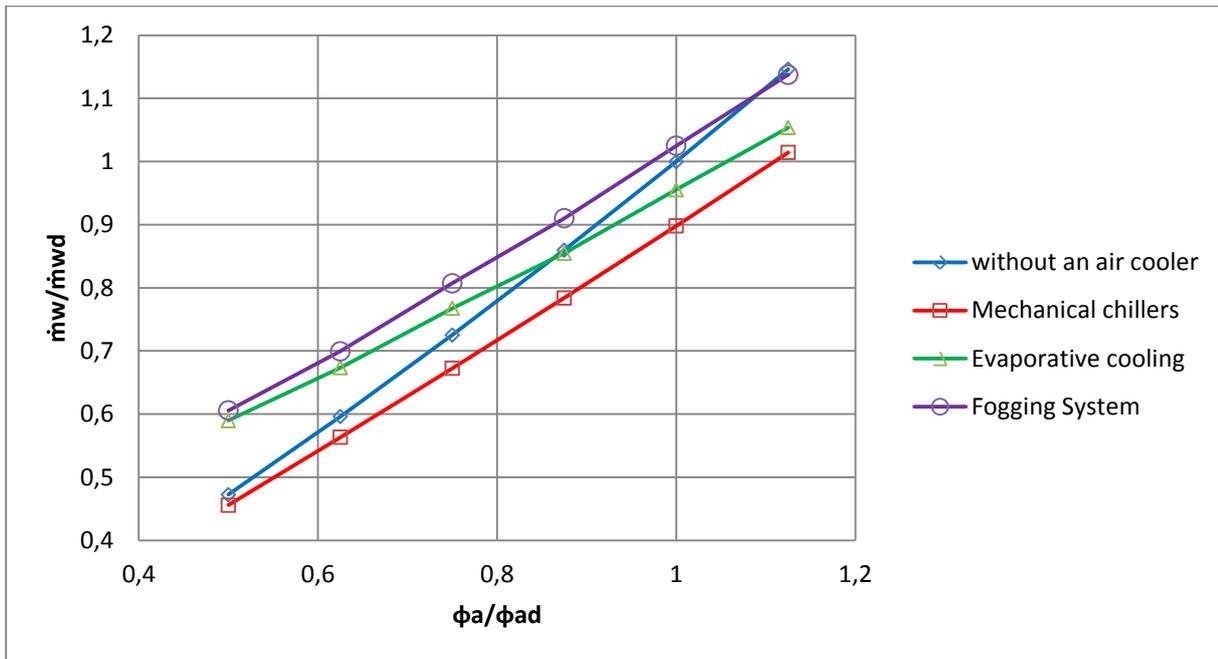


Figure (14): Relative variations of condensable mass of water with relative humidity.

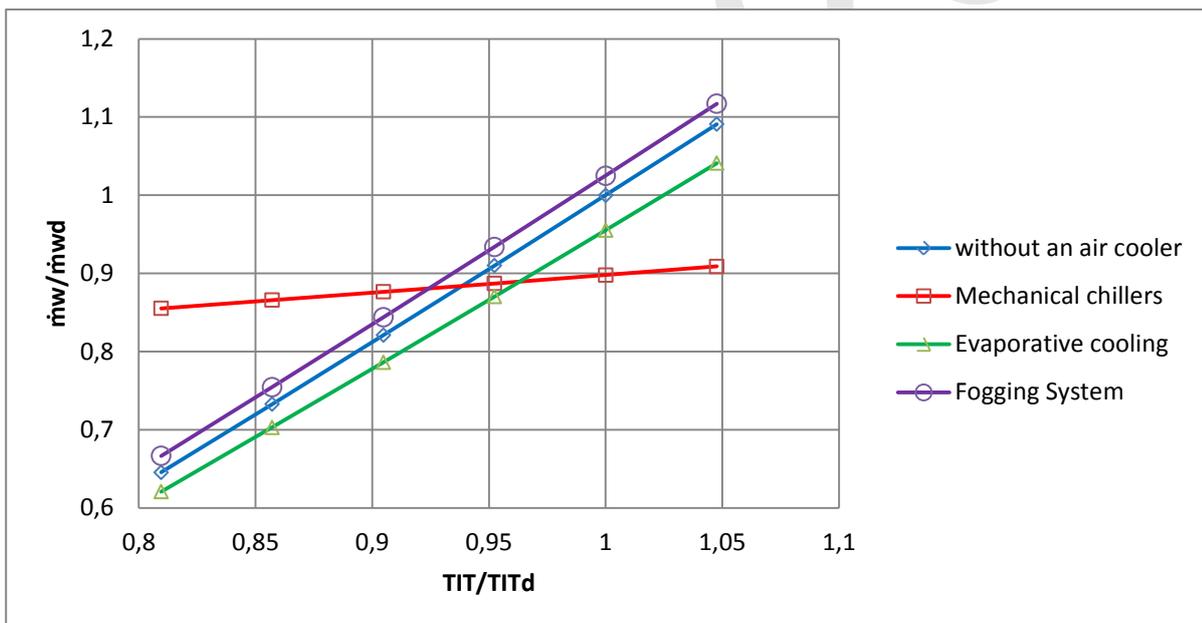


Figure (15): Relative variation of condensable mass of water with TIT.

Table (1): Design and operation variables ranges

| Parameter  | Design Point |     |     |      |      |      |
|------------|--------------|-----|-----|------|------|------|
| $T_a$ (°C) | 25           | 30  | 35  | 40   | 45   | 50   |
| $\Phi_a$   | 40%          | 50% | 60% | 70%  | 80%  | 90%  |
| TIT (°C)   | 850          | 900 | 950 | 1000 | 1050 | 1100 |
| $r_c$      | 6            | 7   | 8   | 10   | 12   | 15   |

Table (2): The percentage change in different parameters using different cooling techniques and operating conditions.

| Parameter | Cooling technique | % change at cold & humid conditions<br>(British Columbia - Canada) | % change at hot & humid conditions<br>(Jeddah - Saudi Arabia) | % change at hot & dry conditions<br>(Mecca - Saudi Arabia) |
|-----------|-------------------|--|---|--|
|           |                   |  |   |  |

|                            |                     |        |         |        |
|----------------------------|---------------------|--------|---------|--------|
| Power ( $P_{net}$ )        | Mechanical Chillers | 7.07%  | 24.27%  | 17.83% |
|                            | Evaporative cooling | 1.17%  | 1.38%   | 8.74%  |
|                            | Fogging             | 1.50%  | 2.78%   | 9.44%  |
| Efficiency ( $\eta_{th}$ ) | Mechanical Chillers | 2.43%  | 18.78%  | 6.71%  |
|                            | Evaporative cooling | 0.41%  | 0.70%   | 3.30%  |
|                            | Fogging             | 0.50%  | 1.29%   | 3.50%  |
| SFC                        | Mechanical Chillers | -2.37% | -15.81% | -6.28% |
|                            | Evaporative cooling | -0.41% | -0.70%  | -3.19% |
|                            | Fogging             | -0.49% | -1.27%  | -3.39% |

Table (3): The percentage change per °C in different parameters using different cooling techniques and operating conditions.

| Parameter                                  | Cooling technique   | % change per °C at cold & humid conditions | % change per °C at hot & humid conditions | % change per °C at hot & dry conditions |
|--|---------------------|--|---|---|
| <b>Power (<math>P_{net}</math>)</b>        | Mechanical Chillers | 0.354%                                     | 0.539%                                    | 0.446%                                  |
|  | Evaporative cooling | 0.492%                                     | 0.385%                                    | 0.726%                                  |
|  | Fogging             | 0.584%                                     | 0.720%                                    | 0.727%                                  |
| <b>Efficiency (<math>\eta_{th}</math>)</b> | Mechanical Chillers | 0.122%                                     | 0.417%                                    | 0.168%                                  |
|  | Evaporative cooling | 0.172%                                     | 0.196%                                    | 0.274%                                  |
|  | Fogging             | 0.195%                                     | 0.334%                                    | 0.270%                                  |
| <b>SFC</b>                                 | Mechanical Chillers | -0.119%                                    | -0.351%                                   | -0.157%                                 |
|  | Evaporative cooling | -0.172%                                    | -0.196%                                   | -0.265%                                 |
|  | Fogging             | -0.191%                                    | -0.329%                                   | -0.261%                                 |

Table (4): Qualitative comparison made between traditional evaporative cooling and high pressure inlet fogging [21].

|                                     | Traditional Evap. Cooling  | High PR Inlet Fogging         |
|-------------------------------------|----------------------------|-------------------------------|
| First Cost                          | X                          | 0.25-0.3X                     |
| Need for high quality water         | Not required potable water | Demineralized water is a must |
| Incremental inlet Pressure          | Higher                     | Low-practically nil           |
| Size Foot Print                     | Large                      | Small                         |
| Effectiveness                       | 0.85 to 0.9                | 0.97 to 1.0                   |
| Maintenance activities              | Higher                     | Comparatively lower           |
| Aux Power consumption               | Requires pump              | High pressure pumps needed    |
| Sensitivity to Relative Humidity    | High                       | Lower                         |
| Installation down time              | Extended outage            | Can be done in 2-3 days       |
| Possibility to intercool compressor | Not Possible               | Possible                      |

## PERFORMANCE OF DIFFERENT TYPE OF FRP SHEETS BONDED TO CONCRETE USING FLEXIBLE ADHESIVE

HeshamDiab

Assiut University, Assiut 71516, Egypt

*heshamdiab2@yahoo.com*

### **Abstract:**

The strengthened effectiveness and the performance capacity of repaired Reinforced Concrete (RC) structures with Fiber Reinforced Polymer (FRP) sheets is dependent on the properties of the adhesive interface layer. Results of an experimental campaign on FRP-concrete debonding are presented. Specimens with different type of FRP sheets (Carbon and Basalt) using flexible adhesives were conducted to determine the effective bonding length and ultimate bond capacity of FRP-concrete interface. The experimental results from double lap shear specimens indicated that an adhesive with relatively large ductility increases the effective bonding length and in turn bond capacity. Bond strength of specimens increased by about 40% to 70% above that of specimens with normal adhesive. Failure mechanisms of specimens with flexible adhesive and those of normal adhesive epoxy are clarified comparatively. By post-processing these data, increase of fracture energy of FRP-concrete interface has been clearly observed due to flexible adhesive for all different type of FRP sheets. A unique feature of the present study is that the simple modification done to the most popular bond strength models to predict bond strength and effective bonding length considering the type of adhesive layer. The validation of bond strength model is supported using numerous test results taken from the published literature.

# PERFORMANCE OF DISTANT EDUCATION SYSTEM IN TURKEY

Deniz Guney  
Department of Structure  
Faculty of Architecture  
Turkey  
deguney@yildiz.edu.tr

**Abstract:** Developing communication technologies have an important power and effect on the field of education in Turkey. These electronic technologies have been increasingly used in education and training for many years. Distance education is one of the newest forms of education that basically depends on these communication and information technologies. As a new and modern approach to deliver instruction, many corporations and organizations for both formal and non-formal educational settings in Turkey and all around the world have increasingly used distance education. This paper investigates the performance of the Distant Education System, explains how the Distant Education Faculty performs and transforms education in Turkey.

**Key words:** Distant, education, performance, Turkey.

## Introduction

Distance education programs worldwide use a variety of technologies that include print materials, audio and videocassettes, audio and video teleconferencing, one-way and two way television, computer-mediated communication (e.g., electronic mail, computer conferencing), and more recently, the Internet. Technologies that deliver instruction to distance learners are often classified as two-way interactive or one-way non-interactive (Bates, A. W., 1995). Two-way interactive technologies can be listed as audio conferencing, audio graphic conferencing, bulletin board system, and computer conferencing via e-mail, computer conferencing via conferencing software, desktop videoconferencing, and internet based desktop videoconferencing, internet-based synchronous text conference, one-way videoconference with response keypads, two-way videoconference and voice mail. Similarly, one-way technologies can be listed as audiotape, CD-ROM, computer-based training (CBT) - computer disk, internet-based gopher, telnet, ftp, laserdisc, one-way videoconference, e.g., satellite, printed materials, radio, television, videotape, virtual reality and Web-based interactive multimedia, e.g., Java scripts, World Wide Web. Turkey has used the European model for its economic, political and educational development while maintaining its cultural ties with the East. Many Turkish art forms; shadow theater, music, dance and literature have their roots in Asia. Similar to its Asian neighbors, Turkey, with a large population of over 70 million people, is a developing country. Institutions of higher education in Turkey have traditionally modeled their programs after their British, German and American counterparts. However the educational problems facing Turkey more closely resemble those of their Asian than their European neighbors (McIsaac, M.S., et al, 1988). Distance Education has been actually applied in Turkey since 1982. When the past of distance education is examined, though it can go back to 50-60 years ago, it seems it appeared in 1970s, closer to its meaning of today. The distance education issue first expressed in 1927 at a meeting where the education problems were discussed and it was discussed that distance education could be used to make the people literate (Alkan, C., 1987).

## Turkish Education System

**A. General View:** Turkish education system is ruled by the Ministry of National Education. Ministry of National Education consists of central, provincial, overseas organizations and affiliated establishments. According to the Basic Law of National Education no 1739, The Turkish Education System consists of two main divisions:

**a. Formal Education**

Formal Education, in other words school system, is divided into four levels:

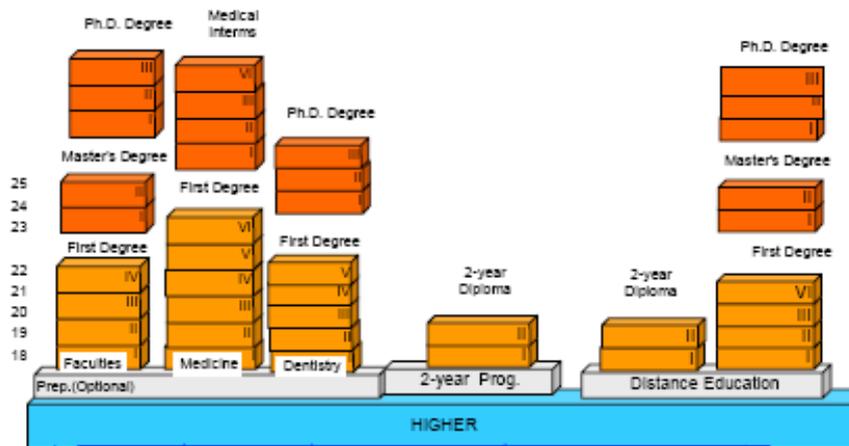
- Pre-school Education (0-72 months)
- Primary Education (Primary Education, which is free at all state schools, is for the education of children between the ages of 6 and 14, and it is compulsory for all.)
- Secondary Education (Secondary Education covers general high schools, and vocational and technical high schools which provide at least three-year education for the graduates of primary education.)
- Tertiary Education (The aims of these schools are to bring up students as individuals who are acquainted with the problems of the society and who contribute to economic, social and cultural development of the country and to prepare them for tertiary education as well)

b. Non-formal Education (Non-formal education aims to teach adults how to read and write, to provide basic knowledge, to develop further knowledge and skills already acquired and to create new opportunities for improving their standard of living.)

In addition to this, based on qualifying exam, students can continue higher education system (two years/pre-undergrad, min. four years undergrad). Higher education system can be seen in Figure 1. General numbers belongs to Turkish education system is given in Table 1.

**Table 1:** Number of Schools, Students, Number of Teachers

| Levels of Education                          | Number of Schools/Institution | Number of Student |                   |                   | Number of Teachers |
|--|-------------------------------|-------------------|-------------------|-------------------|--------------------|
|  |                               | Total             | Boys              | Girls             |                    |
| <b>Pre-School Education</b>                  | <b>3.600</b>                  | <b>701.762</b>    | <b>366.209</b>    | <b>335.553</b>    | <b>10.819</b>      |
| <b>Primary Education</b>                     | <b>34.093</b>                 | <b>10.870.570</b> | <b>5.676.872</b>  | <b>5.193.698</b>  | <b>445.452</b>     |
| <b>Secondary Education</b>                   | <b>8.280</b>                  | <b>3.245.322</b>  | <b>1.789.238</b>  | <b>1.456.084</b>  | <b>191.041</b>     |
| General Secondary Education                  | 3.830                         | 1.980.452         | 1.044.607         | 935.845           | 106.270            |
| Vocational and Technical Secondary Education | 4.450                         | 1.264.870         | 744.631           | 520.239           | 84.771             |
| <b>Non-Formal Education</b>                  | <b>11.864</b>                 | <b>5.117.623</b>  | <b>2.942.086</b>  | <b>2.175.537</b>  | <b>87.285</b>      |
| <b>Higher Education</b>                      | <b>114</b>                    | <b>2.497.473</b>  | <b>1.411.485</b>  | <b>1.085.988</b>  | <b>96.105</b>      |
| <b>Total</b>                                 | <b>57.951</b>                 | <b>22.432.750</b> | <b>12.185.890</b> | <b>10.246.860</b> | <b>830.702</b>     |



**Figure 1:** General structure of Turkish higher education system

Higher education institutions are autonomous for purpose of teaching and research. Higher Education institutions includes faculties, institutes, faculties, institutes of technology, higher education schools, conservatories, higher vocational education schools, and application and research centers. However, they have to submit annual reports to Higher Education Council which is responsible for the planning and coordination of higher education. Higher Education covers all post-secondary programs with duration of at least two years. The total number of universities is about 160 (according to 2012 data). The schooling rate in higher education is about 38.6%. Almost 1.2 million students take university entrance exam in every year. However 100.000 of them (state and private university) can enter classic university departments. The rest of the students should search an alternative education method for higher education. That's why distant education tools are one of the best alternatives for higher education. In addition to this distant education can be used for each stage of education system.

**B. Distant Education in Turkey:** Distant education is provided to ensure equal opportunities for all Turkish citizens, to support the primary, secondary and higher education system and to render lifelong learning opportunities.

The distant education system was initiated in Turkey in 1974. At primary and secondary education level distance education is provided through Open Primary School, Open High School, Open Vocational and Technical High School while at tertiary level through open universities. In addition Vocational certificate programs are offered for all though Open Vocational and Technical School on condition that they are at least primary school graduates. In the 2004/2005 academic year, a total of 1 342 375 students received education through distance education, 581 516 in open primary and secondary schools and 760 859 in open higher education.

## Open Education in Turkey

The first and the most successful example of distant education in Turkey is Anadolu University. It is very successful example and mile stone for Turkish education system. Eskişehir Anadolu University has been providing open higher education services since 1982. The Open Education Faculty began training with Economics and Business Administration curricula. The Economics and Business Administration Departments of the Open Education Faculty were reorganized as Faculty of Economics and Faculty of Business Management in the year of 1993. The Open Education Faculty is also extending services to faculties of Economics and Business Management through its Turkey-wide distributed offices as well as the training and education services extended by the faculty itself. This service is also available for Turkish citizens living in foreign countries. The total number of students registered to Open Higher Education was 760 859 for the academic year 2003/2004. The student numbers of the Open Education Faculty, Faculty of Economics and Faculty of Business Management are 289 659, 213 835 and 257 365 respectively. The details can be seen in Table 2.

**Table 2:** Number Of Students In Distance Education (2004/2005)

| EDUCATIONAL LEVEL                 | TOTAL     | BOYS    | GIRLS   |
|-----------------------------------|-----------|---------|---------|
| OPEN PRIMARY EDUCATION            | 266.742   | 147.117 | 119.626 |
| OPEN EDUCATION HIGH SCHOOL        | 314.773   | 185.302 | 129.471 |
| General Programs                  | 252.030   | 149.873 | 102.157 |
| Vocational and Technical Programs | 62.743    | 35429   | 2.7314  |
| Industrial Vocational H.Sc.       | 26.845    | 23.928  | 2.917   |
| Girls' Vocational H. Sc.          | 16.378    | 292     | 16.086  |
| Trade Vocational H. Sc.           | 12.583    | 7.229   | 5.354   |
| Imam and Preachers H.Sc.          | 6.397     | 3.980   | 2.597   |
| <b>OPEN HIGHER EDUCATION</b>      | 695.591   | 387.413 | 308.178 |
| <b>TOTAL</b>                      | 1.277.107 | 719.832 | 557.275 |

Today, its Open Education System not only serves students in Turkey but Turkish communities in the European Union and Northern Cyprus. It has one of the world's largest student bodies. It currently has 24,300 on-campus students and almost 1,050,000 off-campus students enrolled in the Open Education System. Over 2000 of these are taking graduate programs. The 336,000 distance students who enrolled in 2005/06 constitute over 40% of all university students and 99% of all distance education students in Turkey. By the end of the 2004/05 academic year, 870,000 pre-bachelor and bachelor degree students had graduated through the Open Education System, and at the end of 2006 a further 110,000 graduates are expected. The average Anadolu University distance learning student is in his/her mid-twenties; 65% of the students are metropolitan-based, 70% have jobs, 40% are married, 42% are female and 1.5% has some disability. Anadolu University comprises 12 faculties, three of which—Open Education, Business Administration and Economics—constitute the Open Education System, 10 vocational schools, 6 graduate schools, 26 research centers and a State Conservatory of Music and Drama. It has 1811 full-time teaching staff.

## Open Education Faculty Performance

The OEF offers academic, technical and administrative support for the Open Education System through its various centers and units. The Distance Education Design Unit provides the instructional design for the 4.2 million copies of the 400 self-directed learning textbooks plus many test booklets and other course materials that are needed annually and that are co-developed by more than 750 writers and editors from Anadolu and other universities. The Printing Unit designs and produces the textbooks using the latest computer technology and dispatches these to the OEF centers in Turkey, the European Union and Northern Cyprus for student collection upon registering. They are also increasingly made available as web-based PDF files (e-books). The Television Centre produces or revises some 300 20-minute television programs annually. Most of the 5000 banked programs are studio-based and 'talking head', but there are also dramatizations, documentaries and computer animations. Throughout the year, these programmes are aired nationwide six hours a day on weekdays and three hours a day at weekends on the Turkish Radio and Television Corporation's Channel 4 (TRT4). Prior to the mid-term and final examinations, these pre-recorded programs are replaced with week-long live interactive programs with toll-free telephone, fax and email access to help the students in Turkey prepare for their examinations. Over 1100 programs are also available as streaming video over the Internet and students may purchase videocassettes or VCD/DVDs at minimal cost. Copies are free for students in the European Union unable to receive TRT4.

The Centre also operates a 384-kbs videoconferencing system for teaching within Turkey and Northern Cyprus, and produces hundreds of radio programs and a large number of audiobooks for the visually impaired, employing professional actors to read aloud the texts and self-tests. The Computer-Based Learning Centre collaborates with subject experts in developing the multimedia courseware for CD-Rom or Internet distribution. It employs 12 servers with 34

processors, using 100-Mbit bandwidth on the National Academic Network (ULAK-NET) developed by the Scientific and Technological Research Institution of Turkey (TÜBİTAK) with the support of Turk Telekom (TT) (used mainly by students with computer access in public agencies or other universities) and 200-Mbit bandwidth on TT-NET (for other students accessing the multimedia materials). Although there are critics of the system, with so many students the OEF has found no alternative but to use multiple-choice tests and computerized assessment and evaluation. The tests are developed at the Test Research Centre by teams of teachers; the question books and optically readable answer sheets are dispatched under strictest security to the examination centers and, on their return, the Computing Centre assesses the answer sheets while the Test Research Centre monitors the appropriateness and effectiveness of both the instruction and the questions. The Open Education System is fairly generously funded, with 76% of its income coming from the student fees and 24% from the state. In 1996, Daniel estimated that the Open Education System cost the government 2% of the higher education budget (Daniel, J. S., 1996). Today, the state contribution per Open Education System student is 5% of that of a student at a conventional university. Bayrak and Kesim (2005) estimate that further investment in e-learning will yield further cost benefits (Bayrak, C., Kesim E, 2005). For most of the courses, the annual tuition fee is about US\$250. Repeating students pay around US\$200. Courses involving practical work cost slightly more. The annual fees for the Information Management and English Language Teaching programs are about US\$1000 and US\$600, respectively; the total for the e-MBA is US\$12,600, and the other online graduate programs cost US\$5,000.

## E-Transformation

Like all distance teaching institutions in emerging economies, Anadolu University must balance technological benefits against equitable provision. e-Transformation can improve the infrastructure, provide richer and more interactive programs and enhance learner support. But recent findings (DPT, 2006) show that only 13.9% of the Turkish population can access the Internet, and only two per cent can access broadband. Only 5.9% own computers with an Internet connection. The majority access the Internet at work (41.1%) or at Internet cafes (41.2%). Internet access is primarily in the urban and advantaged regions and 62% of the populations still have no understanding of the Internet. The main reasons for the low adoption rates are the high cost of an Internet connection and a lack of basic Internet/computer skills. For those on the average monthly income of US\$300–500, US\$20 a month for a 512-kpbs digital subscriber line (ADSL) or US\$10 for 15 hours of dial-up is prohibitively costly. But, interestingly, students constitute the largest group (53.8%) using the Internet. Turkey ranked 45th in the Economist Intelligence Unit's 2006 e-readiness Rankings. However, the imperatives of the knowledge economy, globalization, candidacy for the European Union and Turkey's inclusion in the European Council's e-Europe Program Action Plan have led the government to initiate the Turkish e-transformation better, faster and more participative and transparent Information and Communications Technology public services. Universities, research organizations, libraries and documentation centers are linked through the high-speed ULAK-NET, and the rapid expansion of the Internet has led to student demand for online programs and services. In 1999 The Council of Higher Education legislated for Turkish universities to move into e-learning. The Computer-Based Learning Centre had already been developing courseware for use in conjunction with the print materials, and Anadolu University responded readily to this opportunity. The original intention was to install computer laboratories in all of the OEF centers but this proved to be too problematic and costly so the OEF is now setting its sights on supporting home ownership of computers, enhancing Internet connection and working with Turkish Telekom to increase the bandwidth and provide access for those in rural and underdeveloped regions of the country. Deploying WiMax technology is part of this project. The pursuit of these goals is seen as important because it is shown that, regardless of region, age or gender, Open Education System students making regular and sustained use of e-learning perform better than those who do not make use of the technology (Mutlu, M. E., 2004). However, it is still the case that many students lack the requisite computing and self-study skills, quiet, private environments for learning, and confidence to use computers for their learning, that server and bandwidth problems occur during peak hours, and that many faculties are still unfamiliar with technology-based teaching and learning. So there are many issues to be addressed as well as the cell phone, PDA and other m-learning options.

## Strategic Planning and Management

Anadolu University and the OEF realize that they have reached a stage where they need to re-examine trends, needs, obligations and their strengths, advantages and opportunities, re-define their strategic goals and priorities, re-align their management and quality assurance procedures and resources accordingly, and mainstream those innovations that are shown to be working well. They also need to guard against becoming over-extended and/or failing to achieve impact and leverage in politically and educationally significant areas. The Higher Education Council (HEC) has suggested that Anadolu University should increase the range of courses and offer programs in technical fields, science and medicine. At the same time, the Turkish branches of large international firms are asking the OEF to provide nationwide online training for their employees. In August 2006, Ford established an e-learning portal to train its service personnel using materials designed and produced by the OEF. Anadolu University also needs to consider the threats posed by international and for profit online providers and the other socio-economic, political and technological changes that undoubtedly lie ahead for the country. Yılmaz (2005) suggests that universities with an e-transformation mission need to market themselves as providing easily accessed, well-designed, learner-centered, affordable, efficient and

flexible services, sound return-on-investment, greater learner satisfaction and higher retention (Yılmaz, R. A., 2005). Özkul (2005) observes that achieving this at Anadolu University will require significant changes in structures and work practices, and Ulukan (2005) suggests that the requisite shifts in institutional values and staff attitudes and behaviors will require multiple points of inertia and resistance to be addressed systemically. Anadolu University's original positioning as the national center for distance learning in Turkey was attributable to the vision and leadership of its inaugural Rector in the 1970s and 1980s. The new senior management team needs to exercise similar prescience and leadership and to encourage all faculties and staff to align their goals and activities to a new vision. The recent Higher Education Strategy for Turkey (Higher Education Council, 2006) stresses the need for just this form of review and envisioning. While at this stage the report is a draft open to comment, it flags some important issues. It observes that the higher education age group will decline but that the participation rate needs to be increased to match that of other OECD countries; that there is need for more postgraduate study and lifelong learning opportunities; that the university system needs to be more open and flexible; that management, quality assurance measures and resource efficiency need to be improved; and that there is a call for more student centered approaches, greater use of e-learning and increased research activity and international publication. It also suggests that while the participation rate should rise to 65% by 2025, the proportion studying through open learning should be progressively reduced from 35% to 11.2%, which it claims is the norm for developed countries. Anadolu University is already taking steps to respond to this changing environment. A Strategic Planning Task Force representative of the different departments of the university has been charged with developing a strategic plan by the end of the first quarter of 2007. In another major step development, a new Open and Distance Learning Research and Development Office (ARGE) has been established to undertake and commission qualitative and quantitative research studies that will help administrators and faculty improve their services and gain better national and international recognition of the university. On the developmental side, ARGE will encourage and support new forms of online programs, especially in the technical fields, using advanced technologies and more flexible and personalized learning systems. These e-certificate programs will be so designed as to remove the barriers to continuing professional development, including distance, time, qualifications and cost.

## Conclusion

Turkish distance education already provides learner-content interaction through one-way technologies. By applying instructional strategies and interactive technologies that are inspired by cultural context, distance education can also enhance learner-instructor, and learner-learner interaction. Cultural context is a critical ingredient in the development of any distance education program. Because distance education reflects traditional face-to face education, distance education programs must be based on cultural context. In Turkey, patronage and an oral tradition are part of this cultural context. The instructional designer should select technologies that will encourage interaction and cooperation while supporting the cultural context.

As an important social and educational development the Open Education Faculty's significance lies not only in making University education available to adults who can only obtain it through study in their spare time, but also in the variety of teaching methods used. By the way of distance education in Turkey, students who failed to win places at conventional universities as well as those who for economic, geographic or other reasons could not study on university campuses found a chance to be educated. It was felt that distance education would not only benefit the students themselves but, in larger sense, would help to eliminate the student unrest and civil disobedience, which had marked the 1970's.

Anadolu University has successfully provided distance education for Turkish people in Turkey, across Europe and in Northern Cyprus since the early 1980s. The size, diversity and distribution of the student body and associated technological, logistical, legal and political issues present enormous challenges to the Open Education System. Anadolu is now improving its educational products and services through e-transformation and by employing new instructional models in its undergraduate, graduate and e-certificate programs. However, there are still many issues to consider; how to prepare the learners for self-managed, collaborative, technology-based learning; how to train faculty in the new technologies, methodologies and research practices; how to persuade politicians and administrators to write legislation and bills that will support open education; and how to improve the technological infrastructure and services. Senior and middle management and the recently established Strategic Planning Task Force are committed to finding ways of resolving these issues.

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# POPÜLER BİLİM DERGİLERİ VE BİLİMSEL KİTAPLARIN FEN DERSLERİNDE KULLANILMA DURUMLARI

**Yrd. Doç. Dr. Fatime BALKAN KIYICI**

**fbalkan@sakarya.edu.tr**

Sakarya Üniversitesi Eğitim fakültesi Fen bilgisi Öğretmenliği ABD

**Melike YAVUZ**

**meykeyavuz@hotmail.com**

Sakarya Üniversitesi Eğitim Bilimleri Enstitüsü Fen Bilgisi Eğitimi

Doktora Öğrencisi

**Resul SAÇAR**

**resul.sacar@gmail.com**

Sakarya Üniversitesi Eğitim Bilimleri Enstitüsü Fen Bilgisi Eğitimi

Yüksek Lisans Öğrencisi

2005 yılında uygulamaya konulan fen ve teknoloji öğretim programının temel amacı fen ve teknoloji okuryazarı bireyler yetiştirmektir. Öğretmenlerin fen derslerinde bilimsel kitap ve popüler bilim dergilerini kullanmaları bu amaca ulaşmada önemli bir rol oynayabilir. Çünkü popüler bilim dergileri bilim ile bireyler arasında bir bağ kurmakta, bilimsel ve teknolojik gelişmelerin farkında olunmasını sağlayarak, bilgileri günlük yaşamla ilişkilendirmeye fırsat vermekte ve bilimsel bilgiyi bireylere hazır olarak sunmaktansa, onun özünü anlayabilmelerine imkan tanımaktadır. Bu sebepten bu çalışmada, bilimsel kitap ve popüler bilim dergilerinin fen derslerinde öğretmenler tarafından kullanılma durumunun tespit edilmesi amaçlanmıştır. Çalışma grubunu 27 fen ve teknoloji öğretmeni oluşturmaktadır. Çalışmada verilerin elde edilebilmesi amacıyla araştırmacılar tarafından hazırlanan ve açık uçlu sorulardan oluşan bir form kullanılmıştır. Hazırlanan formda demografik bilgiler ve dergi ve kitapların kullanılma durumu ya da kullanılmasının önünde engel teşkil eden durumların tespit edilmesine yönelik sorular yer almaktadır. Öğretmenlere uygulanan bu form sonucunda elde edilen veriler araştırmacılar tarafından analiz edilmiştir. Öğretmenlerden elde edilen veriler sonucunda; öğretmenlerin bilimsel kitaplar ve popüler bilim dergilerini takip etme oranlarının yüksek olduğu çünkü; bilim ve teknoloji ile ilgili olan her türlü gelişmeden bireylerin haberdar olmalarını sağladığı ve eğitim-öğretim faaliyetlerinin yürütülmesine yardımcı olan kaynaklar olarak düşündüklerine ilişkin bulgular elde edilmiştir. Aynı zamanda; bu kitap ve dergilerin fen ve teknoloji dersinin hedeflerine paralel olarak; fen ve teknoloji okuryazarı bireyler yetiştirmeye yardımcı olduğu sonucuna ulaşılmıştır.

**Anahtar kelimeler:** Bilimsel kitaplar, popüler bilim dergileri, fen, öğretmen

## Giriş

Bilim, günümüzde insanların dünyada sahip olduğu hayatı, en çok değiştiren ve yakından etkileyen bilginin kaynağıdır. Bilimin sürekli gelişen ve kendini yenileyen dinamik yapısı beraberinde teknoloji alanındaki gelişmelerin ilerlemesine de olanak sağlamıştır. Bu şekilde bilim ve teknoloji, çift yönlü ve sürekli devam eden bir etkileşim içine girmiştir (Demirci, 1993). Bilim ve teknoloji çağında olduğumuz son günlerde; toplumlar, çağı yakalayıp geleceğe ışık tutmak için bilim ve teknolojiyi, ortak bir payda olan eğitimde buluşturmuştur (Tan ve Temiz, 2003). Böylelikle bilimsel düşünme becerilerine sahip, teknolojik gelişmelerden haberdar olan bireyler yetiştirmek, eğitimin temel hedefleri arasında yer almıştır. Bu bağlamda; günlük hayatı, bilim ile birleştiren ve doğayı anlamaya yardımcı olan fen derslerinin; bilim ve teknolojik gelişmelerle iç içe olması gerekmektedir (Demirbaş, 2001). Bu gereklilik ulusların geleceği ve toplumların ilerleyişi için; fen ve teknoloji eğitiminin önemini daha da arttırmıştır. Bu nedenle ülkemizde program reform hareketleri sonucunda yapılan değişikliklerle, fen öğretim programının temel amacı; bilim ve teknolojik gelişmeleri takip eden, doğal dünyayı anlayan, karşılaştığı problemler esnasında feni kullanıp bilimsel süreçleri takip eden, yaşadığı toplum ve çevreye değer veren, eğitim ve meslek seçiminde fen ve teknolojiyle ilgili olan mesleki yönlerin alt yapısını oluşturmuş bireyler yetiştirmek olarak belirlenmiştir. Bu amaçlar doğrultusunda yeni bir kavram ve anlayış olan fen ve teknoloji okuryazarlığı ortaya çıkmıştır (MEB, 2005). Bireye öğretim programında hedeflendiği gibi formal eğitim ile okul çatısı altında kazandırılmaya çalışılan fen ve teknoloji okuryazarlığı, hayat boyu öğrenme anlamına gelen ve formal eğitimin yanında destekleyici olarak yer alan informal eğitim eşliğinde de sağlanabilmektedir (Eshach, 2007). Bu sebepten; öğrenme için gerekli olan metot ve materyaller genişletilerek, alternatif öğrenme

kaynakları olarak; televizyon, radyo, gazete, dergi, internet ve kitap gibi araçlardan daha fazla yararlanılmıştır (Hill, Hannafin ve Domizi, 2005; Laçın Şimşek, 2011).

İnsanların hayatında uzun yıllardır varlığını sürdüren kitap kültürü; bireylerin kendilerini geliştirmek üzere başvurdukları en önemli kaynaklardan bir tanesi olarak görülmektedir (Uğurlu, Çelik ve Sarı, 2012). Çünkü bireyler; kitaplar sayesinde bilgilerin kaynağına istediği zaman istediği yerde ulaşmakta ve bilgileri istediği miktarda tekrar edebilme imkanına sahip olmaktadır (Küçükahmet,2000). Ancak ders kitaplarının öğretim programına bağlı kalarak hazırlanması; ilgi çekici konuların, bilim ve teknoloji ile alakalı güncel haberler, olaylar ve son gelişmelerin aktarılması konusundaki sınırlılıkları dikkat çekmektedir. Bundan dolayı ders kitapları yardımı ile fen ve teknoloji okuryazarı bireylerin yetiştirilmesi sürecinde, popüler bilim dergileri ve bilim kitapları göz önünde bulundurularak informal eğitim kapsamında ele alınmalıdır. Bu sayede; öğretmenler tarafından kullanılan kitap ve dergi gibi yazılı materyaller, öğrencinin bilimsel bilgileri daha iyi algılamasını sağlayarak, öğrenmesini kolaylaştırmakta ve aynı zamanda edinilen bilgilerin kalıcılığının sağlanmasına yardımcı olmaktadır. Bununla birlikte öğretmenlerin; daha zengin bir bilgi ve içeriğe sahip olmasına, dersi daha planlı ve sistemli yürütmelerine olanak sağlamaktadır.

İlgili literatür incelendiğinde (Uğurlu, Çelik ve Sarı, 2012; Nakiboğlu, 2008; Demirbaş, Yağbasan, 2002); popüler bilim dergileri bilim ile bireyler arasında bir bağ kurmakta, bilimsel ve teknolojik gelişmelerin farkında olunmasını sağlayarak, bilgileri günlük yaşamla ilişkilendirmeye fırsat vermektedir. Aynı zamanda bilimsel bilgiyi bireylere hazır olarak sunmaktansa, onun özünü anlayabilmelerine imkan tanımaktadır. Bu sebepten bu çalışmada, öğretim sürecinde yardımcı materyaller olarak önemli bir yere sahip olan bilimsel kitap ve popüler bilim dergilerinin, fen derslerinde öğretmenler tarafından kullanılma durumunun tespit edilmesi amaçlanmıştır.

## Method

Bu çalışmada, bilimsel kitap ve popüler bilim dergilerinin fen derslerinde öğretmenler tarafından kullanılma durumunun belirlenmesi amaçlandığından betimsel bir çalışmadır. Çalışmada survey yöntemi kullanılmıştır. Bu yöntem; geçmişte veya halen var olan bir durumu olduğu gibi betimlemek amacıyla kullanılmaktadır (Karasar, 2007).

## Çalışma grubu

Çalışma grubunu görev yapmakta olan 27 fen ve teknoloji öğretmeni oluşturmaktadır. Tablo 1’de görüldüğü gibi; çalışmaya katılan fen ve teknoloji öğretmenlerinin %62,96’sı kadın, %37,04’ü ise erkektir. Öğretmenlerin tamamı eğitim fakültesi mezunu olup; %96,29’u devlet okullarında %3,71’si ise özel okulda çalışmaktadır. Fen ve teknoloji öğretmenlerinin %55,55’i 1 ila 4 yıl arasında, %45,45’i ise 5 ila 9 yıl arasında mesleki deneyime sahiptir.

**Tablo 1.** Fen ve Teknoloji öğretmenlerinin demografik özelliklerine göre dağılımı

|                            | F  | %     |
|----------------------------|----|-------|
| <b>Cinsiyet</b>            |    |       |
| Kadın                      | 17 | 62,96 |
| Erkek                      | 10 | 37,04 |
| <b>Mezun Olduğu Kurum</b>  |    |       |
| Eğitim Fakültesi           | 27 | 100   |
| <b>Hizmet verdiği okul</b> |    |       |
| Devlet Okulu               | 26 | 96,29 |
| Özel Okul                  | 1  | 3,71  |
| <b>Mesleki Deneyim</b>     |    |       |
| 1- 4 yıl                   | 15 | 55,55 |
| 5- 9 yıl                   | 12 | 44,45 |

## Veri toplama

Çalışmada verilerin elde edilebilmesi amacıyla araştırmacılar tarafından hazırlanan ve açık uçlu sorulardan oluşan bir form kullanılmıştır. Hazırlanan formda demografik bilgiler, hangi dergi ve kitapların takip edildiği, dergi ve kitapların fen derslerinde kullanılma durumu ya da kullanılmasının önünde engel teşkil eden durumların tespit edilmesine yönelik sorular yer almaktadır. Öğretmenlerden bu formu doldurmaları istenerek, formdaki sorulara verilen cevaplar sonucunda veriler elde edilmiştir.

## Verilerin analizi

Bu araştırmada popüler bilim dergileri ve bilimsel kitapların fen derslerinde kullanılma durumlarının sorgulanması sonucunda elde edilen verilerin analizi için betimsel analiz gerçekleştirilmiştir. Betimsel analizde amaç; elde edilen verilerin okuyucunun anlayabileceği şekilde, daha önceden belirlenen temalara göre özetlenip yorumlanmasıdır (Yıldırım ve Şimşek, 2011).

## Bulgular ve Yorum

Araştırmada verilerin analizi sonucunda ulaşılan bulgular aşağıdaki gibidir.

### 1. Öğretmenlerin Bilimsel Kitapları Ve Popüler Bilim Dergilerini Takip Etme Durumlarına İlişkin Bulgu Ve Yorumlar

Fen ve teknoloji öğretmenlerinin “**Bilimsel Kitapları ve Popüler Bilim Dergilerini takip eder misiniz? Ne sıklıkla?**” sorusuna verdiği cevapların analizi sonucunda elde edilen veriler Tablo 2’ de sunulmuştur.

**Tablo 2.** Öğretmenlerin Bilimsel Kitapları ve Popüler Bilim Dergilerini Takip Etme Durumları

|                         | Evet     |       |            |       |            |       |            |       | Hayır |       | Toplam |     |
|-------------------------|----------|-------|------------|-------|------------|-------|------------|-------|-------|-------|--------|-----|
|                         | Ayda bir |       | 3 ayda bir |       | 6 ayda bir |       | Senede bir |       | f     | %     | f      | %   |
|                         | f        | %     | f          | %     | f          | %     | f          | %     |       |       |        |     |
| Bilimsel Kitaplar       | 6        | 22,22 | 3          | 11,11 | 4          | 14,81 | 6          | 22,22 | 8     | 29,64 | 27     | 100 |
| Popüler Bilim Dergileri | 16       | 59,25 | 6          | 22,22 | 3          | 11,11 | 1          | 3,71  | 1     | 3,71  | 27     | 100 |

Tablo 2 incelendiğinde; öğretmenlerden %70,36’sının bilimsel kitapları takip ettiği, %29,64’ünün ise herhangi bir bilimsel kitabı takip etmediği görülmektedir. Aynı zamanda öğretmenlerin popüler bilim dergilerini takip etme durumuna bakıldığında; öğretmenlerin %96,29’u popüler bilim dergilerini takip ettiği, %3,71’inin ise takip etmediği görülmektedir. Sonuçlara göre öğretmenlerin çok büyük bir kısmının bilimsel kitapları ve popüler bilim dergilerini takip ettiği görülmektedir.

### 2. Fen Eğitiminde Bilimsel Kitapların Yerine/Önemine İlişkin Bulgu Ve Yorumlar

Fen ve teknoloji öğretmenlerinin “**Bilimsel kitapların fen eğitiminde yeri var mıdır? Açıklar mısınız**” sorusuna verdiği cevapların analizi sonucunda elde edilen veriler incelendiğinde öğretmenlerden 26 ‘sı önemli olduğunu belirtirken, 1 öğretmen hayır cevabını vermiştir. Önemli olduğu yönünde görüş bildiren öğretmenlerin cevaplarından oluşan analiz sonuçları Tablo 3’ de sunulmuştur.

**Tablo 3.** Bilimsel Kitapların Yeri/Önemine İlişkin Öğretmen Görüşleri

| Kod   | Öğretmen                                 | frekans |
|---|--|---------|
| <i>Gelişmeleri takip etme</i>               | Ö2,Ö5,Ö6,Ö15,Ö16,Ö17,Ö19,Ö22,Ö23,Ö24,Ö26 | 11      |
| <i>Bilim insanlarını tanıma</i>             | Ö1                                       | 1       |
| <i>Derse ilgiyi arttırma</i>                | Ö5,Ö11,Ö26                               | 3       |
| <i>Dersi eğlenceli yapma</i>                | Ö4,Ö18                                   | 2       |
| <i>Bakış açısı kazanma</i>                  | Ö2,Ö3,Ö21                                | 3       |
| <i>Ufku genişletme</i>                      | Ö10                                      | 1       |
| <i>Araştırmacı-meraklı olmayı sağlama</i>   | Ö8,Ö9                                    | 2       |
| <i>Bilime karşı olumlu yaklaşım sağlama</i> | Ö3                                       | 1       |
| <i>Bilgi edinme</i>                         | Ö6,Ö7,Ö8,Ö9,Ö14,Ö21                      | 6       |
| <i>Öğretmene yardımcı</i>                   | Ö1,Ö15,Ö20,Ö27                           | 4       |
| <i>Öğrenme sağlama</i>                      | Ö1,Ö12,Ö13                               | 3       |

Tablo 3 incelendiğinde; Fen ve teknoloji öğretmenlerinin; bilimsel kitapların önemini; bireylerin derse ve bilime karşı olumlu tutum sağlama, bilimsel gelişmeleri takip etme, bilim insanlarını tanıma ve bireylerin eğitim ve öğretim sürecindeki öğrenmelerine yardımcı olma şeklinde açıkladıkları görülmektedir.

### 3. Fen Eğitiminde Popüler Bilim Dergilerinin Yeri/Önemine İlişkin Bulgu Ve Yorumlar

Fen ve teknoloji öğretmenlerinin “**Popüler Bilim Dergilerinin fen eğitiminde yeri var mıdır? Açıklar mısınız**” sorusuna verdiği cevapların analizi sonucunda elde edilen veriler incelendiğinde öğretmenlerden 25 ‘i önemli olduğunu belirtirken, 1 öğretmen hayır cevabını vermiş, 1 öğretmen ise yorumsuz kalmıştır. Önemli olduğu yönünde görüş bildiren öğretmenlerin cevaplarından oluşan analiz sonuçları Tablo 4’ de sunulmuştur.

**Tablo 4.** Popüler Bilim Dergilerinin Yerine/Önemine İlişkin Öğretmen Görüşleri

| Kod   | Öğretmen                                   | frekans |
|---|--|---------|
| <i>Bilimsel gelişmeleri takip etme</i>            | Ö1,Ö5,Ö7,Ö8,Ö9,Ö10,Ö11,Ö12,Ö13,Ö16,Ö17,Ö18 | 12      |
| <i>Günlük yaşamla fen arasında bağlantı kurma</i> | Ö2,Ö15,Ö19,Ö20                             | 4       |
| <i>Bilim insanlarını öğrenme</i>                  | Ö4   | 1       |
| <i>İlgi çekici olma</i>                           | Ö2,Ö3,Ö4,Ö11,Ö15,Ö21,Ö22                   | 7       |
| <i>Bakış açısı oluşturma</i>                      | Ö3,Ö20,Ö23                                 | 3       |
| <i>Araştırma duygusu/yaratıcılığı geliştirme</i>  | Ö3,Ö14,Ö20                                 | 3       |
| <i>Bilinçli olma</i>                              | Ö3,Ö4,Ö8,Ö9,Ö14,Ö20,Ö23,Ö27                | 8       |

|  |         |   |
|--|---------|---|
| <i>Kaynak olarak kullanma<br/>Konuları anlaşılır<br/>yapma/öğretme</i> | Ö6,Ö17  | 2 |
|  | Ö12,Ö14 | 2 |

Tablo 4 incelendiğinde; fen ve teknoloji öğretmenlerinin; popüler bilim dergilerinin önemini; bilimsel gelişmelere karşı ilgi oluşturmaya yardımcı, günlük yaşam ile bağlantı kurmayı sağlayıcı, araştırmaya yönlendirici, öğrenme ve öğretme sürecine katkıda bulunma olarak belirttikleri görülmüştür.

#### 4. Fen Eğitiminde Popüler Bilim Dergileri Ve Bilimsel Kitaplardan Yararlanma Durumuna İlişkin Bulgu Ve Yorumlar

Fen ve teknoloji öğretmenlerinin “Fen ve teknoloji dersinde bilimsel kitap veya dergilerden yararlanıyor musunuz? Neden?” sorusuna verdiği cevapların analizi sonucunda elde edilen veriler incelendiğinde öğretmenlerden 23 ‘ü yararlandığını ve yararlanma amacını belirtirken, 4 öğretmen hayır cevabını vermiştir. Öğretmenlerin cevaplarından oluşan analiz sonuçları Tablo 5’ de sunulmuştur.

**Tablo 5.** Bilimsel Kitap ve Dergilerden Yararlanma Nedenlerine İlişkin Öğretmen Görüşleri

| Kod  | Öğretmen                    | Frekans |
|--|-----------------------------|---------|
| <i>Gelişmelerden haberdar etme/olma</i>        | Ö13,Ö17,Ö21,Ö22,Ö27         | 5       |
| <i>Bilgiye ulaşma yolunu öğretme</i>           | Ö15,Ö26,Ö27                 | 3       |
| <i>Günlük yaşamla fen etkileşimini artırma</i> | Ö2,Ö6,Ö15,Ö20,Ö23           | 5       |
| <i>Konuların öğretiminde</i>                   | Ö1,Ö12,Ö14,Ö19              | 4       |
| <i>Ders materyali olarak</i>                   | Ö2,Ö16                      | 2       |
| <i>Yardımcı olarak</i>                         | Ö2,Ö6,Ö8,Ö9                 | 4       |
| <i>Etkinlikleri desteklemek amaçlı</i>         | Ö3,Ö4                       | 2       |
| <i>Kaynak olarak</i>                           | Ö5                          | 1       |
| <i>İlgi çekme amaçlı</i>                       | Ö4,Ö5;Ö8,Ö9,Ö10,Ö11,Ö15,Ö16 | 10      |
| <i>Öğrencileri araştırmaya yönlendirme</i>     | Ö21,Ö26<br>Ö17,Ö27          | 2       |

Tablo 5 incelendiğinde; öğretmenlerin bilimsel kitap veya dergilerden yararlanma sebeplerini, öğretim sürecindeki katkıları, günlük hayat ve bilimsel gelişmeler ile fen arasında bağ kurmaya yardımcı olması şeklinde açıkladıkları görülmektedir.

**Tablo 6.** Bilimsel Kitap ve Dergilerden Yararlanmama Nedenlerine İlişkin Öğretmen Görüşleri

| Kod   | Öğretmen | frekans |
|---|----------|---------|
| <i>Müfredatla uyumlu olmama</i>                         | Ö7       | 1       |
| <i>Müfredattaki etkinliklerden farklılık içermemesi</i> | Ö18      | 1       |
| <i>Erişim sıkıntısı/Pahalı olması</i>                   | Ö24      | 1       |

Tablo 6 incelendiğinde; öğretmenlerin bilimsel kitap veya dergilerden yararlanmama sebeplerini, programla ilgili sıkıntılar ve edinmek açısından pahalı olmaları şeklinde açıkladıkları görülmektedir.

### **Sonuç, Tartışma ve Öneriler**

Bilimsel kitap ve popüler bilim dergilerinin fen derslerinde öğretmenler tarafından kullanılma durumunun belirlenmesinin amaçlandığı bu çalışmada; ilk olarak öğretmenlerin bilimsel kitapları ve popüler bilim dergilerini takip etme durumlarına bakıldığında; çok büyük bir kısmının bu tür yayınları takip ettikleri ortaya çıkmıştır. Bunun nedeni olarak ise; öğretmenlerin ders kitaplarının yanında bilimsel kitap ve popüler bilim dergilerini kaynak olarak kullanmaları gösterilebilir. Çünkü bu sayede öğretmenler, hem var olan bilgi kaynaklarını çeşitlendirmekte, hem de hızlı bir şekilde ilerleme kaydeden bilim ve teknolojiadaki gelişmeleri takip edebilmektedirler. Buna ek olarak; araştırmaya katılan öğretmenlerin, popüler bilim dergilerini bilimsel kitaplara oranla daha fazla takip ettikleri dikkat çekmektedir. Popüler bilim dergilerinin daha sık ve daha da önemlisi düzenli olarak yayınlanması ve dolayısıyla bilimsel gelişmeleri ve güncel olayları takip etme kolaylığı sağlaması açısından, bu dergilerin bilimsel kitaplara oranla daha fazla takip edilmesine sebep olabilir.

Araştırmaya katılan öğretmenlerin bilimsel kitapların yeri ve önemiyle ilgili görüşlerine bakıldığında; bilimsel kitapları, gelişmelerden haberdar olmalarını sağlayan ve eğitim-öğretim faaliyetlerinin yürütülmesine yardımcı olan kaynaklar olarak algıladıkları görülmektedir. Benzer şekilde; Uğurlu, Çelik ve Sarı (2012); bilimsel kitapların önemini; bilim ve teknoloji dünyasıyla bireyleri buluşturan ve bireylerin kendilerini geliştirmelerine yardımcı olan bir anahtar görevine sahip olması olarak vurgulamışlardır. Bunun dışında; araştırmaya katılan öğretmenlerin bilimsel kitapların önemine ilişkin dikkat çektiği bir diğer nokta ise; öğrencilerin araştırma becerilerini geliştirmesi ve farklı bakış açıları kazandırması olarak vurgulanmıştır. Öğretmen görüşlerine paralel olarak literatürde yer alan bilimsel kitapların incelenmesine ilişkin çalışmalarda; bu kitapların öğrencilerin bilimsel süreç becerilerini desteklediği ileri sürülmüştür (Dökme, 2005; Okur, 2009).

Popüler bilim dergilerinin önemi hakkındaki öğretmen görüşleri incelendiğinde ise; öğretmenler bu tür dergilerin; bilimsel gelişmelere karşı olumlu tutum geliştirdiğini, bilimsel süreç becerilerini kazandırdığı ve eğitim-öğretim sürecine yardımcı olduğunu belirtmişlerdir. Bu noktada; fen ve teknoloji öğretmenlerinin; popüler bilim dergilerinin önemine ilişkin görüşleri ile; bilimsel kitapların önemine ilişkin görüşlerine benzer olarak ortak noktalar içerdiği görülmektedir.

Öğretmenlerin bilimsel kitap ve popüler bilim dergilerinin önemine ilişkin görüşleri; popüler bilim dergilerinden yararlanma nedenleri ile örtüşmektedir. Çünkü ders kitapları dışında ek kaynak olarak kullanılan bilimsel kitap ve popüler bilim dergileri öğrencilere informal eğitim imkanı sunmaktadır. Bu sayede; bu tür yazılı materyaller okuldaki eğitim ortamını ve feni zenginleştirdiği, soyut kavramları somutlaştırdığı, fen becerilerinin gelişmesini sağladığı ve okulda öğrenilenler ile günlük hayat arasında ilişki kurulmasına öğrencilerin bireysel farklılıklarını göz önünde bulundurarak yardımcı olduğu (Chin, 2004; Bozdoğan, 2007) için öğretmenler tarafından kullanılmaktadır. Ancak bazı öğretmenler müfredat ile ilgili sıkıntılar ve pahalı olmaları nedeni ile bilimsel kitap ve popüler bilim dergilerinden yararlanamadıklarını belirtmişlerdir. Öğretmen görüşlerinde, bilimsel kitap ve popüler bilim dergilerinin müfredatla uyumlu olmayan konulara yer vermesi, müfredat ile uyumlu olan konularda ise farklı etkinlikler içermemesi yararlanmama sebebi olarak belirtilmiştir. Bunun dışında diğer bir sebep olarak bilimsel kitap ve popüler bilim dergilerinin diğer yayınlara göre ulaşılmasının daha güç olduğu belirtilmiştir.

Sonuç olarak; öğretmen görüşleri değerlendirildiğinde; popüler bilim dergileri ve bilim kitaplarının bilim ile bireyler arasında bir bağ kurduğu, bilimsel ve teknolojik gelişmelerin farkında olunmasını sağladığı, bilgileri günlük yaşamla ilişkilendirmeye fırsat verdiği ve bilimsel bilgiyi bireylere hazır olarak sunmaktansa, onun özünü anlayabilmelerine imkan tanıdıkları düşünülmektedir. Bu anlamda eğitim sisteminde fen ve teknoloji dersinin hedeflerinin gerçekleştirilebilmesi ve fen okur yazarlığının artırılabilmesi için bilimsel kitap ve dergilerin kullanılmasına öğretimi destekleyici olarak ağırlık verilmesi gerekmektedir. Bu çalışma sonucunda; bu kaynakların kullanımının öğretim sürecinde olumlu yönde etkilere yol açtığı söylenebilir. Öğretmenlerin kolayca ulaşabileceği benzer kaynakların sayısının artırılması ve yayınlanan kaynaklarda ele alınan konuların programı destekler nitelikte bir içeriğe sahip olması önem taşımaktadır. Bu çalışmaya ek olarak; var olan dergiler ve kitaplar derslere destek olma açısından incelenebilir. Farklı ders içeriklerinde bilimsel kitap ve popüler bilim dergilerinin kullanılma durumu tespit edilebilir ve öğrencilerin çeşitli duyuşsal ve bilişsel özelliklere etkisi sorgulanabilir.

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## POTENCY OF AQUEOUS WHITE GRUBS EXTRACT AGAINST CCl<sub>4</sub> INDUCED LIVER DISEASES IN RATS.

\*M. S. Sule (Prof), \*\*A. J. Alhassan (PhD) and \*\*\*Y. Abdulmumuni (Msc)

\*\*Department of Biochemistry  
Faculty of Science  
Bayero University, Kano  
PMB 3011 Kano - Nigeria

\*\*\*Department of science Laboratory Technology  
College of science ,Engineering And Technology  
Hussaini Adamu Federal Polytechnic Kazaure  
Jigawa State- Nigeria.

\*\*\*Corresponding Author's e- mail address:  
yabdulmumin@yahoo.com  
Mobile phone : +2348033696836

**Abstract** The potency of aqueous white grubs extract was assessed in the cure of carbon tetrachloride (CCl<sub>4</sub>) – induced lipoperoxidation in rats. The three different dosages were administered (1g/kg, 2g/kg and 8g/kg) daily to different groups of rats for up to 9 days after induced with lipoperoxidation using CCl<sub>4</sub> at a dose of 120mg/kg. the serum aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) activities as well as levels of serum malondialdehyde (MDA), total protein (TP) and albumin (ALB) of the rats after 9 days of white grubs administration were found to be similar to those of control rats (not CCl<sub>4</sub> – treated). This shows possible curative effects of the white grubs extract, which was found to be depend on both the dose administered and the duration of treatment.

**Key words:** *White grubs, Potency, carbon tetrachloride and liver disease.*

### INTRODUCTION

Unlike insects and related species, the uses of herbs to treat disease is almost universal among non industrialized societies and in most part of the world 70 - 90% of the people rely on plant for medication (Farnsworth and Soejarto, 1985; Hostettmann et al., 2000). The values of medicinal plants to mankind is very well proven and form the basis of health care world wide, and have roles in international trade (Ahmed et al., 2006). The use of, and research for, drugs and dietary supplements derived from plants have accelerated in recent years. Pharmacologists, microbiologists, botanists, and natural product chemists are perfecting phytochemicals for treatment of various diseases. At least 7,000 medical compounds in the modern pharmacopoeia are derived from plant (Tapsell, 2006). It is timely to venture into search for insects that have medicinal properties in addition to their nutritional roles.

White grubs are the larval stage of beetles' metamorphosis commonly found in dump refuse and animal dung, feeding on plants and animal remains (Alhassan et al., 2009a). In Africa, the species is widely distributed, it is found in Nigeria, Niger Republic, Uganda, etc. Though, white grub is seen and / or presented in the world's field of science as more or less a pest, with less or no positive economic importance, recent research and discoveries indicates white grubs are rich in protein, fats and mineral elements (Alhassan et al., 2009a). It is used among communities as food and as medicine among the Hausa/ Fulani in Northern Nigerian (Alhassan et al., 2009a). In South Western Nigeria, edible insects are conceived as food and source of nutrients and among the traditions and the customs that persist, are the consumption of various insects and usage of insects for rituals and medicinal purposes. From the foregoing discussion, white grub, like any other food item and medicinal specimen, may contain one or more nutrients, elements or compounds necessary for body system up-keeping.

Liver is a discrete largest organ in human body that has many interrelated functions and it may be damaged due to one or more of the following: injury from metabolic disturbances, injury from toxins, drugs, chemicals and poisons, lesion of biliary tract, certain viral' infections, hypoxia, tumours (MacSwean, 1980; Roderick et al., 1998). Carbon tetrachloride (CCl<sub>4</sub>) induces lipid peroxidation and liver damage (Robbins and Cotran, 2006) and high dose of CCl<sub>4</sub> generates an ideal hepatotoxicity model organism that allows for evaluating the curative effects of medicinal rather than reporting natural healing (Alhassan et al., 2009b).

In a survey carried out, seven out of ten individuals contacted around Kano and its environs are in one way or the other aware of using white grubs to cure jaundice i.e. “shawara”. Hausa/ Fulani perception of jaundice “shawara” includes among others, general body weakness, tiredness, general body pain and even lose of appetite, without obvious sign of jaundice. This reported work was carried out to investigate the potency of white grubs extract against CCl<sub>4</sub> induced liver damage.

## MATERIAL AND METHODS

White grubs (WG) found in public wastes of Darmanawa quarters, Tarauni Local Government, Kano State were collected in the months of July and August, 2008. The WG were cleaned of dirt and blot, and was squeezed to release the extract (grubs’ extract). The extract was filtered using cheesecloth and adjusted to concentration of 1.0g/cm<sup>3</sup>. Commercially prepared reagent kits for alanine aminotransferase (ALT), aspartate aminotransferase (AST) alkaline phosphatase (ALP) and total bilirubin (TB) obtained from Randox Laboratories, Antrim, UK, were used to assay the enzymes. Thiobarbiturate, biuret and bromocresol green were used for serum malondialdehyde (MDA), total protein and albumin determination respectively.

## EXPERIMENTAL ANIMALS

Eighty five (85) rats were obtained and divided into five (5) groups of twenty (20) rats each for groups I and II, and fifteen (15) rats each for groups III, IV and V. The rats in the first group (group I) were not induced with lipid peroxidation and liver damage, they served as positive control, whereas rats in groups II, III, IV and V were induced with lipid peroxidation and liver damage using 120mg/Kg CCl<sub>4</sub> according to Alhassan et al. (2009b). Rats in group II were not administered with white grub extract, they served as negative control. Rats in groups III, IV and V were administered with a daily dose of 1.0, 2.0 and 8.0g/kg body weight of white grub extract. Five (5) rats were removed from each group after 3, 6 and 9 days of white grub extract treatment respectively and sacrificed by decapitation.

## BIOCHEMICAL ANALYSIS

Serum was separated and analyzed for alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities by the method of Reitman and Frankel (1957), serum alkaline phosphatase (ALP) activity by the method of Rec (1972), serum malondialdehyde (MDA) concentration by the method of Hunter et al (1963) modified by Gutteridge and Wilkins (1982), total bilirubin (TB) (Malloy and Evelyn, 1937) and serum total protein and albumin by the method of Chawla (1999).

## RESULTS AND DISCUSSION

### RESULTS

Table 1 summarizes the results for serum activities of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) and levels of total bilirubin (TB), malondialdehyde (MDA), total protein (TP) and albumin (ALB) for a group of rats 48hrs after intramuscularly injected with 120mg/Kg CCl<sub>4</sub>. Tables 2, 3 and 4 present the results for groups of rats injected with CCl<sub>4</sub> and administered with various doses of aqueous extract of white grubs daily for 3, 6 and 9 days respectively. There was significant difference (p<0.05) between group I and II in the parameters analyzed except for TP. The groups that received the white grubs’ aqueous extract showed significant decrease (p<0.05) in ALT, AST and ALP activities compared to group II.

Table 1: Serum ALT, AST and ALP activities and TB, MDA, TP and ALB levels in rats 48 hours after intramuscular administration of CCl<sub>4</sub>

| GROUP  | ALT (U/L)                       | AST (U/L)                       | ALP (U/L)                       | TB (μmol/L)                     | MDA (μM)          | TP (g/L)           | ALB (g/L)                       |
|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|-------------------|--------------------|---------------------------------|
| I<br>No CCl <sub>4</sub><br>administered           | 8.39<br>±<br>0.48 <sup>a</sup>  | 21.06<br>±<br>1.23 <sup>b</sup> | 32.50<br>±<br>2.13 <sup>c</sup> | 4.86<br>±<br>0.71 <sup>d</sup>  | 0.08<br>±<br>0.01 | 59.99<br>±<br>1.30 | 32.39<br>±<br>1.84 <sup>f</sup> |
| II<br>120mg/Kg<br>CCl <sub>4</sub><br>administered | 36.00<br>±<br>4.41 <sup>a</sup> | 110.01 ±<br>4.39 <sup>b</sup>   | 68.17<br>±<br>3.01 <sup>c</sup> | 10.40<br>±<br>1.12 <sup>d</sup> | 0.52<br>±<br>0.02 | 60.41<br>±<br>2.47 | 34.87<br>±<br>1.32 <sup>f</sup> |

Values in the same column bearing similar superscript are significantly different at  $p < 0.05$ ,  $n = 5$

Table 2: Serum ALT, AST and ALP activities and TB, MDA, TP and ALB levels in rats after oral administration of white grub extract for 3 days.

| GROUP   | ALT (U/L)                           | AST (U/L)                           | ALP (U/L)                           | TB ( $\mu\text{mol/L}$ )            | MDA ( $\mu\text{M}$ )              | TP (g/L)                          | ALB (g/L)                           |
|---|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|------------------------------------|-----------------------------------|-------------------------------------|
| I<br>No $\text{CCl}_4$<br>administered                  | 8.21<br>$\pm$<br>0.53               | 2.16<br>$\pm$<br>1.32               | 30.89<br>$\pm$<br>2.25              | 4.85<br>$\pm$<br>0.80               | 0.091 $\pm$<br>0.012               | 57.36 $\pm$<br>1.32               | 32.13<br>$\pm$<br>1.44              |
| II<br>No white<br>grub extract<br>administered          | 30.45<br>$\pm$<br>2.05<br>a, b, c   | 72.81<br>$\pm$<br>5.17<br>d, e, f   | 66.18<br>$\pm$<br>2.27<br>g, h, i   | 10.37<br>$\pm$<br>0.90<br>j, k, l   | 0.37<br>$\pm$ 0.01<br>m, n, o      | 64.46<br>$\pm$<br>0.07<br>p, q, r | 33.24<br>$\pm$<br>0.86<br>s, t, u   |
| III<br>1.0g/Kg<br>white grub<br>extract<br>administered | 29.86<br>$\pm$<br>1.06 <sup>a</sup> | 70.56<br>$\pm$<br>4.44 <sup>d</sup> | 67.46<br>$\pm$<br>0.49 <sup>g</sup> | 11.46<br>$\pm$<br>0.65 <sup>j</sup> | 0.33<br>$\pm$<br>0.01 <sup>m</sup> | 56.62 $\pm$<br>0.71 <sup>p</sup>  | 30.95<br>$\pm$<br>0.29 <sup>s</sup> |
| IV<br>2.0g/Kg<br>white grub<br>extract<br>administered  | 25.29<br>$\pm$<br>1.54 <sup>b</sup> | 52.21<br>$\pm$<br>1.32 <sup>e</sup> | 58.20<br>$\pm$<br>1.24 <sup>h</sup> | 9.71<br>$\pm$<br>1.66 <sup>k</sup>  | 0.29<br>$\pm$<br>0.01 <sup>n</sup> | 63.97 $\pm$<br>1.72 <sup>q</sup>  | 31.85<br>$\pm$<br>1.82 <sup>t</sup> |
| V<br>4.0g/Kg<br>white grub<br>extract<br>administered   | 21.57<br>$\pm$<br>2.04 <sup>c</sup> | 51.13<br>$\pm$<br>0.85 <sup>f</sup> | 63.79<br>$\pm$<br>3.34 <sup>i</sup> | 10.50<br>$\pm$<br>0.98 <sup>l</sup> | 0.26<br>$\pm$<br>0.01 <sup>o</sup> | 64.82 $\pm$<br>1.55 <sup>r</sup>  | 32.21<br>$\pm$<br>0.27 <sup>u</sup> |

Values in the same column bearing similar superscript are significantly different at  $p < 0.05$ ,  $n = 5$

Table 3: Serum ALT, AST and ALP activities and TB, MDA, TP and ALB levels in rats after oral administration of white grub extract for 6 days.

| GROUP  | ALT (U/L)                        | AST (U/L)                        | ALP (U/L)                         | TB ( $\mu\text{mol/L}$ )            | MDA ( $\mu\text{M}$ )              | TP (g/L)                         | ALB (g/L)                        |
|--|----------------------------------|----------------------------------|-----------------------------------|-------------------------------------|------------------------------------|----------------------------------|----------------------------------|
| I<br>No $\text{CCl}_4$<br>administered               | 8.19 $\pm$<br>0.48               | 2.06 $\pm$<br>1.23               | 32.50 $\pm$<br>2.13               | 4.96<br>$\pm$<br>0.70               | 0.082<br>$\pm$ 0.011               | 58.36 $\pm$<br>1.31              | 33.18 $\pm$<br>1.54              |
| II<br>No white grub<br>extract<br>administered       | 28.08 $\pm$<br>0.07<br>a, b, c   | 71.31 $\pm$<br>2.12<br>d, e, f   | 63.51<br>$\pm$<br>1.86<br>g, h, i | 14.06<br>$\pm$<br>1.73<br>j, k, l   | 0.28<br>$\pm$<br>0.01<br>m, n, o   | 62.54 $\pm$<br>1.44<br>p, q, r   | 30.91 $\pm$<br>0.01<br>s, t, u   |
| III<br>1.0g/Kg white<br>grub extract<br>administered | 20.29 $\pm$<br>1.90 <sup>a</sup> | 56.16 $\pm$<br>6.42 <sup>d</sup> | 71.03 $\pm$<br>0.76 <sup>g</sup>  | 13.01<br>$\pm$<br>0.51 <sup>j</sup> | 0.21<br>$\pm$<br>0.01 <sup>m</sup> | 63.86 $\pm$<br>1.09 <sup>p</sup> | 31.57 $\pm$<br>0.23 <sup>s</sup> |
| IV<br>2.0g/Kg white<br>grub extract<br>administered  | 16.47 $\pm$<br>1.81 <sup>b</sup> | 31.28 $\pm$<br>0.81 <sup>e</sup> | 58.90 $\pm$<br>2.01 <sup>h</sup>  | 9.01<br>$\pm$<br>0.06 <sup>k</sup>  | 0.18<br>$\pm$<br>0.01 <sup>n</sup> | 65.13 $\pm$<br>0.31 <sup>q</sup> | 30.99 $\pm$<br>0.39 <sup>t</sup> |
| V<br>4.0g/Kg white                                   | 15.28 $\pm$<br>0.22 <sup>c</sup> | 28.94 $\pm$<br>0.57 <sup>f</sup> | 66.81 $\pm$<br>0.41 <sup>i</sup>  | 11.94<br>$\pm$                      | 0.09<br>$\pm$                      | 62.32 $\pm$<br>0.75 <sup>r</sup> | 30.08 $\pm$<br>0.42 <sup>u</sup> |

grub extract administered

 0.46<sup>l</sup>

 0.02<sup>o</sup>

 Values in the same column bearing similar superscript are significantly different at  $p < 0.05$ ,  $n = 5$ 

Table 4: Serum ALT, AST and ALP activities and TB, MDA, TP and ALB levels in rats after oral administration of white grub extract for 9 days

| GROUP  | ALT (U/L)                       | AST (U/L)                       | ALP (U/L)                       | TB ( $\mu\text{mol/L}$ )        | MDA ( $\mu\text{M}$ )          | TP (g/L)                        | ALB (g/L)                       |
|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------------------------|---------------------------------|---------------------------------|
| I<br>No CCl <sub>4</sub> administered          | 8.16 ± 0.59                     | 2.16 ± 1.33                     | 32.60 ± 4.13                    | 4.96 ± 0.90                     | 0.082 ± 0.011                  | 59.56 ± 1.42                    | 34.18 ± 1.53                    |
| II<br>No white grub extract administered       | 25.88 ± 1.59 <sup>a, b, c</sup> | 62.04 ± 0.77 <sup>d, e, f</sup> | 60.72 ± 0.56 <sup>g, h, i</sup> | 10.26 ± 1.36 <sup>j, k, l</sup> | 0.18 ± 0.03 <sup>m, n, o</sup> | 58.66 ± 0.72 <sup>p, q, r</sup> | 28.67 ± 0.67 <sup>s, t, u</sup> |
| III<br>1.0g/Kg white grub extract administered | 18.87 ± 0.36 <sup>a</sup>       | 49.84 ± 1.56 <sup>d</sup>       | 61.72 ± 1.93 <sup>g</sup>       | 12.07 ± 0.07 <sup>j</sup>       | 0.09 ± 0.021 <sup>m</sup>      | 63.92 ± 0.97 <sup>p</sup>       | 31.91 ± 0.59 <sup>s</sup>       |
| IV<br>2.0g/Kg white grub extract administered  | 14.76 ± 0.29 <sup>b</sup>       | 27.62 ± 0.48 <sup>c</sup>       | 60.95 ± 1.16 <sup>h</sup>       | 10.15 ± 1.04 <sup>k</sup>       | 0.08 ± 0.01 <sup>n</sup>       | 64.03 ± 0.31 <sup>q</sup>       | 32.41 ± 0.36 <sup>t</sup>       |
| V<br>4.0g/Kg white grub extract administered   | 14.36 ± 1.74 <sup>c</sup>       | 25.94 ± 0.75 <sup>f</sup>       | 62.11 ± 1.36 <sup>i</sup>       | 11.09 ± 0.01 <sup>l</sup>       | 0.03 ± 0.02 <sup>o</sup>       | 60.05 ± 0.05 <sup>r</sup>       | 31.37 ± 0.41 <sup>u</sup>       |

 Values in the same column bearing similar superscript are significantly different at  $p < 0.05$ ,  $n = 5$ .

### DISCUSSION:

Rats injected with 120 mg/kg CCl<sub>4</sub> had significantly higher ( $p < 0.05$ ) serum AST, ALT, ALP, TB MDA and ALB than the normal rats (Table 1). It is therefore, indicating inducement of acute liver toxicity in the injected rats, it agrees with the report by Price and Stevens (2003) and work of Alhassan et al (2009b).

In phase I of this work (Table 2) rats treated with daily dose of 1g/kg, 2g/kg and 8g/kg aqueous white grubs extract for 3 days showed serum ALT, AST, MDA and ALB not significantly higher ( $p > 0.05$ ) than the control group. This is an indication of possible fibrosis, the initial repair mechanism of liver injury, as indicated by Burtis et al. (2001) that all cellular damage induces fibrosis as a healing response. However, the healing effect is more pronounced in groups that received daily doses of 8g/kg and 2g/kg for 3 days compared to group III rats which received a daily dose of 1g/kg; this may be possibly due to low serum bioavailability of the extract. It may be inferred that the extract facilitates the fibrosis.

In phase II (Table 3) rats in group V, IV and III, treated with different concentration of the white grubs' extract for six days had mean serum activities of ALT and AST and levels of TB and MDA significantly lower ( $p < 0.05$ ) than the control. This shows possible hepatocytes curative effect of the white grubs' extract on the damaged due to CCl<sub>4</sub> possibly by influencing fibrosis and collagen synthesis as indicated by Keith and Robert (2001) that the liver response to injury is hepatocytes regeneration and collagen formation. The observed hepatocurative effect of the white grubs' extract could be associated with proteins, fats, and mineral elements especially iron (Fe) and copper (Cu) (Alhassan et al., 2009a) and humic substances contents of white grubs (Alhassan, 2010).

From Table 4 (phase III), rats treated with daily doses of 1.0g/kg, 2.0g/kg and 8.0g/kg for nine days, had serum activity of ALT and AST and levels of MDA not significantly higher ( $P < 0.05$ ) than the control, and the improvement in the liver was more in group IV and V compared to group III.

The possible hepatocurative effects of white grubs extract could be attributed to the chemical composition of white grub. White grub (WG) is rich in fats, protein, some mineral elements (Alhassan et al., 2009a) and humic substances (fulvic and humic acids) (Alhassan, 2010). WG fats may contain phosphatidyl choline, vitamins A and E which are good natural antioxidants, which may role in hepatocurative effect of the grubs. The protein of white grub may contain some amino acids (glycine, lysine, proline and methionine) that favour collagen biosynthesis which is critical in healing response by the hepatocytes. Collagen consists of a dextrorotatory triple helix made up of three polypeptides ( $\alpha$ -chains). The triplet Gly-X-Y is constantly repeated in the sequence of the triple-helical regions— i. e., every third amino acid in such sequences is a glycine. Proline (Pro) is frequently found in positions X or Y; the Y position is often occupied by 4-hydroxyproline (4Hyp), although 3-hydroxyproline (3Hyp) and 5-hydroxylysine (5Hyl) also occur. These hydroxylated amino acids are characteristic components of collagen. The hydroxyproline residues stabilize the triple helix by forming hydrogen bonds between the  $\alpha$ -chains, while the hydroxyl groups of hydroxylysine are partly glycosylated with a disaccharide (–Glc–Gal) (Koolman and Roehm. 2005). Choline dihydrogen citrate and DL- methionine are used in pharmaceutical preparation indicated for hepatitis, alcoholic hepatitis and drug induced hepatotoxicity. The presence of Fe and Cu also have roles in hepatic healing being required by lysine and proline hydroxylase respectively, the activities of these enzymes are required for maturation of collagen.

Humic acids seem to accelerate cell metabolism, the rate of breakdown of glucose, leucine and uridine. Humic acids seem to retard the rate of incorporation of these organic molecules into the liver, but once they are absorbed, humic acids appear to accelerate their metabolism (Visser, 1973), thereby reducing metabolic burden on the hepatocytes. That may encourage healing of the injured hepatocytes as it has been part of management of hepatitis to reduce fatty and protein rich diet. Humic acids can apparently stimulate respiration and increase the efficiency of oxidative phosphorylation in rat liver mitochondria (Visser, 1987). Cellular respiration, occurring only in the presence of oxygen, results in the breakdown of nutrient molecules to generate ATP. Cells such as the liver and muscle use this ATP for energy to fuel various processes like stimulating the uptake of nutrients, repair of dead or damage tissue (Nelson and Cox 2006)). This may be due to their acidic functional groups, primarily carboxylic acid and phenolic hydroxyl groups, which give them the capacity to react with various species such as free radicals, minerals and biological enzyme systems (Frimmel and Christman, 1988; Aiken et al., 1985; Shils and Shike, 1994). Both non-enzymatic and enzymatic antioxidants serve as defense to cope with oxygen-free radicals. The former includes a wide variety of such compounds as alfa-tocopherol (vitamin E), betacarotene, and ascorbic acid (vitamin C), whereas the latter includes the scavenging enzymes; superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GSH-Px). They form an important defense system to ensure that cytotoxic oxygen species are degraded to less harmful compounds so that extensive cell damage does not occur (De La Torre et al., 1999). White grubs being rich in fats and proteins, may contain some of these antioxidants and its hepatocurative effects may be via some of them.

#### CONCLUSION:

The study has shown that white grubs extract has hepato curative effect even at the dose of 1.0 g/Kg body weight in six days of administration. This may be attributed to chemical composition of white grubs, especially the high fats, protein (rich in proline and lysine), humic acids, fulvic acids, and Fe and Cu contents. The presence of proline and lysine that are very important components of collagen may have played significant role. The contents of humic and fulvic acid may also have roles in the hepato curative effects of white grubs extract, because of their antioxidant property, metabolic roles, decreasing loads on hepatocytes.

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# POTENTIOMETRIC STUDY OF THE REFINING PROCESS IN SYNTHETIC GLASSES BETWEEN 1200 AND 1400°C TEMPERATURES

H. Latelli

Physics and Chemistry Materials Laboratory (LPCM)  
University of M'sila, P.O. Box 166, Ichbilia 28000, M'sila-Algeria

**Abstract** – In the aim of studying the effect of arsenic in refining synthetic glasses, we have chosen to follow the electromotive force (e.m.f) evolution with and without nitrates at temperatures between 1200 and 1400° C. A particular attention was given to the analysis of the electromotive force evolution according to the  $As^{5+}/As^{3+}$  ratio. At high temperatures, we assist to a phenomenon of a decomposition with liberation of oxygen, which makes small bubbles of gas in the glass bigger, and facilitates their ascent to the surface following the Stokes's law.

The results have shown that the composition of samples is a determining factor of the kinetic of the refining process, which is very important in industrial field.

**Key words** : Synthetic glasses, oxygen potential, e.m.f, arsenic, nitrates.

## Introduction

The main glass properties (conductivity, color, residual bubbles, etc ...) depend largely on refinement conditions, particularly oxygen potential [1]. Control of the final glass properties requires therefore the control of refinement and oxygen potential.

El-Harfaoui [2] showed that most of the glasses tested (the methaborate of lithium, the silicate of lead, industrial glasses ready of type crystal ready to use and lead glass collected in industrial environment at different stages of the refining) at a maximum temperature of 1150°C have a potential strongly oxidizing at the beginning of refining (up to 200mV). This potential decreases very slowly with time for temperatures around 1100°C.

To expedite the process of balance with the ambient environment and be closer to actual temperatures of refining, El Harfaoui recommends experiences at higher temperature than the melting (1000-1500°C depending on the mixture composition) to make the glass more fluid and allow gases, that are still present in the dough, to escape. This is ripening.

To release the small gas bubbles of oxygen remaining, we use a Redox system [3-7]. In our case, we have used the couple  $As^{5+}/As^{3+}$ , where  $As^{5+}$  is the oxidized state and  $As^{3+}$  the reduced state. The choice of such a system lies in its ability to mediate between the middle glasses itself and the ambient environment. At high temperature, there is the decomposition of carbonates and nitrates with the release of oxygen that makes fat the small gas bubbles still present and facilitate their ascent to the surface according Stokes' law:

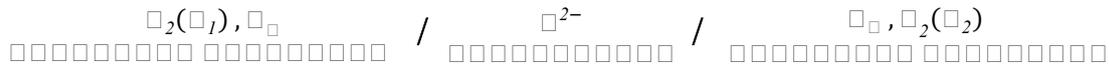
$$v = \frac{2g\rho d^2}{9\eta}$$

with  $v$  is the velocity of rising,  $\rho$  is the mass density of the glass,  $g$  is the gravitational acceleration,  $\eta$  is the glass viscosity and  $d$  is the diameter of the bubble.

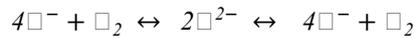
Our objective is to follow the evolution of oxygen potential with time at temperature, and study the effect of refining (arsenic) with and without nitrates.

## Electrochemical system

In an electrochemical system of solid electrolyte, the variation of the substances concentration (of the activity) is determined by measuring the e.m.f of the cell. Knowing that a cell with a compartment is represented by the following diagram:



The solid electrode is made of zirconia (lime doped) which gives predominantly ionic conductivity by  $\text{O}^{2-}$  ion. The transfer of oxygen through the solid electrolyte is made according to the following double electrochemical balance:



The e.m.f (E) of the cell is related to the activity of the oxygen according to the Nernst law:

$$E = \frac{RT}{4F} \ln \frac{a_1}{a_2}$$

$a_1$  and  $a_2$ , the activities of the oxygen on both sides of the electrolyte.

In the pressure range where the Nernst law is satisfied, the electrochemical equilibrium can be represented by the half-reaction:



At a given temperature, E depends on the partial pressure of the body members participating at the reaction of the cell. The oxygen behaves as an ideal gas and the above equation becomes [8]:

$$E = \frac{RT}{4F} \ln \frac{p_{\text{O}_2}(p_1)}{p_{\text{O}_2}(p_2)}$$

where  $p_{\text{O}_2}(p_1)$  is the partial pressure of oxygen in the studied medium (glass);  $p_{\text{O}_2}(p_2)$  is the partial pressure of oxygen in the reference electrode, R is the gas constant in  $\text{J.K}^{-1}.\text{mol}^{-1}$ , F is Faraday's number and T is the absolute temperature in Kelvin.

## Synthetic glasses used

We used synthetic glasses whose compositions are in mol%:  $(100-x)\text{SiO}_2 - x\text{K}_2\text{O}$  with x equal to 15, 20, 25, 30 and 35. These binary mixtures are composed mainly of sand ( $\text{SiO}_2$ ) and potassium carbonate ( $\text{K}_2\text{CO}_3$ ). These glasses are further divided into three categories: glasses without refining, glasses with Redox system (0.15% by weight of  $\text{As}_2\text{O}_3$ ) and glasses with full refining (0.15% by weight of  $\text{As}_2\text{O}_3$  and 1.3% by weight of  $\text{KNO}_3$ ).

The crystal structure  $\text{K}_2\text{O}.4\text{SiO}_2$  was determined by the X-ray diffraction [9]. The basic unit is the tetrahedron  $\text{SiO}_4$  formed of a silicon atom in the center surrounded by four oxygen atoms. Each oxygen atom belongs simultaneously to two tetrahedrons so that they have in common all their summits. All oxygen atoms thus form bridges between silicon atoms.

The incorporation of a metal oxide such as  $\text{K}_2\text{O}$  causes heterolytic breakage of a number of bonds between Si and O. This therefore leads to the formation of two motifs with two non-bridging oxygen, whose negative charges are compensated by those of  $\text{K}^+$  ions.

It should be noted that the records of the e.m.f curves were performed at the Laboratory of Metallurgical Thermodynamic University of Nancy I in France.

## Results and Discussion

Along this study, we have preferred to follow the evolution of the e.m.f versus time for a temperature set at  $1400^\circ\text{C}$  and, to explain the behavior of changes in e.m.f, we treated the effect of temperature change during the operation. Then we have followed the evolution of the  $\text{As}^{5+}/\text{As}^{3+}$  as a function of the e.m.f.

In the reference compartment, the partial pressure of oxygen is 0.6 atmospheres and in the compartment of the working electrode, the oxygen pressure is variable. The cell is maintained at a fixed temperature.

The studies of Brawer *et al* [10], Verweij *et al* [11-14] and Hass [15] on the effect of arsenic on the structure of glasses have shown that for the composition  $xK_2CO_3 - (100-x)SiO_2 + 0.5As_2O_3$  abbreviated KxA ( $x = 10, 20, 30, 35, 40, 50$ ), the structure of K50A consists mainly of metasilicate chains, constructed from tetrahedral  $SiO_2$  with two bridges of oxygen atoms located at corners. While the compositions K20A and K10A contain silicate in their networks which consists of  $K_2O.4SiO_2$  and  $SiO_2$  (vitreous).

Verweij [14] has showed, by using Raman spectroscopy on the glass  $xK_2CO_3-(100-x)SiO_2$  with or without  $0.5As_2O_3$  that  $AsO_4^{3-}$  ions exist for compositions  $x = 50, 40, 35$  while for  $x = 30, 20$  and  $10$  these ions do not exist, rather it forms ions of  $As_2O_7^{2-}$  type.

## 1. E.m.f evolution with time at $T = 1400^\circ C$

### a) Composition : $85SiO_2 - 15K_2O$

The curve obtained at  $1400^\circ C$  when the electrode material is  $85SiO_2-15K_2O$  (without arsenic and nitrate) is shown in Figure 1. The e.m.f initially measured is approximately 100mV. This figure shows the presence of a maximum in the response curve, located above the stationary value. The difference between this maximum and the steady-state value for each time increases and the equilibrium is reached after 50 hours. It should be noted that this phenomenon is even more important when the oxygen pressure is high.

This finding is in favor of the existence of two antagonistic processes during the establishment of equilibrium of the interface after changing the partial pressure of oxygen, for example, we could consider putting in rapid equilibrium the adsorbed phase and a slow phenomenon of equilibrium establishment of the material with oxygen.

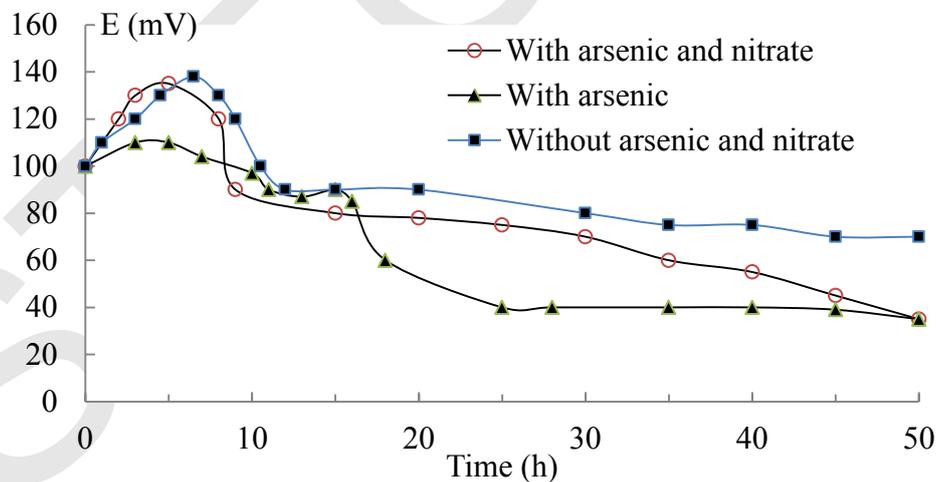


Figure 1: E.m.f evolution with time at  $1400^\circ C$  for  $85SiO_2 - 15K_2O$  composition.

Meanwhile, we took the same composition with samples containing arsenic as  $As_2O_3$  (0.15%) on one hand and on other hand arsenic and nitrate (0.15%  $As_2O_3$  and 1.3%  $KNO_3$ ). We note that the general shape of these curves is retained relatively to the first case and that the maximum emf for composition with only arsenic is low, while for the sample with arsenic and nitrate, the emf is of the same order of magnitude. The return to equilibrium is faster when adding arsenic and nitrate (Figure 1). After a period of one hundred (100) hours, the e.m.f is close to zero (0) with compositions containing arsenic and arsenic plus nitrate while it is 40mV with the composition without refining.

When adding potassium nitrate which decomposes releasing oxygen, we should expect an e.m.f higher at the beginning; this is what found Löh *et al* [16] in the case of a ternary composition (17Na<sub>2</sub>O, 12CaO, 71SiO<sub>2</sub> mol %) at 1100°C. While at high temperature (1400°C), they no longer observe a significant difference, we are actually under dynamic regime: at low temperature, the oxygen supplied by the nitrate cannot diffuse outward, the glass is very viscous. Inversely, at high temperature, the equilibrium with the ambient environment is much faster.

For other compositions (80SiO<sub>2</sub>-20K<sub>2</sub>O, 75SiO<sub>2</sub>-25K<sub>2</sub>O and 70SiO<sub>2</sub>-30K<sub>2</sub>O), the evolution of e.m.f with time is of the same type, the maximum is located around 120 to 140mV. After two days, the e.m.f is only about 20mV. The full return to equilibrium is reached only after a hundred of hours. The 65SiO<sub>2</sub>-35K<sub>2</sub>O composition performs a behavior different from other cases, that we will treat as a special case.

### b) Composition : 65SiO<sub>2</sub> – 35K<sub>2</sub>O

The initial e.m.f is much lower and even negative (Figure 2), the equilibrium is reached after about 5 hours. Apparently, we do not detect a very characteristic difference in behavior between the composition without refining and the composition with refining. This composition has a very different electrochemical behavior compared to other binary mixtures. If one refers to the binary equilibrium diagram SiO<sub>2</sub>-K<sub>2</sub>O [17], we can say that this behavior is due to the formation of compound K<sub>2</sub>O.SiO<sub>2</sub> whose melting point is 1050°C. These findings are also approved by Verweij *et al* [14].

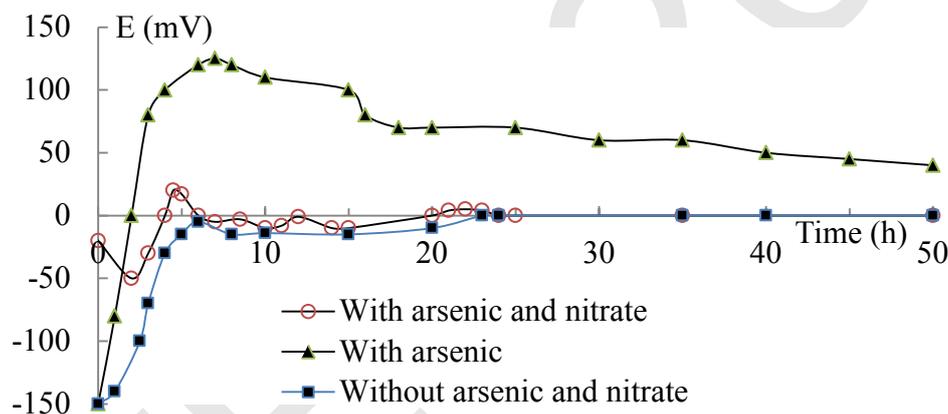


Figure 2 : E.m.f evolution with time at 1400°C for 65SiO<sub>2</sub>-35K<sub>2</sub>O composition.

The e.m.f is very unstable during the early hours of refining, and is about 20mV after 7 hours for both compositions the poorest in SiO<sub>2</sub>, i.e the more fusible. For the composition the richest in the SiO<sub>2</sub>, the e.m.f remained relatively high even after a very long time (65hours).

## 2. E.m.f variation with temperature

To have a stable system, we have preceded the temperature changes by an isothermal hold for several hours and we have chosen the binary composition: 85SiO<sub>2</sub>-15K<sub>2</sub>O. Manipulations are doubled: we have used mixtures with Redox system (with refinement).

During the heat up period at low temperature, the e.m.f is not stable (Figure 3). From 1000 - 1200°C, the e.m.f stabilizes, we measure 40mV at 1400°C; temperature changes followed by isothermal maintaining cause variations of emf almost instantaneous with gradual return to equilibrium.

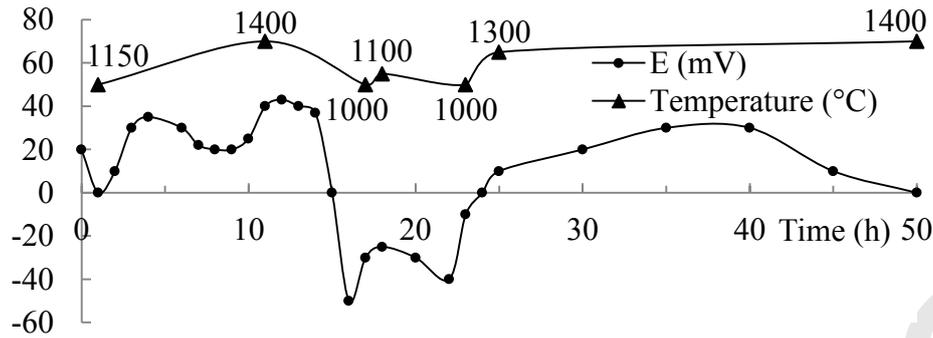


Figure 3: Variation of E with temperature for 85SiO<sub>2</sub>-15K<sub>2</sub>O (with Redox system) composition.

### 3. Forecasting changes in e.m.f

Pyare et al [13] have observed by chemical changes the evolution of As<sup>3+</sup> and As<sup>5+</sup> during refining of 70SiO<sub>2</sub>-30K<sub>2</sub>O composition. They consider that from the time the ratio As<sup>5+</sup>/As<sup>3+</sup> becomes constant, one reached equilibrium, i.e the partial pressure of oxygen inside the glass is equal to the partial pressure of the surrounding ambient medium (0.2atm.).

These authors identified the equilibrium constants corresponding to the different temperatures of 1100 to 1400°C. They found at equilibrium for the ratio As<sup>5+</sup>/As<sup>3+</sup> the value 2.8, a constant K equal to 8.20 at 1400°C and 27.7 at a temperature of 1200°C.

To extend the study of Pyare et al [13], we have tested several compositions: 85SiO<sub>2</sub>-15K<sub>2</sub>O, 80SiO<sub>2</sub>-20K<sub>2</sub>O, 75SiO<sub>2</sub>-25K<sub>2</sub>O, 70SiO<sub>2</sub>-30K<sub>2</sub>O, 65SiO<sub>2</sub>-35K<sub>2</sub>O in the presence and absence of refining. We have proposed to study the variation of ratio As<sup>5+</sup>/As<sup>3+</sup> as a function of e.m.f. The results are shown in Figure 4.

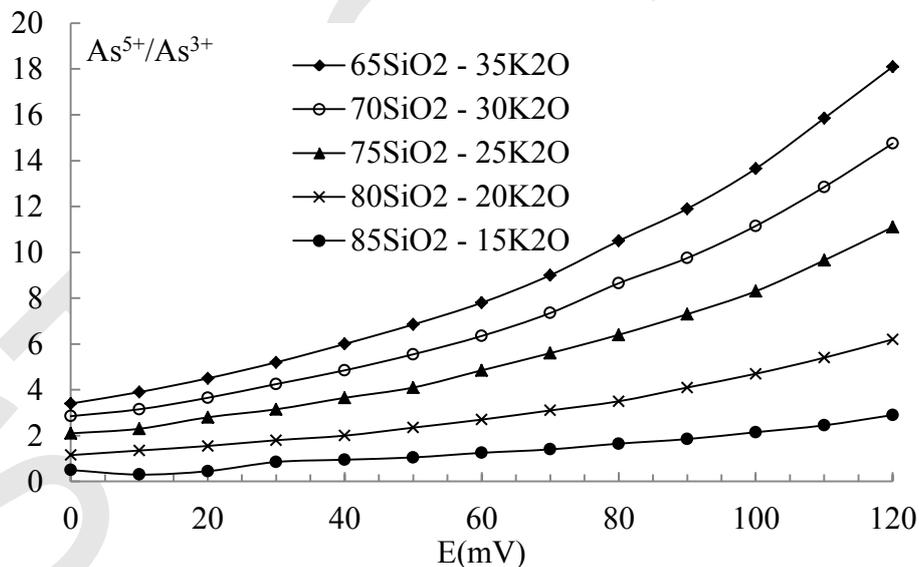


Figure 4 : Variation of the As<sup>5+</sup>/As<sup>3+</sup> ratio with e.m.f at t = 48 hours.

These variations certainly reflect variations the activity coefficient of different ions present in the glass and involved in the equilibrium constant. In the Nernst relationship, the e.m.f varies with temperature, i.e a decrease of 200°C leads to a decrease of 8.4mV if one starts from a e.m.f of 60mV. The decrease in absolute value will be much lower than it is close to equilibrium with the ambient environment, it is what is observed, but the observed experimental decreases are higher than predicted by the term in RT. If for the new temperature, we consider the apparent equilibrium constant obtained from chemical analyzes of Pyare et al [18], the agreement is better.

Thus, for the composition 70SiO<sub>2</sub>-30K<sub>2</sub>O, Pyare et al [18] found at equilibrium a ratio As<sup>5+</sup>/As<sup>3+</sup> equal to 2.8 that is a constant K equal to 20.8 at 1400°C. Similarly, these authors found a value of 27.7 at 1200°C. A e.m.f of 60mV at 1400°C corresponds thus to a ratio of As<sup>5+</sup>/As<sup>3+</sup> equal to 6.45. If we decrease the temperature of 200°C and we consider the ratio

$As^{5+}/As^{3+}$  does not have time to vary, taking into account the new equilibrium constant at 1200°C, we will have  $PO_2=0.6atm$  that is a e.m.f of 35mV at 1200°C.

The results obtained by varying the concentration of alkali are consistent with the proposed new relationship. For equilibrium establishment of the Redox system, Pyare et al [18] use the relative stabilization of  $As^{5+}/As^{3+}$  ratio, obtained at 1400°C after 24 to 48 hours.

## Conclusion

Our electrochemical measurements show that for periods of 24 to 48 hours, the e.m.f is still 30 to 40mV and the return to equilibrium is only reached for a hundred of hours. Often we keep a residual e.m.f of 10 to 20mV with respect to the ambient temperature.

We originally thought to have very different electrochemical behaviors between different preparations. Indeed, the only major difference that we have encountered is of kinetics order, which is important in industrial environments where the notion of refined glass primarily reflects the absence of bubbles, while on a more fundamental level, the concept of oxygen potential reflects the state of the glass. It seems that the Redox system is therefore primarily a refining accelerator and a chemical tracer easy to identify.

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## PREPERATION AND ASSESMENT OF DIFFERENT MIXTURES OF TNT WITH NTO

Hasan Kutay Yıldız, Arif Hışır, Çiğdem Yolaçan, M. Kasım Şener, Nüket Öcal, Ulvi Avcıata  
*Yıldız Technical University, Faculty of Arts and Sciences, Department of Chemistry, Davutpaşa,  
İstanbul, Turkey, 34210*

### Abstract:

Energetic materials (explosives, propellants and pyrotechnics) are used extensively for Civil as well as Military Applications. Today the variety and number of high energy materials for various applications have become innumerable of which chemistry, Synthesis, properties and other salient features are available in the literature. In the past, common explosives hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) and 2,4,6-trinitrotoluene (TNT) were considered adequate for all weapon applications. Because of many catastrophic explosions resulting from unintentional initiation of munition by either impact or shock, aboard ships, aircraft carriers, and munition trains, these explosives have become less attractive. Of course, higher performance has always been a prime requirement in the field of research and development of explosives and the quest for the most powerful high explosives still continues and this search seems to be never ending. The demand from the user for increased performance with reduced or low vulnerability could not be met with existing materials, and the need to control costs ensured that the processes for producing compositions were also subject to rapid change. Thus, in modern ordnance there are strong requirements for explosives having both good thermal stability, impact and shock insensitivity and better performance. However, these requirements are somewhat mutually exclusive. The explosives having good thermal stability and impact insensitivity usually exhibit poorer explosive performance and vice versa. Therefore, the foremost objective at the stage of synthesis of new explosives consists of finding the molecule having both a good energy capability and optimal safety (reduced vulnerability, shock and impact insensitivity) to those in current use [1]. In response to such accidents, programs have been established world wide to develop Insensitive Munition (IM) which respond less violently to accidental environmental stimuli, and policies have been instituted to adopt such weapons into service. There are several different approach to the developement of insensitive munitions, but prominent among them is the use of explosive fillings with reduced sensitivity, but in which performance is not compromised. Two avenues by which to approach IM-compliant explosive compositions are the substitution of sensitive ingredients with intrinsacally less insensitive materials, and the use of tough, rubbery polymeric matrix to absorb environmental abuse and to provide physical and chemical isolation of the energetic components [2]. NTO (3-nitro-1,2,4-triazol-5-one) is an insensitive but relatively powerful explosive which shows promise for application in either approach to IM-compliant formulations. In particular melt-cast based compositions may provide viable IM-compliant options. This report focuses on the properties of NTO and its application in melt cast TNT-based explosives and testing of its sensitiveness. In this proposed study, an insensitivity of TNT which is produced by MKEK will be done by means of the mixture of TNT with NTO (3-nitro-1,2,4-triazole-5-one). Pilot experiments are on the scale of laboratory and then industrial applications will be studied.

**Key words:** Energetic Materials, Insensitive Munitions, 2,4,6-trinitrotoluene, 3-nitro-1,2,4-triazol-5-one, Stability and Performance

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## PRE-SERVICE TEACHERS' OPINIONS ABOUT THE USE OF WEB ADVENTURE IN THE COURSE OF INTRODUCTION TO COMPUTER

Pınar Mihci

*Aksaray University,  
Education Faculty, Aksaray/Turkey  
pinar\_mihci@yahoo.com*

Halise Şerefoğlu

*Gazi University,  
Education Faculty, Ankara/Turkey  
serefogluh@yahoo.com*

**Abstract:** Within the present study, the opinions of the 1<sup>st</sup> year students from the department of mathematics teaching about the use of web adventure in the course of introduction to computer were investigated. The study group of the present study consists of 40 pre-service teachers. The students created groups of 2 or 3 students. The groups were asked to determine the characteristics to be possessed by a good teacher and then to make some comments and create graphs related to these characteristics. The students' comments and graphs were organized in a presentation program and then presented to their classmates. At the end of the application, a data collection tool aiming to elicit the students' opinions about the application was administered. The data collected were analyzed by two evaluators. And as a result, it was found that web adventure is a different and effective method and can be used in various courses by means of some enrichment.

**Key Words:** *web adventure, pre-service teacher, mathematics teaching*

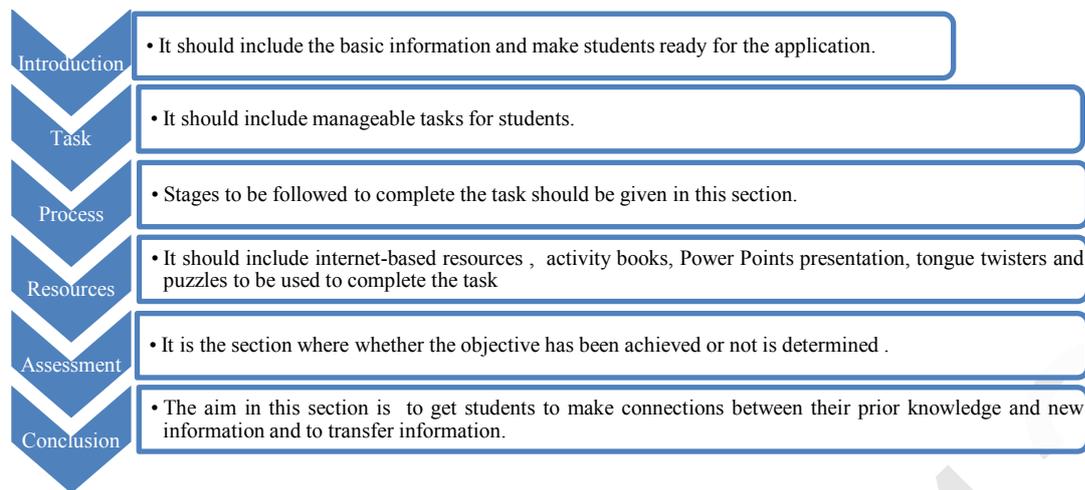
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### Introduction

In today's world, people can have access to incredible amount of information just by one click. This information is available for everyone. Yet, as the information is too much, students and teachers may experience some confusion and despair. Hence, there is a need to be cautious about the activities to be designed through web and much consideration should be given to create quality and appropriate activities. As the resources and steps of the activities to be designed by Web Adventure are under the control of the teacher, the process will be much more orderly for students and the teacher (Crawford and Brown, 2002).

Web Adventure is a tool developed by San Diego University in 1995 to have regular and meaningful information on Internet. The application was developed by Dodge and then its content was enhanced by March. According to Dodge (1998), Web Adventure provides access to internet resources, is group work-centered, and allows researching and using high level thinking skills. March (2003) points out that web adventure can make great contributions to the development of deep understanding of students, and helps them to be more autonomous and learning-centered. According to Polly and Ausband (2009), web adventure is a popular means of using technology in class.

According to Dodge (1998), web adventure represents inquiry-based activities for which all or part of information is received from the resources on internet. Through these activities, it is aimed that students interact with the resources on internet and learn from them. Two different types of web adventures can be designed depending on their time span. Short-term web adventure is limited to three class hours. Here, the purpose is the acquisition and integration of information. Long-term web adventure can last for one week or one month. Here, the objective is to expand and internalize information. Long-term web adventure is influential on many different types of thinking skills. Marzano (1988) states that long-term web adventure includes many thinking skills such as comparison, classification, induction, detection, analysis of mistakes, consolidation, abstraction and analysis of different viewpoints. Dodge (2008) states that for the application to be successful, it should encompass the following sections:



**Figure 1.** Sections of web adventure

The effects of web adventure on students have drawn the interest of many researchers and become the subject of many studies. When the literature was reviewed, it was observed that the effects of web adventure on higher level thinking skills, efficiency of students, teachers' perceptions and opinions were widely investigated. The results reported in the literature show that web adventure activities have positive effects on students (Halat and Jakubowski, 2001), provide students with real life activities (Crawford ve Brown, 2002), increase motivation and make contributions to the development of skills required to work on internet and have access to resources (Hassanien,2006) and pre-service teachers have positive attitudes towards the use of web adventure for educational purposes (Halat, 2007; Zheng, Stucky, McAlack, Menchana and Stoddart, 2005). The research mostly focuses on the teaching of mathematics and very limited number of studies looking at the effectiveness of web adventure in teaching of computer course was encountered in the literature.

The present study investigated the effects of web adventure used in a computer course on the students' opinions and moreover, responses to the question of what kind of characteristics can be added to make web adventure more effective were sought. The present study aims to determine the opinions of first-year pre-service mathematics teachers about the use of web adventure in a computer course. In this respect, the study seeks answers to the following research question:

1. What is the contribution of working with web adventure to students?
2. Addition of which characteristics to web adventure site can make it more effective for students?

## Method

The opinions of the students about the application make up the basis of the study. Hence, this is a case study, which is one of the quantitative research designs.

### Participants

The present study was conducted with the participation of the first year pre-service mathematics teachers taking computer course at the Education Faculty of Aksaray University in 2010-2011 academic year. The participants were selected out of the students who were taught by the researcher so that they could be observed throughout the application and they could seek help when they met any problem. The study was initiated with 47 students and then 7 students were excluded as they did not participate in the lessons. The students conducted the application first by doing individual activities and then working in groups. The groups consisted of 2 or 3 people.

### Data Collection Instruments and Data Analysis

The opinions of the students about the application were collected through an interview form developed by the researchers. The form consists of 3 open-ended questions. The questions developed by the researchers were firstly refined based on the opinions of two experts and then administered to the students. In the analysis of the students' opinions, content analysis was employed, which is one of the qualitative research methods.

### Application Process

Before the application, the students were informed about web adventure and the web site, which was already designed, was introduced. The students were given three weeks to complete the task. In the introduction section, within the framework of the computer course, the students were expected to make a presentation by using word processor, electronic graph and presentation program. The students were also asked to determine the characteristics to be

possessed by a good teacher and explain why these characteristics should be possessed. During the application, the students were given the steps to be followed to complete the task.

In the second week, the students were asked to compare the characteristics expressed and analyze which characteristic was used by how many participants and then plot the findings on electronic graph program and send them to the course advisor through e-mail. In the scale used in the assessment section, the students' efficiency of using the software program, the coherence of the content, spelling and punctuation errors, originality of the product and presentation skills were evaluated and scoring was determined. The scores were assigned ranging from "very good (4)" to "poor (1)".

In the resources section, articles discussing teacher characteristics, manuals of office programs and office utilization animations were included. They were asked to work by using these resources. In the conclusion section, the students were given support for the task they carried out and brief information was given about the benefits of this process.

## Findings

In this section, analyses of the data collected through the data collection instrument are presented. The students' opinions were analyzed by two different evaluators. The analyses revealed that there is a high degree of reliability between the evaluators ( $r = .91$ ).

### Students' Opinions about the Contribution of Web Adventure

The students' responses to the question "What is the contribution of working with web adventure to you?" asked in the form of web adventure student opinions form were classified under eleven categories. High majority of the students (85.0%) think that working with web adventure has positive contribution to them. Among the contributions of working with web adventure are there internalization of information (47.0%), increasing motivation (17.0%), feeling happier (2.5%) and focusing on the information related to the topic at hand (2.5%).

**Table 1:** Students' opinions about the contributions of web adventure

| Statement                         | Frequency (f) | Percentage % |
|-----------------------------------|---------------|--------------|
| <b>It has contribution</b>        | <b>34</b>     | <b>85</b>    |
| Internalization of information    | 19            | 47           |
| Motivation                        | 7             | 17           |
| Real problems                     | 6             | 15           |
| Idea sharing                      | 4             | 10           |
| Opportunities to work on internet | 4             | 10           |
| Group works                       | 4             | 10           |
| Applied learning                  | 3             | 7,5          |
| Recognition of shortcomings       | 2             | 5            |
| Happiness                         | 1             | 2,5          |
| Focusing on resources             | 1             | 2,5          |
| <b>No contribution</b>            | <b>6</b>      | <b>15</b>    |
| <b>Total</b>                      | <b>40</b>     | <b>100</b>   |

Some of the students think that this application did not have any contribution to them at all (15.0%). This may be because of the fact that the students had not studied with such applications beforehand.

### Students' Opinions about the Problems Encountered in Web Adventure

"Did you encounter any problems while carrying out web adventure project? If your answer is YES, explain the problems". Majority of the students stated that they had no problem during the application (57.5%). Most of the problems encountered stemmed from computer and internet connection (27.5%). The students stated that if they had personal computers, they would perform their task better.

*"I encountered some problems. As I did not have a computer, I could not read all of the resources."*

**Table 2:** Student opinions about the problems encountered during the application

| Statement                          | Frequency (f) | Percentage (%) |
|------------------------------------|---------------|----------------|
| <b>I did not have any problems</b> | <b>23</b>     | <b>57,5</b>    |
| <b>I had some problems</b>         | <b>17</b>     | <b>42,5</b>    |
| Technical problems                 | 11            | 27,5           |
| Unfamiliar application             | 4             | 10             |

|                                |           |            |
|--------------------------------|-----------|------------|
| Inadequate information         | 3         | 7,5        |
| Group works                    | 2         | 5          |
| Insufficient office facilities | 1         | 2,5        |
| Time                           | 1         | 2,5        |
| <b>Total</b>                   | <b>40</b> | <b>100</b> |

As the web adventure is new in our country and it is not frequently used in classes, the students are not familiar with the application. Therefore, some students felt unfamiliar to the steps of the application (5%).

### Student opinions about how to enhance the effectiveness of web adventure

The students' responses given to the question "What should be added to web adventure site to make it more effective and useful? Explain your suggestions." were classified under nine categories. Majority of the students think that there is no need to add something (67.5%). According to the students, enhancing the visual characteristics of the web site is one of the elements that can improve its effectiveness (25.0%). There are some students stating that resources should be shorter because reading the resources given is too time-consuming (17.5%).

**Table 3:** Student opinions about how to enhance the effectiveness of web adventure

| Statement                                 | Frequency (f) | Percentage % |
|---|---------------|--------------|
| <b>There is no need to add something.</b> | <b>13</b>     | <b>32,5</b>  |
| <b>There is a need.</b>                   | <b>27</b>     | <b>67,5</b>  |
| To improve visual characteristics         | 10            | 25           |
| Shorter resources                         | 7             | 17,5         |
| Detailed process                          | 3             | 7,5          |
| Enhancing the visual                      | 3             | 7,5          |
| Sample application                        | 2             | 5            |
| Office resources                          | 1             | 2,5          |
| Different design                          | 1             | 2,5          |
| Guidance                                  | 1             | 2,5          |
| <b>Total</b>                              | <b>40</b>     | <b>100</b>   |

## Discussions and results

The present study investigated the students' opinions about web adventure used in a computer course. In light of the findings, it can be argued that majority of the students have positive opinions about the administration. This is because they believe that web adventure increases motivation, provides opportunities to work with technology, includes various activities and allows group works. However, some problems such as lack of computers and internet connection failures affect the students' opinions about the process negatively. Such problems may result in the students' developing negative attitudes towards the use of such applications in their future classes. When the students' opinions about how to enhance the effectiveness of the application are investigated, it is seen that enhancing visual characteristics and presenting shorter resources are believed to make it more effective. Moreover, the students think that addition of detailed guidance and sample applications will also improve the efficiency. Future researches to be conducted on web adventure can be carried out in such an environment with better computer and internet infrastructure, and they should use web adventures having more visuals and shorter resources.

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## PRE-SERVICE TEACHERS' PERCEPTIONS ABOUT THEIR OWN LEARNING STYLES

Didem Kılıç  
Faculty of Education  
Aksaray University  
Turkey  
[didem@aksaray.edu.tr](mailto:didem@aksaray.edu.tr)

Necdet Sağlam  
Institute of Science  
Hacettepe University  
Turkey  
[saglam@hacettepe.edu.tr](mailto:saglam@hacettepe.edu.tr)

**Abstract:** The purpose of the study was to investigate pre-service teachers' perceptions of their own learning styles. The study was carried out with 144 pre-service teachers. Participants of the study were instructed about learning styles and also the features of the visual, auditory and kinesthetic learning styles were explained in depth. Pre-service teachers were asked open-ended questions regarding what might be the most appropriate learning style to them. The data were coded and grouped under relevant categories. The findings indicated that most of the pre-service teachers believe that they have visual (49.8%) learning style. 28.9 percent of the pre-service teachers perceive themselves as kinesthetic and 23.3 percent of them are of the opinion that they are auditory. Besides, some of the pre-service teachers have also expressed that they have more than one learning style.

**Key words:** Learning styles, pre-service teachers, learning.

### Introduction

With increasing importance attached to cognitive conception of learning arguing that learning is an active intellectual process and constructivist approach assuming that learning is a personal endeavor, greater emphasis has been put on individual differences in the field of education. Cognitive and constructivist learning approaches have drawn the attention to the reception of information by the learner, processing of it and constructing of it. These processes occur in different ways for different individuals; hence, individual differences should be taken into consideration in learning. One of the individual characteristics of the learner regarded to be important in learning process is learning styles.

Learning styles can be described as approaches specific to an individual learner used during the processes of reception and processing of information. When the models explaining learning styles having cognitive, affective and physiologic dimensions are examined, it can be concluded that learning styles are specific to individuals. The models emphasizing the cognitive dimensions of learning styles are concerned with the reception of information, processing, storing, encoding and decoding of it. The models emphasizing the affective dimension are concerned with the personality characteristics such as motivation, attention, locus of control, interests, willingness to take risks, perseverance, taking responsibility and liking social life. The learning styles models emphasizing physiological dimension are concerned with the perception through senses (visual, auditory, kinesthetic, and tactile), properties of the setting (level of noise, heat, light and organization of the room), sustenance (need for food and drink) and biorhythms (in which part of the day, they feel the best to learn) (Başbüyük, 2004; Dağhan & Akkoyunlu, 2011). These models dealing with the different dimensions of learning styles explain learning styles through different classifications.

According to Given (1996) learning style models tend to fall into one or more of the following five categories: a) personality and emotional models, b) psychological, cognitive and information processing models, c) social models, d) physical models, and e) environmental and instructional models. Kolb (1984) constructed a bidimensional model resulting in four basic types or styles: diverger, assimilator, converger, and accommodator. The vertical axis in Kolb's model represents a continuum of preferences for how information is grasped or perceived which ranges from apprehending concrete experiences to comprehending abstract concepts. The horizontal axis represents how information once perceived is transformed into meaning. At one end is active experimentation with reflective observation at the other end. It is the crossing of these two continua that creates Kolb's four major learning styles. Anthony Gregorc (1982) also created a bidimensional model and he called his four "mind channels" concrete sequential, abstract sequential, abstract random, and concrete random learning styles. Gregorc believes that individuals can adjust to varying circumstances through their non-dominant channels so long as the dominant style is permitted opportunity to develop. Dunn and Dunn (1992; 1993) investigated emotional factors of style including how students are motivated to learn, how persistent they are when pursuing a task, and the level of responsibility assumed for completing the task. Grasha (1972) developed learning style scales which included aspects of personality to social preferences: independent, dependent, collaborative, competitive, participant, and avoidant learning patterns. Brandt (1983) identified three dysfunctional styles that may appear functional. They were the acquiescent, self-important, and deprived styles. McCarthy (1987) developed the 4MAT System based on brain hemisphericity. The result was a quadrilateral curriculum design with each quadrant divided into left brain/right brain characteristics. McCarthy advocates designing

lessons according to the eight step sequence that includes: a) creating an experience-right mode, b) reflecting, analyzing experience-left mode, c) integrating reflective analysis into concepts—right mode, d) developing concepts, skills-left mode, e) practicing defined “givens”-left mode, f) practicing and adding something of oneself-right mode, g) analyzing application for relevance, usefulness-left mode, and h) doing it and applying to new, more complex experience-right mode (Given, 1996).

Sensory modalities (visual, auditory and kinesthetic) are other primary ways researchers categorize learning style. A modality approach has high face validity because of its practical clarity. Because individuals often display insights into the way they best learn (Given, 1996). For example, visual learners are natural at reading, spelling, proofreading, remembering faces of people (but forgets names), remembering details and colors and creating mental (visual) images. Visual learners solve problems by reading information, listing problems, by preparing graphic organizers to organize thoughts and by using flow charts. Also they learn best by taking notes, making lists, by reading information, by learning from books, videotapes, filmstrips, printouts and by seeing a demonstration. Besides, visual learners read for pleasure/relaxation. They can spend long periods of time studying and require quiet during study. They read rapidly and learn to spell words in configurations rather than phonetically. The difficulties in schools of visual learners can be listed as need to take action before seeing what needs to be done; working in an environment with noise or movement; tuning out sounds; listening to lectures without visual picture or illustrations; dealing with unappealing physical appearance of teacher; working in classrooms with no decorations or drab colors; working under fluorescent lights - makes is hard to concentrate for visual learners. On the other hand for auditory learners, speaking extemporaneously, noticing sounds in environment, remembering names of people (forget faces), and working with words and languages are natural. Auditory learners solve problems by talking about options, by asking others what they would do in a situation, by verbalizing the goal until it sounds right and by auditory repetition. They learn best by talking aloud, by listening to a lecture, by discussing in small or large groups and by hearing music without words as a background in the learning environment. Auditory learners read dialogues and play and sub vocalizes internally or externally for comprehension. They stop while reading to talk to self or others about what is read and they are good at phonetically sounding out new words. The difficulties that auditory learners can be encounter in schools are: reading quickly while they read more slowly than visual learner; reading silently for prolonged periods of times; reading directions while they often unaware of illustrations; taking timed tests that must be read and written; living with enforced silence (can't wait to talk); and seeing significant details. Some other learners, who are natural at sports, dance, adventure, competition, challenge, running, jumping, leaping, rolling and at action using large motor muscles classified as kinesthetic learners. These learners solve problems by taking action, then planning based on results and by attacking problems physically. They seek solutions that involve great physical activity and prefer to solve problems individually or in small groups. Kinesthetic learners learn best by doing, hands-on approach -- manipulation, simulations, live events. They need to be physical involvement in learning. Field trips to gain knowledge and small group discussions are the ways that they learn best. A kinesthetic learner reads primarily for meaning and function, rather than enjoyment. He/she reads action-oriented books/plays and studies for short periods interspersed with moving around. They usually lay on floor or bed to study. The difficulties that the kinesthetic learners can be encounter in school are: sitting still; listening to lectures of more than four minutes; spelling; recalling what was seen or heard (remember everything that was done); expressing emotions without physical movement. (<http://www.westga.edu/~jdbutler/ClassNotes/learnstyles.html>)

Researches reveal that when students are taught through their preferred learning style they demonstrate: a) statistically significant improvement in their attitudes toward instruction, b) increased tolerance for cognitive diversity, c) statistically significant increased academic achievement, d) better discipline/behavior, and e) greater self-discipline for homework completion (Given, 1996).

If a student knows his/her learning style and utilizes it during learning process, he/she can learn more easily and faster and be more probably successful at the end of the learning process (Biggs, 2001; cited in Dağhan & Akkoyunlu, 2011). In addition, what is important for students' achievement is not only knowing which style is their preferred one but also knowing whether they are aware of the characteristics of their dominant style or not (Dağhan & Akkoyunlu, 2011). Aşkar and Akkoyunlu (1993) state that one's knowing which learning style is the best for himself/herself may help him/her to enhance his/her learning potential. Besides Babadoğan (2003) report that when the students with poor academic achievement make use of their dominant learning styles, they can significantly improve their learning performance. When learning styles are systematically taught to students, in a short time, improvement is seen in the amount of information learned and retention of it (Given, 1996).

Students' having quality information about their learning styles thought to contribute to their cognitive and affective qualifications throughout supporting their learning. Being informed about one's own learning style is important because, this leads to their effective arrangement of their learning processes and improvement of their academic achievement and self-confidence. For pre-service teachers to be effective in their professional teaching career, they need to be made aware of their learning styles, which contribute to their achievement and their self-confidence during their learning processes. In light of these facts, the present study aims to investigate the pre-service teachers' perceptions of their own learning styles. Pre-service teachers' being informed about learning styles may help them to take their own students' learning styles into consideration while designing their lessons, so that they will be able to design lessons matching the learning styles of their students in the future.

## Method

The present study investigating the pre-service teachers' perceptions of their own learning styles employs qualitative research methods. Totally 144 pre-service teachers from the departments of English Language Teaching, Mathematics Teaching, Science Teaching and Social Studies Teaching participated in the present study. The pre-service teachers were informed about learning styles and detailed explanations were given about the characteristics of visual, auditory and kinesthetic learning styles and some examples were presented. Şimşek (2002) stated that a student tend to use one of these learning modalities. Open-ended questions were asked to the participants to determine which learning style they think is most suitable for themselves. The data obtained were coded and collected under the related categories. The results that found by calculating the frequencies and percentages were arranged and then interpreted. Furthermore relevant quotations from pre-service teachers' responses were presented.

## Results

The findings of the study were obtained by reducing the statements in the responses given to the open-ended questions. 49.8% of the students participating in the present study think that they have visual learning style. In Table 1, the frequencies and percentages calculated for the statements of the students thinking that they have visual learning style are presented.

**Table 1:** Frequencies and percentages of the students' statements, who think that they have visual learning style.

| Statements   | f  | %    |
|--|----|------|
| I take detailed notes.                                     | 27 | 22.0 |
| I am successful in interpreting and learning visual items. | 21 | 17.1 |
| I best learn and understand by seeing/reading              | 13 | 10.6 |
| I make observations.                                       | 3  | 2.4  |
| It is important for me to watch my teacher.                | 10 | 8.1  |
| I do not forget what I have seen.                          | 20 | 16.3 |
| I cannot understand the things I haven't read.             | 3  | 2.4  |
| I can visualize the things I have read/learned.            | 20 | 16.3 |
| I get distracted unless I make eye contact.                | 1  | 0.8  |
| I can learn better by writing.                             | 2  | 1.6  |
| While studying, I make use of drawings and colors.         | 3  | 2.4  |

As can be seen in Table 1, the pre-service teachers thinking that they have visual learning style state that they can learn better by seeing, understand visual things better, like taking notes and they work by drawing. These pre-service teachers also stated that they visualize what they have learned and read and they do not forget what they have seen; hence, their dominant learning style is visual. Some of the quotations from the statements expressed by the pre-service teachers thinking they have the visual learning style are as follows:

"I solve the problems by visualizing where or on which page their answers are."

"I take detailed notes and I only understand the notes I have myself taken."

"The things which I have only listened quickly fade away from my mind; I remember the notes taken in great detail."

"While listening to the lesson, I closely watch my teacher's behaviors. I feel as if I could not understand if I do not see my teacher."

"I do not forget easily what I have seen."

"While listening to the teacher, I do not focus on what he/she says rather the visual presentations prepared by him/her."

"In order to retain information, I must read it myself, I cannot understand the subject when others explain it to me."

"When I go to a destination I do not know, I do not get the directions from others, I myself look at the map and visualize it."

The percentage of the pre-service teachers thinking that they have auditory learning style was found to be 21.3. Percentages and frequencies calculated for the statements of the pre-service teachers thinking that they have auditory learning style are presented in Table 2.

**Table 2:** Frequencies and percentages of the students' statements, who think that they have auditory learning style.

| Statements  | f | %    |
|---|---|------|
| I can listen to for a long time, I like listening.    | 3 | 6.5  |
| I am highly interested in tone of voice and stresses. | 7 | 15.2 |
| I learn better when I study by telling                | 2 | 4.3  |
| I am sensitive to sounds.                             | 4 | 8.7  |

|  |    |      |
|--|----|------|
| I learn/understand better by listening.                                  | 15 | 32.6 |
| I do not forget what I have heard.                                       | 3  | 6.5  |
| I revise the subjects by talking/reading/discussing/interpreting loudly. | 10 | 21.7 |
| I record and listen to my own voice while studying.                      | 1  | 2.2  |
| I repeat orally not to forget.   | 1  | 2.2  |

As can be seen in Table 2, the pre-service teachers thinking that their dominant learning style is auditory stated that they generally prefer to study by reading loudly, they are interested in the tone of voice and stresses and they best learn by listening. Moreover, these pre-service teachers stated that they like listening and speaking for a long time, they do not forget what they have heard; hence, their learning style is auditory. Some quotations from the responses of pre-service teachers thinking that their dominant style is auditory are given below:

“When I listen to the topics from others, I understand better and they become more permanent.”

“When I read novels loudly, I understand more easily.”

“When there is no silence in the setting, I cannot concentrate.”

“I revise for my exams by telling myself or listening from others, I clearly remember the tone of voice and stresses of the narrator.”

“While studying, I study loudly; even while I am solving problems I explain them loudly to myself.”

“I repeat the information which I mustn’t forget loudly to myself.”

“While studying, it is more effective to study by hearing my own voice.”

“Rather than reading what has been written on the board by the teacher, I prefer to listen to him/her explaining the topic.”

The percentage of the pre-service teachers thinking that they have kinesthetic learning style is 28.9. The percentages and frequencies calculated for the statements of the pre-service teachers thinking that they have kinesthetic learning style are presented in Table 3.

**Table 3:** Frequencies and percentages of the students’ statements, who think that they have kinesthetic learning style

| Statements  | f  | %    |
|---|----|------|
| I do not like staying motionless/passive for a long time. | 16 | 25.4 |
| While studying, I like touching my fingers/pens/hair etc. | 8  | 12.7 |
| I learn better by doing.                                  | 10 | 15.9 |
| I am good at designing projects/plans/drafts.             | 8  | 12.7 |
| Using materials facilitates my learning.                  | 2  | 3.2  |
| I can understand better when I touch/feel.                | 7  | 11.1 |
| I do not forget what I have done and others’ movements    | 5  | 7.9  |
| I talk by using my hands/body/gestures and mimics.        | 7  | 11.1 |

As can be seen in Table 3, the pre-service teachers thinking that they have kinesthetic learning style stated that in general they learn better by doing, they get bored with staying motionless for a long time, they like doing projects and they use their body while solving problems, thinking or speaking. Moreover, these pre-service teachers stated that use of materials facilitates their learning and they can only understand by touching the material; hence, their dominant learning style is kinesthetic. Some of the statements of the pre-service teachers thinking that they have kinesthetic learning style are presented below:

“I cannot listen to the lesson for a long time without moving. While studying, I need to walk around with the book in my hands; otherwise, I cannot learn fast enough.”

“I cannot sit and listen for a long time. I learn something by myself touching.”

“I usually feel bored while writing; I can commit many punctuation mistakes while writing.”

“I cannot add numbers fast, I need to count with my fingers first.”

“While telling something to someone I always move. While imagining, I like animate with my hands.”

“When I read a recipe of a cake or someone tells it to me, I do not understand it, I need to watch it being cooked or do it myself.”

“Even if I see someone solving a problem, I cannot understand it well without doing myself.”

“My friends always tell me ‘why you are touching the things you see’.”

Some of the pre-service teachers participating in the present study stated that they have more than one style. Some quotations of these pre-service teachers’ statements are given below:

“If one tells the topic to me and uses some kind of visualization while explaining, my learning becomes more effective.”

“I understand the lesson by listening but visual materials strengthen my understanding; that is, I need both to hear and see to learn.”

“Figures, pictures and maps draw my attention and with these materials I learn better. I do not only watch but

also want to touch and describe the materials.”

The findings of the present study show that the dominant style preferred by nearly half of the pre-service teachers (49.8%) to learn matches with visual learning style. This is followed by the pre-service teachers thinking that they have kinesthetic learning style (28.9%). The least preferred style by the pre-service teachers is auditory among the learning styles (21.3%).

## Conclusions and Discussion

The effects of learning styles on learning and their contribution to the organization of the learning environment have been reported in related researches (Felder, 1993; Given, 1996; Babadoğan, 2000; Collison, 2000; Hein & Budny, 2000). Unlike the studies carried out to determine the learners' learning styles, the present study looks at the learners' perception of their own learning styles. When pre-service teachers are aware of their own learning styles, even if they encounter different teaching settings, they can effectively organize their own learning processes. Therefore, the present study aims to investigate which learning style the pre-service teachers think they possess rather than determine their learning styles.

In light of the findings of the present study, it can be argued that the most common style adopted as primary style by the pre-service teachers is visual learning style and this is followed by kinesthetic and auditory learning styles, respectively. The pre-service teachers thinking that they have visual style stated that they learn better by seeing and reading, they understand visual elements better, they like taking notes and they study by drawing figures and shapes. As they visualize what they have learned and read in their minds and as they do not forget what they have seen, they think that their dominant style is visual. Some of the pre-service teachers stated that they learn better by doing, they are good at doing projects and use of materials facilitates their learning; hence, they think that their dominant learning style is kinesthetic. The other pre-service teachers; on the other hand, stated that they prefer reading loudly, they are interested in tone of voice and stresses and they learn best by listening. Moreover, these pre-service teachers stated that they like listening and speaking for a long time and as they do not forget what they have heard, they think that their dominant learning style is auditory.

Through the present study, the pre-service teachers were made aware of their own learning styles. They also understood that they can organize learning environment better when the characteristics of learning styles are known. In this way, it is believed that some contribution was made to their academic achievement and self-confidence. In addition, when pre-service teachers are knowledgeable about learning styles, they will more probably take their future students' learning styles into consideration while designing teaching environment for these students.

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# PROBLEM ÇÖZME BASAMAKLARININ GÖSTERİ ARAÇLARI İLE ÖĞRETİMİ

Dr. Kerim Karabacak  
University of Sakarya  
kerimk@sakarya.edu.tr

**Özet:** Beşinci sınıf öğrencileri üzerinde deneysel bir çalışma olarak gerçekleştirilen bu araştırma eğitimde gösteri araçlarının kullanılmasının öğrencilerin Matematik problemi çözme başarısına olan etkisini ortaya koymaya yöneliktir. Deney ve kontrol gruplarından elde edilen veriler SPSS'e aktarılmış, bağımsız grupların ortalamalarını karşılaştırmak için t-test kullanılarak verilerin analizi yapılmıştır. Elde edilen bulgulara göre klasik yöntemler ile karşılaştırıldığında öğrencilerin bilgi düzeyindeki başarısında bir fark olmadığı, kavrama ve uygulama düzeyindeki başarılarında ise bir artışın olduğu belirlenmiştir. Ayrıca gösteri araçlarının kullanıldığı sınıflarda öğrenim gören öğrencilerde bilginin kalıcılığının daha fazla olduğu da bu araştırma sonucunda belirlenmiştir.

## Anahtar Kelimeler

Problem çözme, Problem çözme basamakları, Matematik problemi çözme, Gösteri araçları problem çözme, Gösteri araçları

## Giriş

Birey günlük yaşamında bazı engeller, sorular, güçlükler ve sorunlar ile karşı karşıya kalır. Bir şekilde birey, yaşam kalitesini etkileyen bu durumları ortadan kaldırarak, yaşamını daha kaliteli bir hale getirme ihtiyacı duyar. Bunun için karşı karşıya kaldığı engelleri, soruları, güçlükleri, sorunları çözerek ortadan kaldırması bir zorunluluk haline gelir. Ortadan kaldırılması gereken bu durumlar birey için bir problemdir.

Heddens ve Speer (1997) problemi genellikle ilkökul matematik ders kitaplarındaki, konu sonlarında verilen dört işleme dayalı matematik problemleri şeklinde tanımlandığını, ancak problem kavramının daha geniş bir anlama sahip olduğunu ve matematikle ilgisi olmasının şart olmadığı görüşünü ileri sürmektedir. Başka bir ifade ile problem kavramı yaygın olarak Matematik dersi ile ilişkilendirilmekle birlikte çok daha genel bir anlama sahiptir. Bu bağlamda Türk Dil Kurumu tarafından (TDK) problem, teoremler ve kuramlar yardımıyla çözülmesi istenen soru veya mesele olarak tanımlanmaktadır (TDK, 2005). Çözülmesi zor olan, olay, olgu veya kişiler bir problemdir. Morgan (1995) problemi, bireyin bir hedefe ulaşmasında, engellenme ile karşılaştığı bir çatışma olarak tanımlamaktadır. Kalaycı (2001) ise, zor ve sonucu belirsiz bir durum olarak görmektedir. Ona göre bireye soru sorulduğunda hemen cevap veremediği her şey bir problemdir. Dewey, insan zihnini karıştıran, ona meydan okuyan ve inancı belirsizleştiren her şeyi problem olarak görmektedir. Genel olarak giderilmek istenen her güçlük bir problemdir. Gerek günlük yaşantıda, gerek eğitim döneminde gerekse tüm hayat sorunlarında insanların yaşamlarını etkili bir biçimde sürdürebilmeleri için problem çözme becerilerini kullanabilmeleri gerekir (Taylan, 1990).

Problem çözme ise “kişinin problemi hissedişinden, ona çözüm buluncaya kadar geçirdiği bir düşünce sürecidir” (Ülküer, 1988). Anderson (1985) problem çözme için “bilişsel işlemleri sıra ile bir hedefe yöneltmek” olarak ifade etmektedir. Morgan (1995) ise problem çözme için “karşılaşılan engeli aşmanın en iyi yolunu bulmak” olarak tanımlamaktadır. Problem çözme becerisi, hem bireylerin toplumsal yaşama uyum sağlamalarına, hem de toplumsal kalkınmaya katkıda bulunmalarına yardımcı olan bir özellik olarak görülmektedir. Bu nedenle Erden (1986), çağdaş eğitim programlarının en önemli amaçlarından biri olarak öğrencilerin Matematik, Fen bilgisi, Sosyal Bilgiler gibi çeşitli alanlarda problem çözme becerilerini geliştirmek gerektiğini ileri sürmektedir. En genel anlamı ile alan yazında yöntem, teknik, strateji, süreç, yaklaşım, model olarak adlandırılan (Kalaycı, 2001; Bock, 2000; Saban, 2000; Küçükahmet, 2000; Demirel, 1999; Barth, 1996; Bilen, 1990) problem çözme, matematik dersi ile de özdeşleşmiştir. Matematik dersinin ayrılmaz bir parçası olarak görülmüştür (Taylan, 1990). Bu nedenle öğrencilerde problem çözme becerisini geliştirmek matematik eğitiminin önemli amaçlarından birisi (Reusser ve Stebler, 1997) olarak ele alınmaktadır.

Okul hayatının başladığı ilk yıllardan itibaren öğrenciler, Matematik problemleri ile karşı karşıya gelmektedir. Öğrencilerin bir matematik problemini çözebilme becerisi, problem çözme sürecindeki bilgilere sahip olması ve onları kullanabilmesi ile mümkündür. Bu nedenle problem çözme sürecinde yer alan ve birçok kaynakta veya uygulamada “problem çözme basamakları” olarak bilinen bir matematik probleminin çözümünde izlenen yolun öğrenciler tarafından çok iyi bilinmesi gerekmektedir. Bunun içinde öğretmenlerin problem çözme basamaklarını öğrencilerinin kalıcı bir şekilde öğrenmelerini sağlayacak öğretim yöntemlerini kullanması gerekmektedir. Çünkü öğrenciler bu temelde almış oldukları bilgileri yaşamı boyunca kullanacaktır. İnsan ve toplum hayatında, ne zaman ne tür güçlüklerle karşılaşacağı

ya da ne tür ihtiyaçların doğacağı önceden bilinmediği için, çağdaş eğitim kendi kendine güçlüklerin üstesinden gelebilen insanı yetiştirmeyi hedeflemektedir. Bu bakımdan problem çözme yeteneğinin geliştirilmesi sadece karşılaşılan problemleri çözmeye kullanılan bir yaklaşım kalmamalı, aynı zamanda öğretimde hâkim bir yaklaşım olmalıdır (Altun, 2000).

Bireylere gelecekte karşılaşabilecekleri problemin üstesinden gelebilecek becerileri kazandırmak, eğitimin öncelikli hedefleri arasında ise dört işlem problemlerinin çözümünü öğretmenin amacı, Çocukların;

1. Günlük hayatta gerekli olan işlem becerilerini geliştirmeleri
2. Problem hikâyesinde geçen bilgileri matematik eşitliklere aktarmayı öğrenmeleri
3. Düşüncelerini şekillerle anlatmaları, yazılı ve görsel yayınları anlamaları ve problem çözenin gerektirdiği temel becerileri kazanmaları (Altun, 2000) olmalıdır.

Öğrencilere bu becerileri kazandırmak, ancak problem çözenin eğitimin merkezinde olması ile mümkündür. Birçok matematik öğretmeni, problem çözenin, eğitimin hedeflerine ulaşılmasında çok önemli olduğunu ve eğitimin her kademesinde matematik eğitiminin öncelikli amacı olması gerektiği konusunda fikir birliğindedir. Bu nedenle 1980 yılından sonra problem çözme, matematik müfredatında en çok araştırılan konu haline gelmiştir. Yapılan araştırmalar “öğrencilerin problem çözme becerileri nasıl geliştirilebilir” sorusuna cevap aramış ve aramaya da devam etmektedir (Karataş ve Güven, 2004).

Keşfetme ve icat etme yeteneğinin, öğrencilerin keşif ilkelerini fark etmesini sağlayan ve ona bu pratikleri uygulama şansı veren nitelikli bir eğitimle geliştirilebileceğine inanan Polya, “Nasıl Çözüm yapılır?” konusunda global bir plan geliştirmiştir (Davis ve Hersh, 2002). Polya'nın planına göre aşağıdaki sıra takip edilmelidir (Altun 2003):

1. Problemin anlaşılması
2. Çözümle ilgili stratejilerin geliştirilmesi
3. Seçilen stratejilerin uygulanması
4. Çözümün değerlendirilmesi

Altun (2003)'a göre bu basamakların bilinmesi problemi çözmeyi sağlamamaktadır. Ancak bu dört basamağa uygun olan çalışma şekli çözümü kolaylaştırmaktadır. Karataş ve Güven (2003)'de bir problemin çözümünde bireyin, problem cümlesini anlaması, çözüm için gerekli verileri seçmesi, çözüm için uygun planı seçmesi, problemi cevaplaması ve bu cevabın mantıklı olup olmadığına karar vermesi, problemi genişletmesi, alternatif önermesi gibi bir bilişsel süreçten geçmesi gerektiğini ileri sürmektedir. Bu süreçlere benzer şekilde İlköğretim Matematik Programı'nda problem çözme basamakları aşağıdaki gibi sıralanmıştır (MEB, 2000):

1. Problemden verilen ve istenenleri söyleme, yazma
2. Problemi özet olarak yazma
3. Probleme uygun şema ve şekil çizme
4. Problemin çözümünde kullanılacak işlem veya işlemleri sebepleriyle birlikte sırası ile söyleme ve yazma
5. İşlemin ve problemin sonucunu tahmin etme, söyleme ve yazma
6. İşlemleri yapma, sonucu söyleme ve yazma
7. Problemin çözümünün doğru yapıldığını kontrol etme, yanlış yapılmış ise yanlışları belirleme, söyleme ve yazma
8. Varsa problemin çözümünün değişik yollarla gerçekleştirme, sonucu söyleme ve yazma
9. Öğrenilen bilgileri kullanabilecek şekilde bir problem söyleme ve yazma

Anderson (1985) problem çözmeyi “bilişsel işlemleri sıra ile bir hedefe yönlendirmek” olarak ifade ettiğine göre bir sınıf öğretmeni, öğrencilerinin sırası ile bu basamakları takip ederek bir Matematik problemini çözebilme becerisi kazandırmaya çalışır. Bu beceri kazandırma çabası bilişsel bir süreçtir. Bilişsel bir süreç olması nedeni ile de öğrencilerine bir Matematik probleminin nasıl çözüleceğini öğretmek isteyen bir öğretmen, Bloom'un bilişsel alandaki öğrenmelere ilişkin taksonomisini dikkate almak durumundadır.

Bloom, bilişsel alandaki öğrenme basamaklarını, bilgi, kavrama, uygulama, analiz, sentez ve değerlendirme olmak üzere altı düzeyde toplamıştır. Bilgi, basamağındaki öğrenmelerde, herhangi bir nesne ya da olguyla ilgili özellikleri öğrencilerin görünce tanıması, sorunca söylemesi ya da ezberden aynen tekrar etmesi vardır. Kavrama basamağındaki öğrenmelerde, bilgi düzeyinde öğrenilen davranışların özümsemesi, tam olarak anlamının yakalanması söz konusudur. Bu basamakta öğrenci, neden, niçin, nasıl sorularına cevap verebilir. Uygulama basamağında bilgi ve kavrama basamaklarında kazandığı davranışlara dayanarak bireyin bir sorunu çözmesi söz konusudur. Analiz ise bireyin çevresinde yer alan ve pek çok öğeden oluşan nesnelere olgu ve olayların, var ise öğeler arasında bulunan çeşitli düzey ve yöndeki ilişkilerin, kural, ilke, sistem ve yapıların içeriğinin öğrenilmesi için gerçekleştirilen bütünü parçalara ayırarak inceleme işlemidir. Sentez ise bir kişinin öğeleri, yenilik, özgünlük, buluş, icat yaratıcılık gibi özellikleri kullanarak bir ilişki ve kurallara göre birleştirmek sureti ile bir bütün oluşturma işidir. Değerlendirme ise kişinin,

bilişsel, duyuşsal, devinişsel, sezgisel alanlarla ilgili ürün ya da süreçleri hem kendi içinde hem de kendi dışındaki özellikler açısından bir ölçütle karşılaştırıp bir yargıya varmasını içerir (Sönmez, 2001).

Öğrenciler bu bilişsel alan basamaklarına göre karşılaştıkları Matematik problemlerini çözmeye çalışır. Öncelikle problem çözme basamaklarının bilgisini kazanmıştır. Kavrama basamağında bu bilgileri nasıl ve niçin kullanacağını özümser. Uygulamada ise bu bildiklerini ve kavradıklarını hayata geçirir. Daha sonra analinzi yapar, kendinden bir şeyler katarak sentezde bulunur ve en sonunda değerlendirmelerde bulunabilecek bir düzeye gelir. Burada öğretmenlere çok büyük bir görev düşmektedir. Bu da öğrencilerinin bu basamakları çok iyi takip ederek karşılaştıkları bir Matematik problemini çözebilme becerisini kazanmalarını sağlamaktır. Bunun için de öğretmenler eğitim teknolojilerini kullanma ihtiyacı duyar.

Şimşek (2002)'e göre eğitim teknolojisi, insanların bildiklerini başkalarına nasıl öğreteceği sorusunu kendisine sormasıyla ortaya çıkan durumları belli bir yöntemi uygulayarak, yararlandığı araç ve gereçleri en etkin şekilde kullanılmasını sağlayan bir bilim dalıdır. Bu nedenle eğitim teknolojileri eğitim hizmetlerinin etkililiğini artırma çabası içerisindedir. Eğitimde materyal kullanımı öğrencilerin derse olan ilgisini arttırdığı, kalıcılığı sağladığı bilgilerin hatırlanmasını kolaylaştırdığı alan yazında ortaya konulmuştur (bkz. Baytekin, 2001; Şimşek 2002; Akkoyunlu, 2002,1998; Tandoğan, 1998; Alkan 1998; Demirel, 1999; Demirel ve Yağcı, 2001; Rogers, 2003). Özellikle bilgisayar teknolojilerine dayalı gösteri araçlarının eğitimde kullanılması birden fazla duyu organına hitap etmesi ile öğrenmede hız ve kalıcılık gibi özelliklerin artmasını sağlamıştır (Akkoyunlu ve Yılmaz, 2005). Bilgisayara bağlı olarak kullanılan data projeksiyonlar gösteri teknolojilerinden birisidir. Data projeksiyon, bilgisayar aracılığı ile her türlü ses, video, görsel ve yazılı materyallerin, powerpoint sunularının rahatlıkla yansıtıldığı bir eğitim-öğretim aracıdır. Bu aracın eğitim-öğretim faaliyetlerine katkıları aşağıdaki gibi sıralanabilir (İsman, 2005):

1. İstenilen her türlü ses, video, yazılı ve görsel materyaller anında bilgisayar ile sınıf ortamına sunulur.
2. Üç boyutlu resimler çok etkili bir şekilde yansıtılabilir.
3. Öğrenciler eğitim-öğretim ortamlarında hazırladıkları her türlü materyali anında diğer öğrencilere göstererek paylaşabilirler.
4. Öğrenmeyi canlı tutar. Görsel sunum sayesinde öğrenciler eğitim öğretim faaliyetlerinde aktif rol alırlar.
5. Kalıcı öğrenmeler oluşabilir. Öğrenci faal olduğundan kalıcı izli öğrenmeler gerçekleşir.
6. Öğrencilerin normal şartlarda yaşayamayacağı deneyimler sağlanır. Konu ile ilgili çok nadir bulunan ses, video, yazılı ve görsel materyaller sunulur.
7. Kullanımı çok kolaydır. Öğretmenler rahatlıkla kullanabilir.
8. Çok büyük olmadıkları için istenilen yere taşınabilir.
9. Gerekli tasarım faaliyetleri yapılarak konular yada üniteler basitten karmaşığa doğru öğretilir.
10. Sınıf yönetimine etkili bir şekilde yardım eder.
11. Öğretmenin yüzünün sınıfa dönük olmasını sağlar.
12. Öğretmen ve öğrencileri tebeşir tozundan korur.
13. Öğrenciler kolay bir biçimde not tutabilir.
14. Öğretmenler etkili görsel faaliyetler ile öğrencileri öğrenmeye kaşı güdüler.
15. Öğretmen data projeksiyonu kullanırken istediği yerde durup gerekli açıklamaları yapabilir.
16. Öğretmen istediği an, istediği her hangi bir ses, video, yazılı ve görsel materyalleri sunabilir.
17. Öğretmen her türlü ünite ve konuyu rahatlıkla öğretebilir.
18. Öğretmenler data projektörlerini her eğitim-öğretim basamağında (ilkokul-ortaokul-lise-üniversite) rahatlıkla kullanabilirler.

Bu çalışma yukarıda eğitim-öğretim etkinliklerine katkıları ortaya konan gösteri araçlarının (data projeksiyon) bir Matematik probleminin, problem çözme basamaklarının öğretiminde geleneksel yöntemlere göre öğretiminin öğrencilerin başarıları arasında bir fark yaratıp yaratmadığını belirlemeye yöneliktir. Bu nedenle de araştırma, aşağıdaki problem ve hipotezleri test etmek üzere gerçekleştirilmiştir.

#### **Problem Cümlesi**

Problem çözme basamaklarının gösteri araçları kullanarak öğretilmesi, öğrencilerin Bloom'un bilişsel alan taksonomisine göre Matematik problemi çözebilme başarısını arttırmakta mıdır?

#### **Hipotezler**

Gösteri araçları kullanarak bir Matematik probleminin çözüm basamaklarını öğrenen öğrenciler;

1. Geleneksel yöntemler ile öğrenen öğrencilere göre bu basamakları daha başarılı bir şekilde sıralayabilir.
2. Geleneksel yöntemler ile öğrenen öğrencilere göre bu basamakları kavramda daha başarılıdır.
3. Geleneksel yöntemler ile öğrenen öğrencilere göre bir matematik problemini daha başarılı bir şekilde çözebilir.
4. Geleneksel yöntemler ile öğrenen öğrencilere göre bu basamakları doğru bir şekilde hatırlayarak bir problemin çözümünde kullanabilirler.

### Araştırmanın Önemi

Problem, çözülmesi istenen soru, mesele, çözülmesi veya uğraşılması zor olan şey, olay veya kişi, bireyin bir hedefe ulaşmasında, engellenme ile karşılaştığı bir çatışma olarak tanımlandığına göre öncelikle problemi çözme becerisinin bireye kazandırılması bir zorunluluktur. Burada ifade edilen problem, bir matematik problemi veya daha genel anlamda olabilir. Ancak hangi alanda olursa olsun, bir matematik problemini çözmek için kullanılan basamaklar aynı zamanda bireylere bir problemi çözmek için sırası ile bazı aşamaların takip etmesi gerektiği bilincini verecektir. Bu bağlamda karşılaşılan bir matematik problemini çözebilme becerisine sahip olmak, güncel hayatta karşılaşılan diğer problemleri çözebilme becerisini de yordayacaktır. Bu nedenle Problem çözme basamakların öğrenciler tarafından bilinmesi, iyi bir şekilde kavranması ve bu bilgileri kullanarak bir problemi çözebilmesi çok önemlidir. Bu noktadan hareketle problem çözme basamaklarının nasıl en iyi şekilde öğrencilerin öğrenebileceği üzerine gerçekleştirilen bir çalışma olması nedeni ile bu araştırma önemlidir.

### Sayıtlar ve Sınırlılıklar

Deney ve kontrol grubu bir birine benzer özelliklere sahiptir. Bu araştırma ilköğretim okulu beşinci sınıf öğrencileri ve bir matematik probleminin, problem çözme basamaklarının öğretimi ve Bloom'un bilişsel alandaki öğrenmelere ilişkin taksonomisinin bilgi, kavrama ve uygulama düzeyindeki öğrenmeleri ile sınırlıdır.

### Yöntem

#### Araştırmanın Modeli, Evren ve Örneklem

Araştırma, deneysel çalışmalar içerisinde yer alan Kontrol grubu olan modellerden Kontrollü Son-Test Modelinde gerçekleştirilmiştir. Çalışma grubu amaçlı örnekleme yöntemi ile belirlenmiş olan bir ilköğretim okulunda öğrenim gören beşinci sınıf öğrencilerinden oluşmaktadır. Örnekleme yer alan öğrencilerden 39'u deney grubunda, 37'si kontrol grubunda yer almaktadır. Deney ve kontrol grubu belirlendikten sonra her iki gruba ön test uygulanarak örneklem geçerliği test edilmiştir. Test sonuçlarına ilişkin veriler Tablo 1'de verilmiş, her iki grubun ortalamaları arasında anlamlı bir farkın bulunmadığı belirlenmiştir.

Tablo 1. Deney ve Kontrol grubunun Uygulama Öncesi Puanlarına Ait "T-Testi" Sonuçları

| Zaman    | Gruplar       | $\bar{X}$ | N  | ss.   | t     | Sd. | p     |
|----------|---------------|-----------|----|-------|-------|-----|-------|
| Uygulama | Deney grubu   | 50,81     | 37 | 14,80 | 0,718 | 36  | 0,477 |
| Öncesi   | Kontrol Grubu | 48,38     | 37 | 16,42 |       |     |       |

Tablo 1'de, her iki gruba uygulamaya başlamadan önce yapılmış olan test için gerçekleştirilen t-testi sonuçları görülmektedir. Bu tabloya göre " $t=0,712$ " ve " $p=0,477$ " değerlerine sahip olduklarından " $p<0,05$ " anlamlılık düzeyinde her iki grubun konuya ilişkin bilgileri veya başarı durumları arasında anlamlı bir fark yoktur. Başka bir ifade ile uygulama öncesi testine ait bu veriler deney ve kontrol gruplarının başarı düzeyleri arasında bir fark bulunmadığını ortaya koymaktadır. Bu da deney ve kontrol grubunun deneysel bir çalışma için geçerli bir örneklem grubu olduğunu ortaya koymaktadır.

#### Veri Toplama Araçları ve Verilerin Toplanması

Araştırmada veri toplama aracı olarak bir adet öntest, üç adet son test (bilgi kavrama, uygulama olmak üzere üç adet) ve bir adet kalıcılık testi olmak üzere beş farklı test uygulanmıştır. Bu testlerden her biri on sorudan oluşmaktadır. Testlerde öğrencilere Bloom'un bilişsel alan taksonomisinde yer alan bilgi, kavrama ve uygulama düzeyinde sorular yöneltilmiştir.

Bilgi düzeyinde öğrencilerden sıralamaların bilgisi, yani matematik problemi çözme basamaklarını doğru bir şekilde sıralamaları istenmiştir. Kavrama düzeyinde öğrencilerden problem çözme basamakları ile ilişkili olarak neden, nasıl, niçin gibi sorulara cevap vermeleri istenmiştir. Uygulama düzeyinde ise öğrencilerden bu problem çözme basamaklarına uygun olarak kendilerine verilen matematik problemlerini çözmeleri istenmiştir. Aynı zamanda öğrenciler problem çözme işlemini gerçekleştirdikleri esna da gözlemlenmiştir. Uygulamaya başlamadan önce her iki gruptaki (deney ve Kontrol grubu) öğrencilere 10 tane matematik probleminin bulunduğu öntest verilmiş ve öğrencilerden bu testi problem çözme basamaklarını belirterek çözmeleri istenmiştir. Bu veriler deney ve kontrol grubunun bir birine yakın özelliklere sahip olup olmadıklarını belirlemek için kullanılmıştır.

Uygulamaya 26 Mart 2012 de başlanmış bazı haftalar bir, bazı haftalar 2'şer saatten olmak üzere toplam 15 saatlik bir uygulama gerçekleştirilerek, 31 Mayıs 2012'de sona ermiştir. Uygulamanın gerçekleştirildiği deney grubunda çalışmalar yürütülürken kontrol grubunun da geleneksel şekilde olmak üzere aynı sürede problem çözme basamaklarını öğrenme çalışmalarını sürdürmesi sağlanmıştır. Uygulamada, öncelikle öğrencilere problem çözme basamaklarının sıralama bilgisi verilmiştir. Ardından kavrama düzeyindeki çalışmalara yer verilmiş, son olarak da öğrencilere sahip oldukları bilgileri uygulama fırsatı tanınmıştır. Her basamaktaki çalışmanın ardından deney ve kontrol grubuna bir test

uygulanmıştır. Deneysel çalışma bitikten beş ay sonra Ekim 2013’de öğrencilerin problem çözme basamaklarını uygulama düzeylerini belirlemek amacı ile bir test daha uygulanmıştır. Ancak öğrenciler altıncı sınıfa geçtiklerinden, okuldan ayrılan öğrenciler bulunduğu için, kalıcılık testinin uygulanması esnasında deney ve kontrol grubunda yer alan öğrencilerin tamamına ulaşılammıştır.

### Verilerin Analizi

Uygulama sonucunda elde edilen veriler, SPSS 15 istatistik programına aktarılmıştır. Her iki grubun dağılımının normal bir dağılım sergilediği belirlenmiş ve bütün hipotezlere ait verilerin analizinde eşleştirilmiş gruplara ait ortalamalarının karşılaştırılmasında kullanılan, eşleştirilmiş gruplara ilişkin t testi (Paired Sample T-Test) istatistiksel analiz tekniği kullanılmıştır. Araştırmanın dördüncü hipotezinde ayrıca tek grup ortalamalarının karşılaştırılmasında kullanılan “t-testi” (One-Simple T-Test) kullanılmıştır. Bu testle grupların uygulama düzeyindeki ortalamaları ile kalıcılık testindeki ortalamaları karşılaştırılmıştır.

### Bulgular ve Yorumlar

Tablo 2’de araştırmada gerçekleştirilen test sonuçlarına göre eşleştirilmiş gruplara ait t-testi sonuçlarına ve bazı betimsel istatistiklere ait bulgular verilmiştir.

Tablo 2. Deney ve Kontrol grupları arasında gerçekleştirilen t-testi Sonuçları

| Düzeyleyler          | Gruplar       | $\bar{X}$ | N  | ss.   | t     | Sd. | p      |
|----------------------|---------------|-----------|----|-------|-------|-----|--------|
| Bilgi                | Deney grubu   | 76,22     | 37 | 13,41 | 1,898 | 36  | 0,066  |
|                      | Kontrol Grubu | 70,54     | 37 | 11,29 |       |     |        |
| Kavrama              | Deney grubu   | 71,62     | 37 | 19,37 | 3,124 | 36  | 0,004* |
|                      | Kontrol Grubu | 58,65     | 37 | 13,77 |       |     |        |
| Uygulama             | Deney grubu   | 73,78     | 37 | 18,16 | 4,340 | 36  | 0,000* |
|                      | Kontrol Grubu | 59,46     | 37 | 14,33 |       |     |        |
| Kalıcılık (uygulama) | Deney grubu   | 70,75     | 27 | 8,74  | 5,025 | 26  | 0,000* |
|                      | Kontrol Grubu | 54,81     | 27 | 11,22 |       |     |        |

\*P<0,05

#### 1. Hipoteze ait Bulgular

Araştırmanın birinci hipotezinde “Gösteri araçları kullanarak bir Matematik probleminin çözüm basamaklarını öğrenen öğrenciler, geleneksel yöntemler ile öğrenen öğrencilere göre daha başarılı bir şekilde sıralayabilir.” ifadesi test edilmektedir. Bilgi düzeyindeki bir öğrenmeyi ortaya koyan bu ifadeye ilişkin, deney ve kontrol grubu arasında gerçekleştirilen t-testi sonuçlarına göre “t=1,898 ve p=0,066” değerleri elde edilmiştir. Elde edilen bu değerler “p<0,05” anlamlılık düzeyinin altında bulunma şartını sağlamadığından, bilgi düzeyinde deney ve kontrol grubu arasında anlamlı bir farkın bulunmadığını göstermektedir. Bir başka ifade ile problem çözme basamaklarının öğretiminde gösteri araçlarının kullanıldığı sınıflar ile geleneksel şekilde problem çözme basamaklarının öğretildiği sınıflardaki öğrencilerin bilgi düzeyindeki başarıları arasında bir fark bulunmamaktadır. Bu anlamda birinci hipotez reddedilmiştir.

#### 2. Hipoteze ait Bulgular

Araştırmanın ikinci hipotezine ait “Gösteri araçları kullanarak bir Matematik probleminin çözüm basamaklarını öğrenen öğrenciler, geleneksel yöntemler ile öğrenen öğrencilere göre bu basamakları kavramada daha başarılıdır.” hipotezine ilişkin bulgular aşağıda verilmiştir:

Tablo 2’deki kavrama düzeyi için gerçekleştirilen t-testi sonuçları incelendiğinde “t=3,124” ve “p=0,004” olarak görülmektedir. Elde edilen bu değerler “p<0,05” anlamlılık düzeyinde her iki grubun ortalamaları arasında anlamlı bir farkın bulunduğunu göstermektedir. Bu durumda aynı tablodan her iki grubun ortalamaları incelendiğinde deney grubunun ortalamasının “71,62” kontrol grubunun ortalamasının “58,65” olduğu görülmektedir. Elde edilen bu değerlere göre kavrama düzeyinde, deney grubundaki öğrencilerin başarı ortalaması, kontrol grubundaki öğrencilerin başarı ortalamasından “12,67” puan daha yüksektir. Bu bulgular araştırmanın ikinci hipotezini desteklemektedir. Başka bir ifade ile gösteri araçları kullanarak bir Matematik probleminin çözüm basamaklarını öğrenen öğrenciler, geleneksel yöntemler ile öğrenen öğrencilere göre problem çözme basamaklarını kavramada daha başarılıdırlar.

#### 3. Hipoteze ait Bulgular

“Gösteri araçları kullanarak bir Matematik probleminin çözüm basamaklarını öğrenen öğrenciler, geleneksel yöntemler ile öğrenen öğrencilere göre bir matematik problemini daha başarılı bir şekilde çözebilir” ifadesi araştırmanın üçüncü hipotezini oluşturmaktadır. Bu Hipoteze ilişkin öğrenmeler için gerçekleştirilen t-testi sonuçlarına tablo 2’den

baktığında ise “t” değerinin “4,340” ve “p” değerinin “0,000” olduğu görülmektedir. Elde edilen “p” değeri, aranan “0,05” anlamlılık düzeyinden daha düşük olduğu için her iki grubun uygulama düzeyinde, başarı ortalamaları arasında anlamlı bir farkın bulunduğu belirlenmiştir. Bu nedenle her iki grubun ortalamaları aynı tablodan incelendiğinde deney grubunun ortalamasının “73,78”, kontrol grubunun ortalamasının “59,46” olduğu görülmektedir. Görüldüğü üzere deney grubunun başarı ortalaması kontrol grubunun başarı ortalamasından “14,32” puan daha yüksektir. Elde edilen bu bulgular ortaya koymaktadır ki gösteri araçları kullanılarak matematik problemi çözme basamaklarının öğretildiği öğrenciler, diğer öğrencilere göre bir problemi çözmeye daha başarılıdır.

#### 4. Hipoteze ait Bulgular

Araştırmanın dördüncü hipotezini oluşturan “gösteri araçları kullanarak bir Matematik probleminin çözüm basamaklarını öğrenen öğrenciler, geleneksel yöntemler ile öğrenen öğrencilere göre bu basamakları daha doğru bir şekilde hatırlayarak bir problemin çözümünde kullanabilirler” ifadesine ait bulgular aşağıda verilmiştir:

Uygulama düzeyindeki öğrenmenin kalıcılığına ilişkin t-testi sonuçlarına tablo 2’den bakıldığında  $t=5,012$  ve “ $p=0,000$ ” değerlerin elde edildiği görülmektedir. “ $P<0,05$ ” olduğu için her iki grubun ortalamaları arasında anlamlı bir farkın bulunduğu belirlenmiştir. Her iki grubunun ortalamalarına baktığımızda deney grubunun ortalaması “70,75”, kontrol grubunun ortalaması “54,81”, her iki grubun ortalamaları arasındaki fark ise “15,94”dür. Elde edilen bu bulgular, gösteri araçları kullanılarak Matematik problemlerinin çözme basamaklarının öğretildiği öğrenciler, uygulamada, geleneksel yöntemlerle öğrenen öğrencilere göre aradan zaman geçse de daha başarılıdır.

Tablo 3. Deney ve Kontrol gruplarına uygulanan Tek grup ortalamalarına ilişkin t-testi

| Grup    | $\bar{X}$<br>(Test Edilen) | N  | $\bar{X}$ | $\bar{X}$<br>Farkı | s.s.  | s.d. | T     | p     |
|---------|----------------------------|----|-----------|--------------------|-------|------|-------|-------|
| Deney   | 73,78                      | 27 | 70,74     | 3,04               | 8,74  | 26   | 1,807 | 0,082 |
| Kontrol | 59,46                      | 27 | 54,81     | 4,65               | 11,22 | 26   | 2,151 | 0,041 |

Grupların kendi ortalamalarına bakarak kalıcılığı belirlemek amacı ile deney ve kontrol grubuna ayrı ayrı tek grup t-testi uygulanmıştır. Bu testte deney grubunun kalıcılık testindeki ortalamaları, aynı grubun uygulama testindeki ortalamasıyla, kontrol grubunun kalıcılık testindeki ortalaması ise aynı grubun uygulama testindeki ortalamaları ile karşılaştırılmıştır. Elde edilen bulgular Tablo 3’de verilmiştir.

Deney grubuna uygulanan tek grup t-testi sonuçlarına Tablo 3’den bakıldığında “ $t=1,807$ ” ve “ $p=0,082$ ” olarak görülmektedir. “p” değeri “0,05” anlamlılık düzeyinden büyük olduğu için öğrencilerin uygulama düzeyindeki başarılarında bir düşüş olmadığı bulgusuna ulaşılmıştır. Başka bir ifade ile gösteri araçlarının kullanıldığı sınıflardaki öğrencilerin öğrendikleri bilgiler kalıcıdır. Çünkü uygulama aşamasından sonra deney grubuna gerçekleştirilen test ortalamaları ile bu testten beş ay sonra gerçekleştirilen kalıcılık testi ortalamaları arasında anlamlı bir fark bulunmamıştır.

Kontrol grubunun uygulama sonrası test ortalaması ile yine kontrol grubunun kalıcılık testi arasında gerçekleştirilen t-testi sonuçlarına tablo 3’den bakıldığında anlamlı bir farkın bulunduğu görülmektedir. Çünkü “t” değeri “2,151” “p” değeri “0,041” olarak bulunmuştur. Bu değerler “ $p<0,05$ ” düzeyinde her iki ortalama arasında anlamlı bir farkın bulunduğu göstermektedir. Bu bulgular geleneksel yöntemlerle problem çözme basamaklarını öğrenen öğrencilerin bilgilerinin kalıcılığının daha düşük olduğunu ortaya koymaktadır. Başka bir ifade ile öğrencilerin geleneksel yöntemlerle sahip olduğu bilgileri unutmalarının daha yüksek olduğu söylenebilir. Sonuç itibarıyla Tablo 3’den elde edilen verilere göre gösteri araçları ile matematik problemi çözme basamaklarını öğrenen öğrencilerin bilgileri kalıcı iken, geleneksel yöntemlerle öğrenen öğrencilerin bilgilerinin aynı oranda kalıcı olmadığı belirlenmiştir.

## Tartışma

Bloom’un bilişsel öğrenme alanı taksonomisinin ilk üç basamağında yer alan bilgi, kavrama ve uygulama düzeyindeki öğrenmelerin incelendiği bu araştırma bulgularına göre kavrama ve uygulama düzeyindeki öğrenmelerde gösteri araçlarının kullanılmasının öğrencilerin öğrenmelerinde farklılıklar yarattığı belirlenmiştir. Bilgi düzeyinde ise geleneksel yöntemler ile gösteri araçları kullanılarak gerçekleştirilen derslerdeki öğrenciler arasında anlamlı bir fark olmadığı belirlenmiştir. Birçok araştırma modern eğitim teknolojilerinin kullanımı öğrencilerin başarılarını arttırdığını (İsman, 2005; Akkoyunlu ve Yılmaz, 2005; Forgasz, 2006; Harter ve Ku, 2007; Mercan, Filiz, Göçer ve Özsoy, 2009; Efe, Efe ve Hevedanlı, 2010) ifade ederken, bu araştırma sonucunda elde edilen bulgular, bilgi düzeyindeki öğrenmelerde bu görüşleri desteklememektedir. Yani gösteri araçları kullanılarak öğrencilerin Bloom’un bilişsel alan taksonomisinin bilgi düzeyindeki öğrenmelerinde, geleneksel yöntemlere göre bir farkın bulunmadığı belirlenmiştir. Çekbaş, Yakar, Yıldırım ve Savran (2003) bilgisayar destekli eğitimin öğrenciler üzerine etkisini araştırdıkları çalışmalarında bu bulgulara benzer sonuçlara ulaşmışlardır. Bu çalışmada kontrol grubuna uygulanan geleneksel öğretim yöntemleri sonucunda, öğrencilerin fizik dersindeki teorik başarılarında bir artış olduğu, ancak uygulama düzeyindeki

başarılarında bir fark bulunmadığı tespit edilmiştir. Bu da bilgi düzeyindeki öğrenmelerde geleneksel yöntemlerin etkili olduğunun ve buna bağlı olarak da gösteri araçları kullanılan deney grubu ile geleneksel yöntemin kullanıldığı kontrol grubu arasında anlamlı bir farkın bulunamamasının nedeni olarak açıklanabilir.

Öğretmenler, yeni eğitim teknolojilerinin öğrencilerin öğrenmelerine daha fazla katkı sağladığı görüşündedir (Sakallı, Bakay, Hüssein, 2008). Ayrıca, derslerde eğitim-öğretim materyalleri kullanmak, öğrenciyi öğrenme ortamında etkin kılmaktadır (Akkoyunlu 1998; Alkan 1987; Demirel 1999; Şimşek, 2002; İşman, 2005). Öğrencilerin ilgisini çekmede ve dikkatleri daha uzun süre üzerinde toplaması, gösteri araçlarının Bloom'un bilişsel alan taksonomisinin kavrama ve uygulama düzeyinde etkili olmasının nedeni olarak görülebilir. Burada gösteri araçları ile öğretmenlerin, etkili görsel faaliyetler ile öğrencileri öğrenmeye karşı güdüleyebilmesi, öğrencinin ilgisini canlı tutabilmesi ve görsel sunum sayesinde öğrencilerin eğitim-öğretim faaliyetlerinde aktif rol almalarına imkân vermesi (İşman, 2005) de göz ardı edilmemesi gereken bir durumdur.

Matematik müfredatlarında, öğrencilerin problem çözme becerilerini değerlendirmek diğer becerilere göre oldukça zordur. Matematik Öğretmenleri Ulusal Konseyi (NCTM) (2000)'ne göre matematiği etkileyen ve öğrencilerin öğrenmesini artıran teknoloji, öğrenme ve öğretmede faaliyetlerinin yürütülmesinde gereklidir. NCTM (2000)'ye göre ayrıca eğitimin bütün aşamalarında öğrenciler, problem çözme süreçlerini açıklayabilmelidir. Özellikle bu açıklamalar kavrama düzeyindeki öğrenmelere karşılık gelmektedir. Elde edilen bulgulara göre gösteri araçlarının kullanımı öğrencilerin kavrama düzeyindeki başarısını geleneksel yöntemlere göre daha çok arttırdığı için, NCTM'nin istediği problem çözme süreçlerini açıklayabilme becerisini de arttırdığı söylenebilir.

Rogers (2003) eğitim-öğretim de araç kullanmanın öğrencilerin problem çözmelerine yardım ettiğini, araçlarla yapılan anlatımlarla öğrenilenler bellekte daha uzun süre kaldığını ve öğrenmeyi somutlaştırdığını ileri sürmektedir. İşman (2005)'de teknoloji kullanımının kalıcı öğrenme oluşturduğu görüşüne sahiptir. Araştırma'nın dördüncü hipotezine ait bulgulara göre de gösteri araçlarının kullanımı öğrencilerin problem çözme becerilerinde kalıcılığı sağladığını ortaya koymaktadır. Bu da İşman (2005) ve Rogers (2003)'in görüşlerini destekleyen bir bulgudur. Gösteri araçları arasında yer alan data projeksiyon, bilgisayar aracılığı ile her türlü ses, video, görsel ve yazılı materyallerin yansıtıldığı bir eğitim öğretim aracıdır. Üç boyutlu resimler de çok etkili bir şekilde yansıtılabilir (İşman, 2005). Çoklu ortam ürünlerinin etkili şekilde sunulduğu bir araçtır. Birçok duyu organına hitap etmesi nedeni ile geleneksel yöntemlere göre daha kalıcı öğrenmelere neden olması doğal olarak karşılanmalıdır.

## Sonuçlar

1. Gösteri araçları kullanılarak bir Matematik probleminin çözüm basamaklarını öğrenen öğrenciler, geleneksel yöntemler ile öğrenen öğrencilere göre bilgi düzeyindeki öğrenmelerde daha başarılı olduklarına ilişkin bir sonuca ulaşamamıştır. Başka bir ifade ile bilişsel alan taksonomisinin bilgi düzeyinde gösteri araçlarının kullanılması ile geleneksel yöntemlerin kullanılması öğrencilerin öğrenmeleri arasında bir fark yaratmamaktadır. Bu anlamda birinci hipotez reddedilmiş, geleneksel yöntemler ile gösteri araçları kullanılarak gerçekleşen öğrenmeler arasında bir fark yoktur sonucuna ulaşılmıştır.
2. Bilişsel alan taksonomisinin kavrama düzeyinde gösteri araçları kullanılarak bir Matematik probleminin çözüm basamaklarını öğrenen öğrenciler, geleneksel yöntemler ile öğrenen öğrencilere göre bu düzeydeki öğrenmelerde daha başarılıdır. Bu ifadeden de anlaşılacağı üzere ikinci hipotezi destekleyen bir sonuç elde edilmiştir.
3. Gösteri araçları kullanarak Matematik problemi çözüm basamaklarını öğrenen öğrenciler problem çözmeye geleneksel yöntemler ile öğrenen öğrencilere göre daha başarılıdır. Başka bir ifade ile gösteri araçları kullanıldığı ortamlarda problem çözme basamaklarını öğrenen öğrenciler karşılaştıkları bir matematik problemini çözmeye geleneksel yöntemlerle öğrenen öğrencilere göre daha başarılıdır. Bu sonuç, araştırmada ileri sürülen üçüncü hipotezi desteklemektedir.
4. Bilişsel alan taksonomisinin uygulama düzeyindeki öğrenmelerin kalıcılığına bakıldığında ise gösteri araçlarının kullanıldığı öğrenme ortamlarında gerçekleşen öğrenmelerin geleneksel yöntemlerle gerçekleşen öğrenmelere göre daha kalıcı olduğu belirlenmiştir. Elde edilen bu sonuç da araştırmanın dördüncü hipotezini desteklemektedir.

Sonuç olarak, gösteri araçları kullanılarak, matematik problemlerinin çözüm basamaklarını öğrenen öğrenciler, geleneksel yöntemler ile bu basamakları öğrenen öğrencilere göre, Bloom'un bilişsel alan taksonomisinin kavrama ve uygulama düzeyindeki öğrenmelerde daha başarılıdır. Ancak, bilgi düzeyindeki öğrenmelerde ise öğrencilerin başarıları arasında bir fark yoktur. Ayrıca gösteri araçlarının kullanıldığı ortamlarda gerçekleşen öğrenmelerin kalıcılığı, geleneksel yöntemlerin kullanıldığı ortamlardaki öğrenmelere göre daha yüksektir.

## Öneriler

Günümüzde merkezi okullarda gösteri araçları yaygın olarak bulunmakta ve öğretmenler bunları etkin bir şekilde kullanmaktadır. Ancak eğitimde fırsat eşitliği dikkate alındığında özellikle taşradaki okullarda gösteri araçları konusunda sıkıntılarının bulunduğu bir gerçektir. Bu nedenle bu okulların da bir an önce bu araçlara sahip olması sağlanmalıdır. Bu konuda gerekirse İşman (2005)'in da ifade ettiği gibi okul aile birlikleri bu sürece dâhil edilebilir.

Öğretmenler daha etkili öğrenmeler sağlamak istiyor ise gösteri araçlarını etkin bir şekilde sınıflarında kullanmalıdır. Ancak öğretmenler bilgi düzeyindeki öğrenmelerde, geleneksel yöntemlere göre gösteri araçlarının çok etkili olacağı gibi bir yanılgı içerisine girmemelidir.

Öğretmenlerin yeni ilköğretim programları ile birlikte modern eğitim teknolojilerini klasik teknolojilere göre daha çok kullanmaya başlamaları (Aygün ve Akgün 2010) bir fırsat olarak görülebilir. Ancak matematik dersinde teknoloji kullanımına yer verilmediğini (Koğ ve Başer, 2010) ortaya koyan araştırmalar da bulunmaktadır. Ayrıca gösteri araçları gibi çağdaş eğitim teknolojilerini kullanan öğretmenler hazır materyaller kullanmayı tercih etmektedir (Aygün ve Akgün, 2010) Bu hazır materyalleri kullanmak yerine sınıflarından öğrencilerinin seviyesine uygun materyalleri kendilerinin hazırlaması daha doğru olacaktır. Ancak gösteri araçlarında kullanılan ses, görüntü, şekil ve animasyonların hazırlanmasının özel bir uzmanlık gerektirdiği de göz ardı edilmemelidir. Bu nedenle eğitim fakültelerinin bütün bölümlerinde powerpoint sunusu hazırlamadan başlayarak, animasyonlar yapabilecek düzeyde öğretmenler yetiştirilmelidir.

Olkun ve Tolkun (2003)'un ifade ettiği gibi problem çözmenin matematik eğitiminde doğru ve etkili bir şekilde kullanılabilmesi için öğretmenlere gösteri araçları ile problem çözme öğretimi konusunda hizmet içi eğitimler düzenlenebilir.

#### *Araştırmacılara Öneriler:*

- Gösteri araçlarını kullanımı ile problem çözmeye süresi üzerine bir araştırma gerçekleştirilebilir.
- Bloom'un bilişsel alan taksonomisinin daha üst düzeydeki öğrenme basamaklarına göre daha üst sınıflarda araştırmalar gerçekleştirilebilir.
- Gösteri araçlarının kullanılmasının diğer derslerdeki öğrenci başarılarına etkisi araştırılabilir.

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# PRODUCTION OF ALUMINIUM MATRIX COMPOSITES REINFORCED WITH TiB<sub>2</sub> PARTICLES

Hasan Erdem ÇAMURLU, Feyzi Emrah BAŞAR

Akdeniz University, Faculty of Engineering, Mechanical Eng. Dept., Antalya, Turkey  
[erdemcamurlu@gmail.com](mailto:erdemcamurlu@gmail.com)  
[febasar@akdeniz.edu.tr](mailto:febasar@akdeniz.edu.tr)

## ABSTRACT

Aluminum matrix composites reinforced with TiB<sub>2</sub> particles were produced by sintering aluminum and copper (4 %) powders and TiB<sub>2</sub> particles. Aluminum and titanium diboride powders were mixed at the ratios of 10%, 15%, 20% and 30% TiB<sub>2</sub> by volume. The powder mixtures were cold pressed uniaxially at 800 MPa. The composites were obtained after sintering at 620°C in nitrogen atmosphere. The composites were subjected to density measurements, microstructure examinations, 3 point bending, hardness and wear tests. Same tests were repeated after T6 age hardening of the composites. Unreinforced sample presented a maximum 3 point bending strength of 940 MPa, 28 percent strain and 100 HB10 hardness values after age hardening treatment. Wear rate was  $12.16 \pm 3.16 \times 10^{-3} \text{ mm}^3 / \text{N.m}$  in the unreinforced sample. The least wear rate was seen in 20% TiB<sub>2</sub> containing samples, in which the wear rate decreased about 30 fold as compared to unreinforced samples. This composite presented 867 MPa bending strength, 130 HB10 hardness and 7.4 percent strain.

**Keywords:** Powder Metallurgy, Sintering, Aluminum Matrix Composites, Metal Matrix Composites, TiB<sub>2</sub>

## PUTTING CUSTOMER IN CHARGE OF DESIGN: OPPORTUNITIES AND CHALLENGES

Risdiyono  
Department of Mechanical Engineering  
Islamic University of Indonesia  
Yogyakarta, Indonesia  
risdiyono@uii.ac.id

**Abstract:** Involving customer in value creation to fulfill individual requirements has been popular for several years under the domain of mass customization and personalization. Not all manufacturers adopted the concept succeeded in its execution process. It is possibly because the value generated by manufacturer does not meet the value demanded by customers. Discussed in this paper is the identification of several important additional values that can be generated by incorporating customers in product creation in order to help designers to have better understanding on current trend of personalization. New roles of the designers due to paradigm shift about customers from one market to market of one are also discussed to get some idea about future directions.

**Key words:** design by customer, value creation, customer involvement, personalization.

### Introduction

Customer satisfaction has been identified as the most important factor determines the long-term success of a company. It can be achieved when customers perceive that the value of products and/or services they received is as (or exceed) what they expected. In order to create a premium value for customers, manufacturers should focus on the total customer experience, related to (1) superior solution to the need, (2) fair price, (3) treatment with respect, (4) emotional connection and (5) convenience (Berry, 2002).

While the last three deal with the quality of services (customer experience in transaction processes), the first two are more related to the quality of product (customer experience in using the product). Focus on superior solution to the customer need may sound simple but in fact it is very complicated. Manufacturer must understand what people need and how to fulfill the need better than competitors. A key challenge will be how to ensure that the need manufacturer perceived is the real need customers demanded because it will differentiate between a successful product and a fail one. It is important to note that understanding customer need is not a trivial task especially in this era of personalization where the extent of market-of-one has been foreseen as a prospective driving force for the next transformation of global economy (Pine, 2009).

The difficulty in understanding customer need is due to the large range of individual, cultural and physical difference among people. In the past, when competition is still low, the concept of “voice of majority” could be successfully adopted to define product specifications in order to fulfill mass market need. Later on, in order to face the increased competition due to technology advancement, the concept of “market segmentation” was adopted. The manufacturer must know the audience for whom the product is intended. A mobile phone manufacturer, for example, might produce many models and series for different target (segment) to acquire wider market share. Manufacturers tried to use technology to generate variety in products and to manage the way the products evolve. The concept of platforms, family, generation, add-on, version, models, option, etc. have been well recognized and in turn, these are becoming the bases of mass customization.

Under the system of mass customization, the market is re-segmented further into smaller group of customers with similar preference (market niches). Hence, in product development process, not only “voice of majority” but also “voice of minority” is taken into account. Product variety is not predefined by final product in terms of model,

version and series, but instead it is handed over to customer preference. Customers can involve themselves to specify their own variety by choosing predefined components and assembly them to get the final configuration.

Furthermore, in this inevitably high competitive environment, where companies are trying to focus more on customer satisfaction to win in the market place, treating customer as a personal (so-called personalization) is becoming a trend. Its adoption in service industry faces less challenge than in manufacturing sector due to their different natures. While it is not difficult for a mobile phone services provider, for example, to offer personalized phone number (where customers can choose their own unique number) or to offer personalized ring tone, it will be a very hard task for a mobile phone manufacturer to personalize the phone itself. Mass production is still the best way in this regard.

Personalization means treating all customers individually based on each personal preference. For designers, it results in a very big challenge to define product specification since the well-established general procedure in product design and development could not be directly employed. This is because the customers as one market have evolved gradually into segment market, niche market and finally into market of one (figure 1).

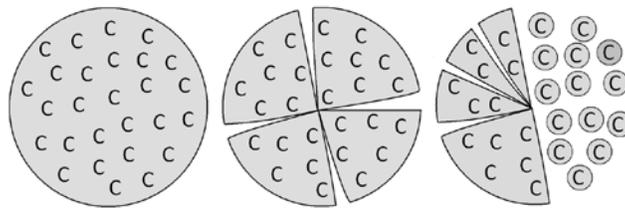


Figure 1. From one-market to market-of-one

It is important therefore to discuss how companies offer their customers a personalization experience and then to characterize some of its values which are considered significantly able to improve customer satisfaction. Those will be comprehensively discussed in this paper.

## Putting Customer in Charge of Design

It is a nature that customers usually purchase products (goods or services) for a reason; they have a problem (a need) and expect manufacturer or service provider to come up with a solution (to fulfill their need). Their utmost satisfaction will be achieved when they get exactly what they want without compromising any requirement. As each customer may have her/his own preference, a rigid predictive-based product specification will be difficult to compete. As an alternative, a flexible responsive-based one should be adopted. Involving customers in value creation is believed as a way to achieve this purpose

### Design

There is no generally-accepted definition of “design” exists (Ralph and Wand, 2009) and the term has different connotations in different fields. In this discussion, design refers to a process of establishing the basic parameters of a product. It comprises activity to initiate, to select, to combine, to arrange, to modify and to manipulate things in order to meet intended requirements. Sketching, where the lines (including straight line, arc, circle, curve, etc.) are selected, arranged and combined together with the colors, is an example of design form. In practice, the term design is often used by manufacturers engaged in mass customization, for example “design your own watch”, “design your special shoes”, “design your own shirt”, etc. However, when customers come to utilize the offered option, they will know that the meaning of design here is “to mix and match” predefined available components to get final desired configuration. Hence the activity of selecting and combining things to make a new form in practice is also known as design activity.

### Design and Value

Basically, customers spend their money not simply because of the product itself, but more likely because of the value within it. The value may come from many sources, including physical value and emotional value. While

physical value is related to the experience of using the product and usually obtained from the quality of behavioral (functional and kinesthetic) or visceral design, emotional value is about the feeling of satisfaction resulting from emotion rather than realism when owning or displaying the product (Norman, 2004).

Depended upon customer's individual preference, the important level of the value may differ from one customer to others. Some might place physical value higher so that they will be satisfied enough to own a good quality product from general brand, while others might put their interest on emotional value so that they prefer to spend more money to own the branded product even though the quality does not differ much.

Many companies are competing in the area of physical value as it is easy to evaluate. However, it is worthy to note that the successful product should excel in both values. Involving customers in value creation has potential to improve those values as it can result in better product fitness (physical value) as well as in emotional bond between the product and the customer (emotional value).

### Customer in Design

There is a paradigm shift of customer's role in design; from passive audience in the era of mass production (Design for Customer) into active player in current age of mass customization and personalization (Design by Customer). The paradigm of "closed innovation" (in which the innovation is taking place just within the boundary of manufacturer) has shifted to "open innovation" (cooperation between manufacturer and customers or users). As a result, designers' task is shifted from designing a final product to designing a system that enables customer involvement in value creation. Customers are then placed as designers (or sometimes called as co-creators) of their own final product specifications by using design tool provided by manufacturer. Table 1 exhibits these fundamental changes. This trend should be anticipated by manufacturer in order for them to survive in the business competition.

Table 1. Fundamental changes in product design

|                            | Design for Customer                  | Design by Customer                                   |
|----------------------------|--------------------------------------|--|
| o Source of design         | voice of majority                    | voice of niches or individual customers              |
| o Customer's role          | as object (passive)                  | as subject or co-creator (active)                    |
| o Product development task | to design a final product            | to design a system that enables customer involvement |
| o Supply for demand        | anticipative (forecast-based demand) | responsive (real demand)                             |
| o Type of innovation       | closed innovation                    | open innovation                                      |
| o Assessment               | focus on quality and low cost        | focus on quality and personal emotion                |
| o Value creation           | manufacturer oriented                | customer oriented                                    |

### Point Of Customer Involvement

Putting customer in charge of design does not mean that customers are given free hand to design in a blank space. Instead, they are guided to define the fittest alternative that meet the cost, schedule and the product requirements through the capabilities of a company. Depended mainly on the type of product, the point where customer can involve in production chain may vary, from simple involvement of skinning personalization to total design by customer (figure 2).

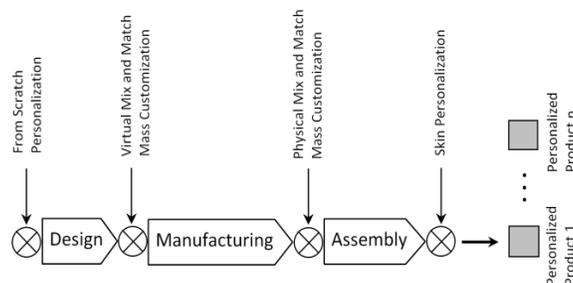


Figure 2. Points of customer involvement

### Skin Personalization

This type of personalization is the simplest one in term of manufacturing complexity. In this system, the general product has been manufactured while the differentiation is postponed by letting customer to personalize final skin of product (skinning process). In other word, customers are allowed to design “the skin” of a predefined standard product to add emotional value on it. The offered personalization is usually in terms of selecting color, adding self-elected name, word, number or picture.

Skinning personalization can be considered as a successful example of current implementation of customer involvement in value creation. It improves product uniqueness and creates emotional value of self expression without significantly increases production cost and time. Mugs, tissue box, t-shirt, hat, jacket, shoes, paper folder, photo frame, etc. are examples of its products while printing, embroidering and engraving are the technologies typically used for this application. In addition, the advancement of internet technology makes the process becoming easy and efficient. Figure 3 shows an example of personalized mug designed by using online design tool provided by [www.yourdesign.co.uk](http://www.yourdesign.co.uk). Customers are guided to personalize the product by selecting one of predefined standard mugs and then to add picture and text either on the front, back or full wrap.

Personalized packaging which is adopted by many food and beverage industries is also in this category. Customers, for example, are now able to have personalized label on a wine bottle or on a cereal package based on their design. The product is then becoming unique and personal, even though the contents do not differ from others. Customers are willing to pay additional cost for the emotional feeling resulted from this personalization experience.



Figure 3. Skin personalization example

### Mix and Match Mass Customization

Mass customization aims to provide products or services that serve individual customers’ personal needs with near mass production efficiency (Pine, 1993; Tseng and Jiao, 1996). The popular one is by configuration design where a wide variety of components are provided and customers are allowed to mix and match different components to configure final product according to their preference.

Based on the state of its components, mass customization can be categorized into two types; physical and virtual, which both can be done by using online or offline system. Physical mix and match happens when all components have been pre-designed and physically pre-produced to provide fast response. No inventory for final product but for components is needed as assembly process is postponed until customers complete their selection. However, since the components are made according to forecast demands, this method is very risky as not all components will be selected by customers. Hence, setting its optimum solution space will determine the success of the company. The example of this customization can be found easily in personal computer industry, automobiles, food, etc. Figure 4 shows the implementation of this concept by Harley Davidson Company using its H-D1 Bike Builder application.

On the other hand, virtual mix and match happens when manufacturer only provide virtual components for customers to select and the physical ones will be made after the order is confirmed. This replaces the limited physical inventory by unlimited virtual inventory which will significantly reduce the cost. As a consequence, the response time will be longer due to its made-by-order system. In customized clothing industry, for example, customers are allowed to select the style (collar, cuff, pocket, placket, button, etc) change the fabric (material, color,

and motif), to personalize brand, and to adjust the size. When customers have finished the customization process, manufacturer will start to cut raw material and then stitch the shirt accordingly. Hence, there is no risk of overstock finished product but managing the response time will be the most challenging task in this system. The other examples can also be found in jewelry industry, furniture, cake decoration, etc.



Figure 4. H-D1 Bike Builder by Harley Davidson

### From Scratch Personalization

This type of personalization places the point of customer involvement in the most upstream of the value chain in which customers will have full control to define their product specification at earlier stages. Based on its characteristic, the adoption of this concept in real business is mainly for products that by their nature are individually crafted under made-to-order system. The advancement of internet and manufacturing technology are becoming enabler to make the interaction between customers and manufacturer easier and to produce the products much faster. EGO3D, for example, allows customers to upload their designs in the form of photograph to make personalized bust (sculpture in 3D) or in the forms of CAD model or graphic designs for personalized vases, cups, picture frames, bookends, money boxes, pen stand, 3D medallion, etc. Additive layer manufacturing is employed to create the physical products in which artificial stone is used as raw material. To improve the quality, a hardener liquid is utilized to imbue the products so that they become later hard as chinaware but not as fragile. Figure 5 shows the example of a photograph-based personalized bust from EGO3D. Personalized ceramic mosaic decoration is also categorized in this group.



Figure 5 Example of a photograph-based personalized bust from EGO3D

## **Discussion 1 : Gaining Value by Customer Involvement**

A study by Hippel showed that for mass produced products, about 10-40 percent of the customers engage in modifying their products to meet their specific requirements after purchasing (Hippel, 2005). This group of customers is willing to pay additional cost and to wait for a while to get their product modified (Blecker and Abdelkafi, 2006). Hence, it can be seen as good opportunity for manufacturer to offer before-purchase modification by involving customers in production stage.

In order to adopt the concept of customer involvement in specifying their own personalized product, it is important for manufacturers to analyze the significant of additional values that will be generated. The higher the value gained the higher the possibility to success will be. Based on a comprehensive observation on successful story of customer involvement in value creation, there are several additional values that customers look for, including: (1) better product fitness, (2) feeling of accomplishment, (3) uniqueness, (4) self expression of personal identity, and (5) source of memory. The first is related to physical value, while the rest are all related to the emotional value.

### **Value of better product fitness**

As aforementioned, the concept of one-size-fits-all in mass production is difficult to fulfill the need of all customers. Customers only have “take it all or leave it” option. Modification after purchase is commonly adopted by customer when they could not get the product that fit to their requirements. Therefore, the first value that customer will gain when they are involved in production stage is the better product fitness. Personalized sizing for clothing, ring, shoes, hats, furniture, apartment, etc and personalized dietary food and beverage are example of this value creation. Coke Freestyle from Coca-cola, for example, offers personalized service where customers are freely design their own coke by using a zesty touch-screen system to mix selections from over 100 choices into a custom beverage to meet their individual requirement.

### **Value of feeling of accomplishment**

Consider the booming of electronic kits in the early of 1980s, where built your own radio, your own audio system, your own tape recorder, and your own television set were becoming a trend. People constructed the kits and they felt immense pride in their accomplishment as well as a common bond with other kits builders. The experience of building kits is a personal feat; the less skilled the kit builder, the more the special feeling. The experts did not feel pride in their kits; it was those who have no expertise felt so satisfied. It is important to note that the kits were not much cheaper than the finished one. People bought the kits for the feeling of accomplishment, not to save money. The similar case can be found in the current cook-your-self restaurant, personalized cake decoration, built your own robot, etc.

### **Value of uniqueness**

Everyone, by nature is unique and psychologically has tendency to differ from others. According to a study by Risdiyono and Koomsap (2009), for several types of products, uniqueness plays a significant role in customer buying decision. Souvenir and gift were identified as common products demanded by customers to be unique. The aforesaid photograph-based personalized bust from EGO3D can be considered as a good example of personalized unique gift in this matter.

### **Value of self expression of personal identity**

Rooke and Ouadi (2009) stated that the true luxury is when we are able to express ourselves as we like. Self expression is a need for most of people with different ways of fulfillment. The Wall Street Journal, for example, reported that the personalized license plates for automobile in the US is now becoming a trend and during this budget crunches, states are raising surcharges or proposing annual fee hikes for custom plates due to its potential market is indicated very huge. Based on the investigation, thing that drives people to take a personalized license plate is a self expression of personal identity. This value has been becoming a starting point to offer personalization for many other products, including personalized car’s audio system, t-shirt, stickers, tattoos, etc.

### Value of source of memory

Based on a study by Norman (2004), when people are asked about what the most valuable things they own, their answer will not always refer to the most expensive thing. Many refer to a simple thing but having emotional value of memory. Based on this value the product is then considered as “a token of remembrance”. Self-experience in a process of making things can be a source of memory that boosts high value for customers.

### Discussion 2: New Roles of Designers

Based on the previous discussion, it appears that there are big opportunities to create additional product value by involving customers in the creation process. However, there are also big challenges faced by manufacturer and designers interested in this area, including their new roles in:

1. Value added identification.  
Identifying what values of the products that demanded by customers will be the most crucial initial step to take. Inaccurate justification in this step will results in unwanted product failure. Type of products and customer preference should be characterized properly.
2. Value added generation.  
Designers should analyze whether the demanded value can be generated by involving customers in product creation. If yes, where the best position for the point of their involvement is should be.
3. System development and optimization.  
Developing products based on individual customer preference means developing a complicated system that does not only be able to respond to customer’s personal need individually, but also has a stability to provide a dynamic flow of products. Value creation for personalization should be within a system that is able to stably deliver high variety of goods. Analyzing product attribute to define solution space is very crucial in the system optimization. Identifying factors to classify which parts customers are allowed or not allowed to involve in the creation is another important thing to handle.

As the roles of designers are becoming more complicated, a new comprehensive method in product design and development process is needed. It will be one of important challenges for the future work.

### Conclusion

The opportunity and challenge to add value on products by putting customer in charge of design have been discussed in this paper. Putting customer in charge of design does not mean that customers are given free hand to design in a blank space. Instead, they are guided to define the fittest alternative that meet the cost, schedule and the product requirements through the capabilities of a company. This means the new roles of designers will be more complicated in the future competitive market. New method to develop personalization-based product and system is needed to help designers accomplishing their new task.

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# QUERY BASED CONTEXT AWARENESS ARCHITECTURE FOR HEALTHCARE SYSTEMS

Safiye Sencer

Department of Management Information Systems  
Sakarya University  
TURKEY

safiyesencer@yahoo.com, sencer@sakarya.edu.tr

Harun Taşkın

Department of Industrial Engineering  
Sakarya University  
TURKEY

taskin@sakarya.edu.tr

Cemalettin Kubat

Department of Industrial Engineering  
Sakarya University  
TURKEY

kubat@sakarya.edu.tr

**Abstract:** Context-awareness develops human-centric, intelligent behavior in an integrated environment; however, context aware domain purely logic-based reasoning on respectively context and services may not be enough. This paper presents query based agent middleware architecture for providing context-aware services for incorporated spaces to afford effective support for context acquisition, representation, interpretation, and utilization to healthcare management application. A context inference mechanism based on an extended fuzzy logic approach is used to enable automated reactive and deductive reasoning. The middleware is used in a case study in a healthcare management, and performance evaluation result shows that the context reasoning algorithm is good for non-time-critical applications and that the complexity is highly sensitive to the size of the context dataset.

**Key words:** Context Aware and Reasoning, Context Awareness Middleware, Fuzzy Logic, Multi Agent System.

## Introduction

Query based context awareness arranges human-centric, intelligent behavior in an integrated environment. The query based context awareness architecture realizes and conscious the selection of the data, preparation, pattern discovering, and pattern development processes in an agent-based structure within the multi agent system. As well as, it is designed to ensure communication between patients and hospital person to effective operation via agents within the multi agent system. Context plays an important role in intelligent area in providing information about the status of the people, activities, location, physical environment, and computing entities. Applications in intelligent areas use contextual information to become context-aware of changing situations relevant to the intelligent interactions with users (Dey, 2000; 2001).

The system is suggested in a way to process and evaluate fuzzy incomplete information by the use of fuzzy SQL query method. This paper presents query based agent middleware architecture for providing context-aware services for incorporated spaces to afford effective support for context acquisition, representation, interpretation, and utilization to healthcare management application. A context inference mechanism based on an extended fuzzy logic approach is used to enable automated reactive and deductive reasoning. The middleware is used in a case study in a healthcare management, and performance evaluation result shows that the context reasoning algorithm is good for non-time-critical applications and that the complexity is highly sensitive to the size of the context dataset. Also, the modeled system gains the intelligent feature, thanks to the fuzzy approach and makes predictions about the future with the learning processing approach. Context modeling and service representation is the main steps in the suggested architecture. Context modeling supports recognition of user conditions. Services representation relates to the context ontology models. Commonly, computing environment, a context model should provide application adaptability, resource awareness, mobile service, semantic service discovery in a everywhere. In particular, context modeling should describe the relationship between the domain vocabulary and the concept of the domain knowledge. A number of context modeling techniques exist such as key-value modeling, mark-up scheme modeling, graphical modeling, object-oriented modeling, logic based modeling and ontology-based modeling. This architecture emphasizes the need of

synergic approach between ontology and fuzzy logic to model the user's context. In particular, healthcare context domain ontologies are used to model static (e.g., user profile, preferences, etc.) and dynamic context (e.g., temperature, lab results etc.) data. On the other hand, soft computing techniques are used to enhance ontology context by means of qualitative representation of underlying data context. As an example, blood pressure could influence some different contexts but in order to discover the right set of recommendations that may be useful to manage the situation there is a need to be aware about in which range falls parameters values (i.e., high/low blood pressure, etc.). This paper presents a query based context aware mechanism, a process in which the agents within the multi-agent system filter and evaluate both the knowledge in databases and the knowledge received externally by the agents

The paper is organized as follows: The next section presents an overview of works in the literature related to both query based context awareness and computational intelligence approaches that deal with healthcare; the next section introduces overall architecture which attains the proposed aims and emphasizes the roles played by all the system components; and describes the complete working flow and details theoretical approach on which relies the work; then, the next describes the process model applied to healthcare case study. Conclusions and future works close the paper.

## Literature Survey

Context awareness represents the process of the context information during the change application behavior, which has been reported as a key essential for pervasive systems (Satyanarayanan, 2003). The query based context awareness system in agents utilizes fuzzy SQL queries from the agents, then creates and optimizes a query plan that involves the multiple data source of the whole multi agent system. Accordingly, it controls the execution of the task to generate the data set. Also set of design structure for location sensing, behavior adaptation related with mobility is so important components (Fortier et al. (2010), Kung and Lin (2006)). Query processing within peer to peer network structure with SQL structure was discussed generally (Idreos et al., 2004; Cybenko et al. 2004; Bernstein et al. 1981). Query processing and database was reviewed with relational database (Genet & Hinze, 2004). Lee et al.(2011) suggested the context-aware authentication and access control systems and verifies flexible and easy-to-use security systems to use for social network services in smart phone environment via scenarios. In addition, the paper also contains comprehensive reviews on algorithms that analyze contextual information of users and determine security level. Gui et al. (2009) developed client –side context aware search application which is built on the context-aware infrastructure. Qin et al. (2007) presented an agent-based middleware for providing context-aware services for smart spaces to afford effective support for context acquisition, representation, interpretation, and utilization to applications Fortier et al. (2010) presented set of design structure for location sensing, behavior adaptation related with mobility. Kung and Lin (2006) categorized the context-aware research scope.

Fenza et al. (2012) presented an integrated environment aimed at providing personalized healthcare services which appropriately meet the user's context. Mansour and Hopfner (2009) proposed XML-based XXREAL model. The Semantic Web formalisms are expressed the model healthcare services and context with an integrated environment aimed at providing personalized healthcare services which appropriately meet the user's context (Fenza et al. (2011), Fenza et al. (2012)).

Lee and Chung (2011) suggests context-aware authentication and access control systems and verifies flexible and easy-to-use security systems to use for social network services in smart phone environment via scenarios. In addition, the paper also contains comprehensive reviews on algorithms that analyze contextual information of users and determine security level. Zhang et al. (2007) presented context aware mechanism in dynamic fuzzy logic. Jiang et al. (2010) presented a distributed fuzzy context domain relevance model for presentation in fuzzy ontologies relevance relations between fuzzy context ontology and distributed fuzzy domain ontologies. Bobillo et al.(2008) proposed formal model for representing in ontologies relevance relations between context descriptions and domain knowledge subsets. Ko and Sim (2008) suggested Bayesian Network based context reasoning for probabilistic inference to solve the uncertain reasoning in flexible and adaptive situation. Strassner et al. (2008) proposed autonomic networking model. Doukeridis and Vazirgiannis (2008) proposed context-based index for services on top of any traditional service directory and design algorithms for construction search, update and merge of such directions. Fuzzy set was proposed by Zadeh (1965) and the division of the features into various linguistic values was widely used in pattern recognition and in the fuzzy inference system. Some scientists, making use of this, came up with various results. Relational database system particularly assists the system in making evaluations for making decisions about the future and in making the right decisions with fuzzy logic approach (Raschia & Mauaddib, 2002; Tatarinov et al. 2003; Galindo et al. 2001; Chaudhry et.al. 1999; Saygin et.al. 1999; Turgay et al.2006).

## Context Aware Management

Context aware model provides context information that could be collected, processed, inferred, and distributed to spontaneous applications. It offers this interaction faultlessly without revealing the inherent complexity required to manage the heterogeneous sources that provide the context information. All this is realized all the way through a

layered architecture. In the first layer, context is sensed and captured through sources embedded in the environment. In the second layer, the context is interpreted and structured by the context represent module. The context inference module deduces other contextual information that has not been explicitly sensed by the first layer. Context is now ready for invocation by applications and mobile users. However, Context-Aware Model provides additional functionalities such as service discovery that provides context awareness about services in the environment.

## Agent Based Context Aware Management

Agent based framework provides the feasibility and cooperate with each other agent to accomplish task in suggested architecture. Several context aware architecture have been developed to assist patients and medical professionals. Some studies about context information architecture approaches are represented as COSS (Brones, 2004), and COPEUS (Samulowitz, et al., 2001). On the other hand, medical knowledge on the context environment, patients data are sources of imprecision and vagueness. The nature of these data reveals the requirement of treating the uncertainty by means of robust theoretical modeling. Fuzzy approach and semantic formalisms integrated an appropriate coding of this kind of knowledge. This approach presents a hybrid system which main aim is related to provide an integrated environment that combines theoretical support and technologies in the Computational Intelligence domain. The suggested architecture based on the FIPA framework.

Suggested framework includes the following procedures with concurrency; distributed computation; modularity; cooperation features:

:

- automated identifying actual patient and local environment upon approach,
- automated recording the events with coming to and leaving off the actual patient,
- automated presentation of the orders or service due on the current location and with,
- supported documenting the required information keying in a minimum of data into prepared form entries.

The distributed query context awareness mechanism was proposed as a cooperative agent-based solution for information management with fuzzy SQL query. A multi-agent approach to information management includes some features such as:

The knowledge, rule and task are symbolized with the fuzzy approach in the system as follows:

- Knowledge :  $\text{str}(K_{i,y}, A_i) = \text{str}(L_{i,m}(Q_{i,n}(A_i \leftarrow \text{true}) \leftarrow \text{true}) \leftarrow \text{true})$ ,  
 ○ if  $K_{i,y} = L_{i,m}(Q_{i,n}(A_i \leftarrow \text{true}) \leftarrow \text{true}) \leftarrow \text{true}$  is a fuzzy
- Rule :  $\text{str}(R_{i,x}, A_i) = \min \{ \text{str}(R_i, A_i), \dots, \text{str}(R_{i,x}, A_i) \}$ ,  
 ○ If  $R_{i,x} = L_{i,m}(Q_{i,n} \leftarrow \text{true}) \leftarrow L_1, \dots, L_m$ , is a knowledge, where  $R_{i,x}$ , is the rule in  $A_i$  with conclusion  $L_m$ .
- Task :  $\text{str}(T_{i,t}, A_i) = \min \{ \text{str}(T_i, A_i), \dots, \text{str}(T_{i,t}, A_i) \}$ ,  
 ○ If  $T_{i,t} = L_{i,m}(Q_{i,n} \leftarrow \text{true}) \leftarrow Q_1, \dots, Q_n$ , is a rule, where  $T_{i,t}$ , is the task in  $A_i$  with conclusion  $Q_{i,n}$ .

### Query Processing

The agent performs two types of query in the process of defining keywords, concepts or attributes during knowledge processing. The first is external query, which is realized among the agents, while the second is the internal query, where the agent scans the knowledge within itself. During these query processes, the fuzzy SQL approach is applied. The multi-agent system consists of more than one agent.

$A = \{A_1, A_2, \dots, A_i\}$

The task set is  $T = \{T_1, T_2, \dots, T_j\}$ . The task base is <Definition of Task, Attribute, Dependency Situation, Agent >. The rule set is  $R = \{R_1, R_2, \dots, R_x\}$  The rule base is <Definition of Rule, Attribute, Dependency Situation, Agent >. The knowledge set is  $T = \{K_1, K_2, \dots, K_y\}$  The knowledgebase is <Definition of Knowledge, Attribute, Dependency Situation, Agent > (in Figure 3).

Table 1. The Nomenclature of Query Based Context Awareness Management System

|                          |  |
|--------------------------|--|
| A                        | i agent set $\{A_1, A_2, \dots, A_i\}$                                   |
| T                        | j task set in $\{T_1, T_2, \dots, T_j\}$                                 |
| $A_{i,x}$                | i agents x percept   |
| $\bigcup_{k=1}^m T_{jk}$ | i agent's j task sets refers to continuing subsets from k to m situation |
| $L_{i,m}$                | i agents m learning situation  |
| $Q_{i,n}$                | i agents n querying situation  |
| $A_i$                    | i agents attribute situation   |
| $R_{i,r}$                | i agent's r decision situation   |
| $K_{i,y}$                | i agent's y knowledgebase  |
| $R_{i,x}$                | i agent's x rule base  |
| $T_{i,t}$                | i agent's t task base  |

$t_0$  represent target context  
 $t_i$  represent the  $i$  th context  
 $d_s(t_0, t_i)$  denotes the distance between  
 $t_j$  is the  $j$ th smallest value in all distances  
 $x_{0s}$  and  $x_{is}$  are corresponding values of the two contexts on the  $s$  th feature

When data arrives from the external environment, it is perceived as input :  $\langle A_{i,x}, A_i, \emptyset \rangle$  When “x” is perceived by Agent  $i$ , it is referred to as  $A_{ix}$ . This input can also be used in knowledgebase, rule base and task base.

Feature-Attribute  $At$  and relation  $R$  are elements formed among the components within the system. These elements are the databases of knowledgebase, rule base and task base. While attribute refers to agent specifications, Resource includes not only raw data externally received but also knowledgebase, rule base and task base which each agent possesses.

$A = \{At, R(K_{i,y}, R_{i,x}, T_{i,t})\}$

Let  $P(At)$  denote the set of all possibility distributions that may be defined over the domain of an attribute  $At$ .

A fuzzy relation  $R$  with  $\cup$  schema  $A_1, A_2, \dots, A_n$ , where  $A_i$  is an attribute is defined as  $R = P(At_1) \times P(At_2) \times \dots \times P(At_n) \times D$ , where  $D$  is a system-supplied attribute for membership degree with a domain  $[0,1]$  and  $\times$  denotes the cross product.

Each data value  $V$  of the attribute is associated with a possibility distribution defined over the domain of the attribute and has a membership function denoted by  $\mu_v(x)$ . If the data value is crisp, its possibility distribution is defined by

$$\mu_v(x) = \begin{cases} 1 & \text{if } x = v \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Like standard SQL, queries in fuzzy SQL are specified in select statement of the following form:

```

SELECT      Attributes
FROM        Relations
WHERE       Selection Conditions.
    
```

The semantics of a fuzzy SQL query is defined based on satisfaction degrees of query conditions. Consider a predicate  $X \Theta Y$  in a WHERE clause. The satisfaction degree, denoted by  $d(X \Theta Y)$ , is evaluated for values of  $X$  and  $Y$ . Let the value of  $X$  be  $U$  and that of  $Y$  of  $V$ . Then,  $d(X \Theta Y) = \max_{x,y} (\min(\mu_u(x), \mu_v(y), \mu_\Theta(x,y)))$ , where  $x$  and  $y$  are crisp values in the common domain over which  $U$  and  $V$  are defined. Note that, in this definition, the comparison  $\Theta$  may be non-binary, i.e. defined by similarity relations, and crisp,  $V$  is fuzzy and  $\Theta$  is binary equality(=), trapezoidal membership functions and binary equality is considered, then  $d(X=Y)$  is the height of the highest intersection point of the two possibility distributions.

As shown in Figure 2, bids are taken as a set, the frequencies of the received bids are fixed and then the bids are decomposed into groups. The decomposed bids are included into databases of the multi-agent system. The information in databases is fuzzified and the interrelation between them is determined in terms of weight and importance level. The execution semantics of Query  $N$  is as follows. Each pair of tuples  $r$  in  $R$  and  $s$  in  $S$  satisfy the selection condition with a degree

$$d_{r,s} = \min((\mu_R(r), \mu_S(s), d(P_1(r)), d(P_2(s)), d(r, Y=s, z))) \quad (2)$$

is represented.

## The Proposed Query Based Context Aware Management Framework

In this section, query based fuzzy context awareness is suggested. The fuzzy query based context-aware middleware is designed based on a multi-agent system which aims to support applications that make use of contextual information in a smart space environment. The agent model consists of several individual, collaborating agents as depicted in Fig. 1.

Suggested model structure includes the four main phases: knowledge acquisition interface; dynamic index creation; context awareness mechanism; query based fuzzy context confidence identification mechanism and context importance degree ranking mechanism. The main purpose of the system is to serve as patients and physicians. The system provides recommendation for controlling the diseases depends on the symptoms. It can be used as a tool to aid and hopefully improve the quality of care given to patients. Fig. 1 shows the architecture of the fuzzy query based context awareness system.

*Knowledge acquisition interface:* It includes the past and present all of the data which is gathered by this part. The knowledge base is diverse and linked through a number of indices, frames and relationships.

*Context representation:* It involves the some what should be contained in a case; how to choose the storage structure of a case; and how to organize and index the cases to facilitate the retrieval of potentially useful cases. The organization and indexing aspects are especially important when the system handles thousands of complex cases.

*Context retrieval mechanism:* It is the process of finding the potentially useful cases and choosing the best match utilizing the search information.

*Dynamic index creation:* It involves assigning indices to cases to facilitate their retrieval. The main indexing methods include near neighbor, induction, knowledge guide, or their combinations.

*Context importance degree ranking mechanism:* It is the process of comparing pair-wise cases to determine the degree of matching on the two cases. For numeric values, the most commonly used similarity measure between pair-wise cases on each feature is derived from the distance, which can be calculated as follows.

Analysis models are used to analyze the target case, identify and elicit the information used to find the best match. It can be illustrated in Figure 1. During the analysis process, suggested approach consider the below index list in Table 1.

The system is able to process incomplete or fuzzy knowledge intelligently with the fuzzy SQL query approach.

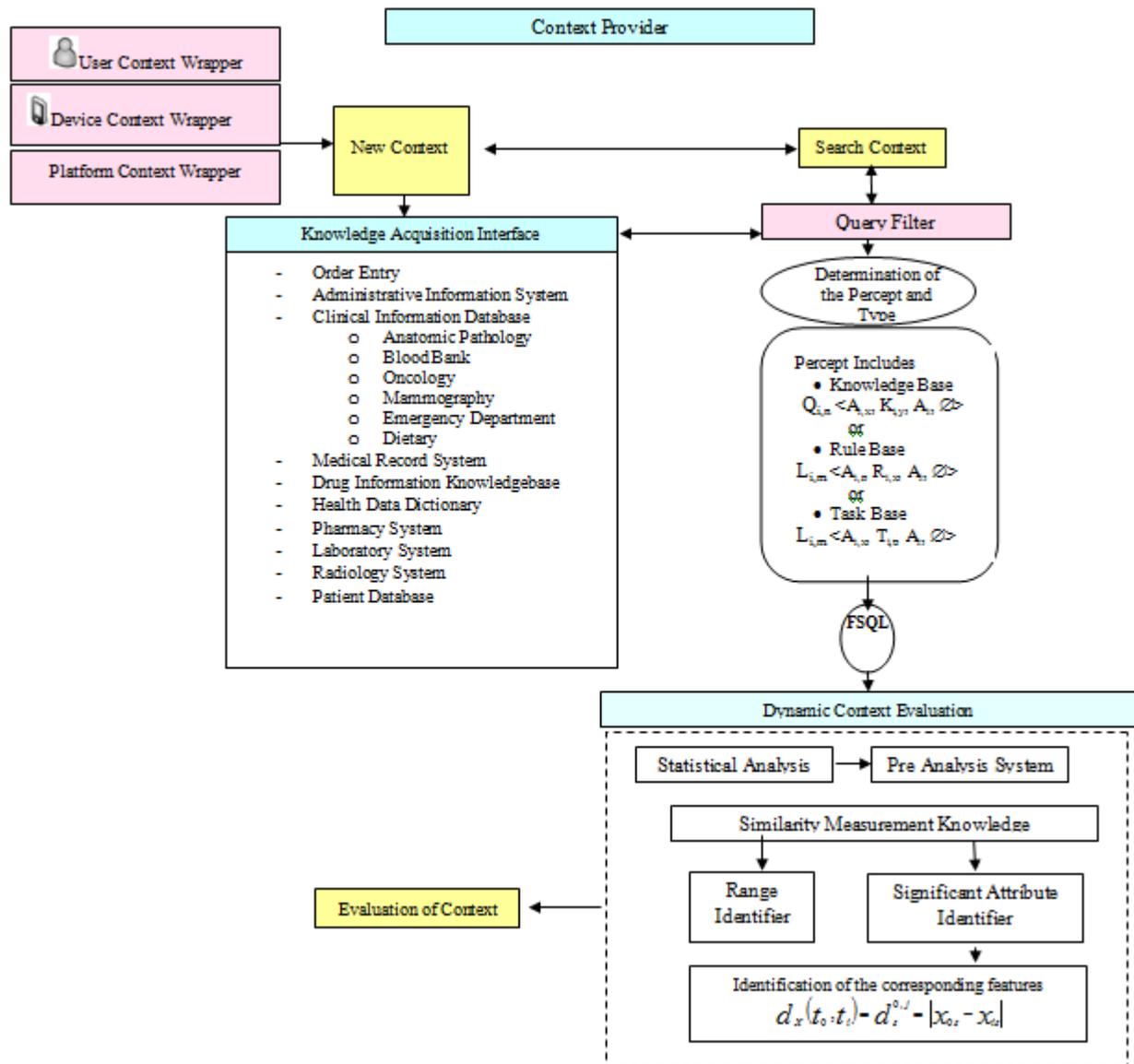


Figure 1. Context model extensions

### Context analysis

Data pre-processing: collected data are processed through filtering and normalization procedures, in order to get an accurate and homogeneous representation of the information with fuzzy logic.

$$d_X(c_0, c_i) = d_s^{0,j} = |x_{0s} - x_i| \quad (3)$$

The following parameters out of the range of normality: blood pressure, temperature, hearth beat that are considered and obtained the rule base like this:

R1: If  $x_1$  is  $A_{11}$  and  $x_2$  is  $A_{12}$  and ... and  $x_n$  is  $A_n$  then  $y_1$

The proposed fuzzy query based context awareness framework steps applied subsequently to the medical decision case in below, During the evaluation healthcare warehouse framework, also we consider the Ritter & Kohonen study's and Sencer et al. (2012) symptom and diseases evaluation matrix(In Table 2, Table 3).

Table 2. Attribute values sample (Sencer et al. 2012)

|                | $X_0$ | $X_1$ | $X_2$    | $X_3$       | $X_4$    | $X_5$   | $X_6$           | $Y_1$     | $Y_2$      | $Y_3$     | $Y_4$     | $Y_5$     | $Y_6$             | $Y_7$                |
|----------------|-------|-------|----------|-------------|----------|---------|-----------------|-----------|------------|-----------|-----------|-----------|-------------------|----------------------|
| Patient Number | Fever | Cough | Headache | Muscle pain | Swelling | Vomitus | Angina Pectoris | Influenza | Bronchitis | Arthrosis | Pneumonia | Arthritis | Myocardial attack | Fuzzy Ranking Values |
| 5              | 1     | 0,14  | 0,352    | 0,089       | 0,118    | 0,835   | 0,983           | 1,118     | 2,378      | 2,911     | 0,983     | 0,983     | 0,983             | 0,9826               |
| 14             | 1     | 0,499 | 0,713    | 0,104       | 0,508    | 0,994   | 2,197           | 0,684     | 2,604      | 3,696     | 2,197     | 2,197     | 2,197             | 0,6835               |
| 19             | 1     | 0,851 | 0,049    | 0,12        | 0,441    | 0,285   | 2,832           | 1,966     | 0,853      | 3,086     | 2,832     | 2,832     | 2,832             | 0,8534               |

Table 3. Obtained weight values (Sencer et al. 2012)

| Weights for Diseases | Fever | Cough | Headache | Muscle pain | Swelling | Vomitus |
|----------------------|-------|-------|----------|-------------|----------|---------|
| Angina Pectoris      | 0.054 | 0.078 | 0.167    | 0.173       | 0.167    | 0.961   |
| Influenza            | 0.806 | 0.552 | 0.682    | 0.067       | 0.167    | 0.806   |
| Bronchitis           | 0.917 | 0.884 | 0.078    | 0.172       | 0.044    | 0.018   |
| Arthrosis            | 0.215 | 0.067 | 0.154    | 0.852       | 0.961    | 0.117   |
| Pneumonia            | 0.107 | 0.955 | 0.167    | 0.067       | 0.018    | 0.041   |
| Arthritis            | 0.142 | 0.126 | 0.107    | 0.905       | 0.078    | 0.117   |
| Myocardial attack    | 0.311 | 0.02  | 0.067    | 0.098       | 0.167    | 0.943   |

## Conclusion

This paper discusses a variety of issues in adapting query based fuzzy context awareness concepts to an active multi agent database system which incorporates active rules in a multi computing environment. The partitioning of the rule set into multi agent system events has also been discussed as an example of inter-rule fuzziness. Similarity based event detection has been introduced to active multi agent databases, which is an important contribution from the perspective of performance. This system helps patients to reach healthcare resource easily.

Finally, due to frequent changes in the positions and status of objects in an active mobile database environment, the issue of temporality should be considered by adapting the research results of temporal database systems area into active mobile databases.

The paper presents briefly query based context awareness systems to help patients and physicians with easily communication and diagnosis. It presents an essential technology of building intelligent agent based context evaluation system for medical diagnoses that can aid significantly in improving the decision making of the physicians. These systems help physicians and doctors to check, analyze and repair their solutions.

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# REDOX POLYMERIZATION OF VINYL ACETATE BY XRArNRX/RO<sub>2</sub>RCATALYST

F. Dehmchi<sup>a</sup>, F. Halaimia<sup>a</sup>, A. Gasmi<sup>b</sup>, A. Boukhari<sup>a</sup>, T. Chelloufi<sup>b</sup>, A. Djerourou<sup>a</sup>, F. Ismael

<sup>a</sup>Chemistry Dept, Badji Mokhtar University, Annaba 23220, Algeria.

<sup>b</sup>Physics Dept, Badji Mokhtar University, Annaba 23220, Algeria

**Abstract** Investigations on redox polymerization started in Germany in 1937. Then, research on redox polymerization appears in USA, and in England, post second war. Redox mechanism appears as a way which allows the control of the main polymerization parameters. The redox catalyst study has contributed to the recognition in recent years that short-lived free radicals may be intermediates in many types of reactions. Alternatives for controlled radical polymerization (CRP) were developed at the end of last century. Three main classes of controlled/living polymerization techniques, such as nitroxide mediated polymerization (NMP), reversible addition-fragmentation transfer (RAFT) and atom transfer radical polymerization (ATRP) are globally used. However, many defects affected the use of these techniques of controlled radical polymerization CRP. So we investigated a new alternative of CRP by using redox catalysts which are complexes of multi functional amines RNX<sub>Y</sub> and peroxides RO<sub>2</sub>R. This redox technique appears to be most effective. The principal result of our investigation is that polymerisation occurs rapidly, that it becomes easier to conduct it at low temperatures, and with very small concentrations of initiators, or in equipment designed to function continuously. Our investigation lets us to reach at low temperatures, 30°C, polyvinylacetate PVAc essentially linear, with high molecular weight.

**Key words:** redox polymerization, PVAc, CRP, redox controlled CRP

## Nomenclature

|                                |                                    |                   |                       |
|--------------------------------|------------------------------------|-------------------|-----------------------|
| APV                            | Polyvinylalcohol                   | MEA               | monoethanolamine      |
| PVAc                           | Polyvinylacetate                   | DEA               | diethanolamine        |
| Bz <sub>2</sub> O <sub>2</sub> | Benzoyl peroxide                   | TEA               | triethanolamine       |
| XRArNRX                        | Alkylarylamine functionalized      | RO <sub>2</sub> R | Alkyl peroxide        |
| CRP                            | Controlled Radical Polymerization. | IP                | Polydispersity indice |

## 1. Introduction

Historically, post-war investigations on redox polymerisations have been essentially carried out in the U.S.A. and Canada and were principally turned to North American synthetic rubber based largely on a particular pair of monomers, butadiene and styrene, which are copolymerised in aqueous emulsion and became the backbone of the rubber industry (Atkinson, 1979). Redox techniques appear to be most effective in aqueous media, but they can be employed in organic solvents or in bulk monomers. Some redox systems involve direct electron transfer between reductant and oxidant, while others involve the intermediate formation of reductant-oxidant complexes. The best-investigated type of redox initiator is a two-component system, comprised of a peroxidic oxidising agent and a reducing agent.

## 2. Tertiary amines as reductants:

The use of tertiary amines as cocatalysts has been the study of different workers (Takemoto K. and al, 1960). No nucleophilic displacement of oxygen peroxide has received more attention than the amines. Lal and Green (Lal J. and al 1955) have reported the effect of various amine accelerators in the bulk polymerization of methyl methacrylate with benzoyl peroxide. At about the same time, Imoto and Takemoto (Imoto M. and al, 1955) reported the solution polymerization of acrylonitrile in the presence of substituted benzoyl peroxide-dimethylaniline redox system. Takemoto et al. reported also the polymerization of styrene using a solution of benzoyl peroxide and various di-n-alkylaniline redox systems. The presence of free radicals in the reaction of tertiary amines and benzoyl peroxide was

observed by electron spin resonance (ESR) spectroscopy. Replacement of methyl groups in dimethylaniline by hydroxy ethyl does not significantly affect the reactivity of the amine to accelerate the polymerization. Tribenzylamine benzoyl peroxide decomposes very rapidly (within 5 min), but no polymer is obtained in the bulk polymerization of methyl methacrylate. The amine may function as its own inhibitor. The molecular weights of the polymers obtained are in the neighborhood of 10,000 to 120,000 in the case of trialkyl and 1,000,000 in the case of aromatic amines .

### 3. Controlled Radical Polymerization:

Three main techniques of controlled/living polymerization, such as nitroxide mediated polymerization (NMP) (Georges MK and al,1993) reversible addition-fragmentation transfer (RAFT) (Hawthorne DG and al,1999) and atom transfer radical polymerization (ATRP) are generally used. However, drawbacks in three main techniques of CRP impede the mass production on an industrial scale. For example, the NMP system has to be carried out at high temperatures (>120°C), due to its inherently slow reaction rate and it works better in styrene derivatives. The difficulties of catalyst removal from the polymer for ATRP and relatively complicated synthesis pathway as well as the unpleasant odor in RAFT are known defects. DPE is known for its inability to form homopolymers because of the steric hindrance . Hence, it also acts as a molecular weight retarder during polymerizations.

M. Imoto and K. Takemoto, *J. Polym. Sci.*, 18, 377 (1955).

M. Imoto and K. Takemoto, *J. Polym. Sci.*, 18, 377 (1955).

Literature mentioned that Controlled radical polymerization (CRP) has been investigated by many authors since 1990. The complex [Co(II)(tmhd)(2)] (4; tmhd = 2,2,6,6-tetramethylhepta-3,5-dionato) has been investigated as a mediator for controlled radical polymerization of vinyl acetate (VAc) and compared with the analogue [Co(II)(acac)(2)] (1; acac = acetylacetonato)(Santhosh K.).

The successful simulation of the kinetic data shows that mechanism operates simultaneously by associative (degenerative transfer, DT) and dissociative (organometallic radical polymerization, OMRP) mechanisms. However, observation of stagnating molecular weights at long reaction times with concomitant breakdown of the first-order rate law for monomer consumption indicates a competitive chain-transfer process catalyzed by an increasing amount of Co(II).

The mechanism of controlled radical polymerization of vinyl acetate using vanadium catalysts is investigated using a range of experimental and computational studies. Optimal control is achieved using the noninnocent bis(imino)pyridine ligand framework. [BIMPY]VCl<sub>3</sub>, where BIMPY = 2,6-[(2,6-<sup>i</sup>Pr<sub>2</sub>C<sub>6</sub>H<sub>3</sub>)N=C(Me)]<sub>2</sub>(C<sub>5</sub>H<sub>3</sub>N)), is one of only a few transition metal systems capable of mediating the polymerization of vinyl acetate. The poor control exerted over styrene versus the excellent control observed for vinyl acetate under these conditions is not only dependent on radical reactivity but also due to chelation of the carbonyl group of vinyl acetate to the vanadium center, making the trapping step more favorable. These examples reported by literature show the multiple defects which occur in CRP experiments.

### 4. Controlled redox polymerization

Polyvinyl acetate PVAc is an advantageous precursor to polyvinyl alcohol APV which can be crosslinked to a hydrogel , a material able to swell in water and to retain a significant fraction of water within its structure. In order to produce ultra-high molecular weight PVAc , and APV, it is necessary that the number of extended branches contained by the precursor polymer, polyvinyl acetate, be minimized as much as possible. Branching at the alpha and beta carbons is known to occur much less frequently than branching at the methyl carbon of the acetate group. However branching at the methyl group of the acetate side group will lead to polyvinyl acetate having a significant number of branch points . Substantial branching during vinyl acetate polymerization is most undesirable if one desires to convert PVAc to APV. One must first appreciate that upon alcoholysis of PVAc for the production of APV , the acetate groups are cleaved from the backbone of the polymer. Thus, the molecular weight of APV will necessarily be about one half that of PVAc due to the molecular weight of the repeat units for each polymer. In this order, imperatively, catalyst phenomenon must delete the reactions which lead to branching if we hope to reach best properties of PVAc, APV, by increasing their molecular weights.

In the growing field of asymmetric catalysis and synthesis, amines have played a prominent role . XRNaR<sub>x</sub>X is a chiral aromatic amine which we have tested in combination with benzoyl peroxide Bz<sub>2</sub>O<sub>2</sub> in redox polymerization of VAc. The interaction occurs quasi exclusively between the catalyst R-R ( Bz<sub>2</sub>O<sub>2</sub> - XRNaR<sub>x</sub>X ) and the monomer M, exit interactions between solvent S and M, or any other interaction, in regard to energetic considerations. The mechanism of interaction between XRNaR<sub>x</sub>X and Bz<sub>2</sub>O<sub>2</sub> is regioselective. Thus the decomposition of the complex [ XRNaR<sub>x</sub>X-Bz<sub>2</sub>O<sub>2</sub> ] is controlled. N-Chiral amines as nucleophilic catalysts in asymmetric synthesis let the redox process of VAc polymerization following a controlled mechanism (see Fig ., 1,2,3).

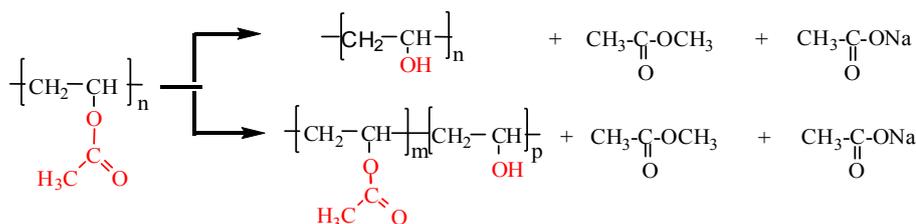


Fig.1



Fig.2 a. Radical initiation b. Redox initiation

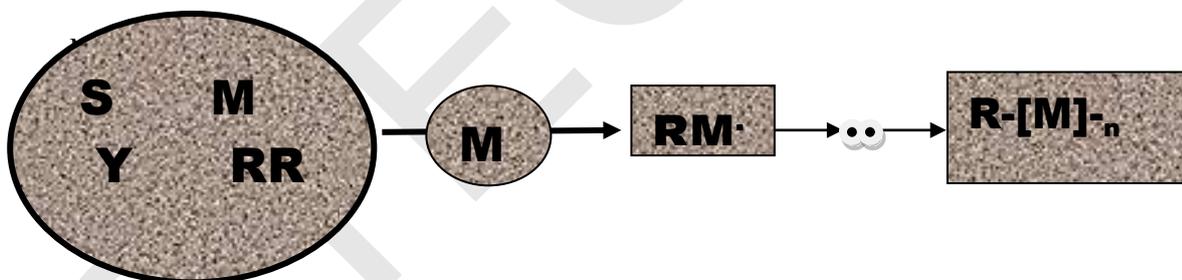


Fig.3 Regioselectivity redox interaction

## 6. Experimental

### 6.1 Solution polymerization of Vinyl Acetate

Vinyl acetate, VAc monomer, provided by Aldrich, was distilled under vacuum at the most 24 h before use. The first 20-50 ml of distillate were discarded and stored at  $-20^\circ\text{C}$  before use.

All polymerizations were performed in carefully dried glassware, under a purified nitrogen atmosphere. Experiments were performed in a 250 ml three-necked round bottom flask which was washed with THF and dried with acetone before use. The following ingredients were added as follows. The monomer VAc and methanol (10-20 ml of solvent used for initiator injection) were introduced into the reactor, heated to  $30^\circ\text{C}$ , and degassed with nitrogen. The initiator dissolved in the remaining solvent is then injected. The polymerization reactions were carried out at the required temperature ( $\pm 2^\circ\text{C}$ ) in an automatically controlled water bath.

All the experiments were run with mechanical stirring at 250 rpm. This speed is in the range where the agitation has no noticeable effect on the rate of polymerization (Matsumoto et al, ) .  
 Successively, we used as initiators  $Bz_2O_2$ -MEA,  $Bz_2O_2$ -DEA,  $Bz_2O_2$ -TEA . Finally, we investigate redox polymerization using  $Bz_2O_2$ -XRArNRX ( Fig.4) .

## 6.2 Saponification reaction of PVAc

Poly(vinyl alcohol) is conventionally produced in a two step process. The initial step comprises polymerizing vinyl acetate to produce poly(vinyl acetate). The second step comprises subjecting the poly(vinyl acetate) to alcoholysis (methanolysis or ethanolysis) in order to convert the poly(vinyl acetate) to Poly(vinyl alcohol) .

Saponification has been carried out in a flask equipped with a reflux condenser ,thermometer, dropping funnel , magnetic stirrer bar. An amount of 0.5g of PVAc is dissolved in 50 ml of THF. 20% hydroxyde potassium/methanol/water(45/5/v/v)solution and the PVAc solution in the dropping funnel are flushed with nitrogen The alkali solution is added to the PVAc solution and while being stirred at 55°C.At the end of the reaction ,the solid saponification product is filtered and washed three times by methanol.Then it's dried in a vacuum oven at 40°C for 24 h.

## 6.3 Viscosimetry of APV solution

$[\eta]$  is determined by viscosimetric technique ,using an Ubbelohde viscosimeter (Brandup.I,1966) .

$$[\eta] = K[Mv]^a = 1.315$$

Where :  $[\eta]$  is the intrinsic viscosity,  $Mv$  the viscosimetric weight ,  $K$  and  $a$  are the constantes of Mark-Houwink-Sakurada. Their values are dependent of the nature of the solvent used and the temperature of the experiment.

At 30°C ,solvent methanol,  $K = 6.66.10+5$   $a = 0.64$  ref.45

$$Mv_{APV} = ([\eta] / K)^{1/a} = 1.4 \cdot 10^5$$

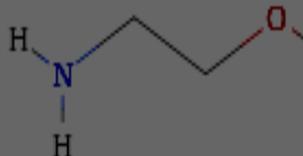
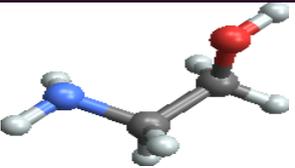
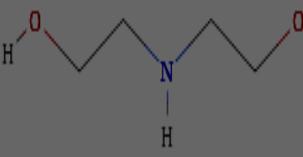
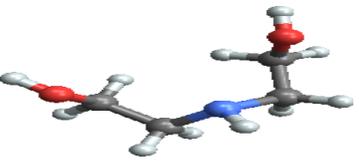
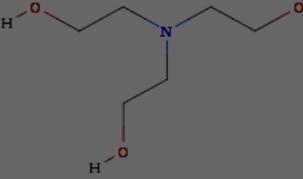
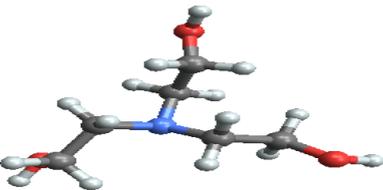
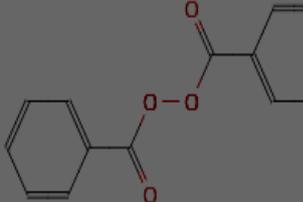
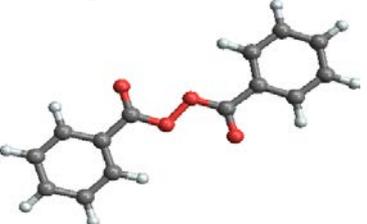
| Name  | Structure   | 3D structure   |
|---|---|--|
| <b>Monoethanolamine :MEA</b>                          |   |   |
| <b>Diethanolamine : DEA</b>                           |  |  |
| <b>Triethanolamine : TEA</b>                          |  |  |
| <b>Benzoyl peroxide :-Bz<sub>2</sub>O<sub>2</sub></b> |  |  |

Fig.4

### Ethanolamines Gel Effect

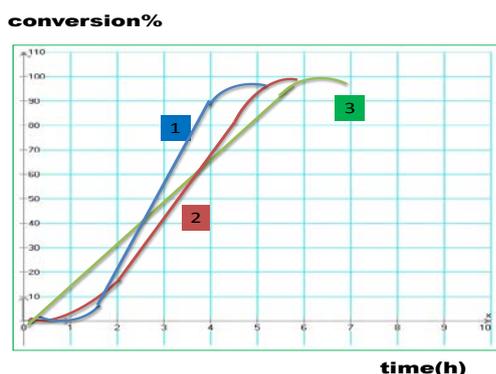


Fig.5 Gel effect 1.MEA 2.DEA 3.TEA

### Gel effect Bz2O2-XRARNRX

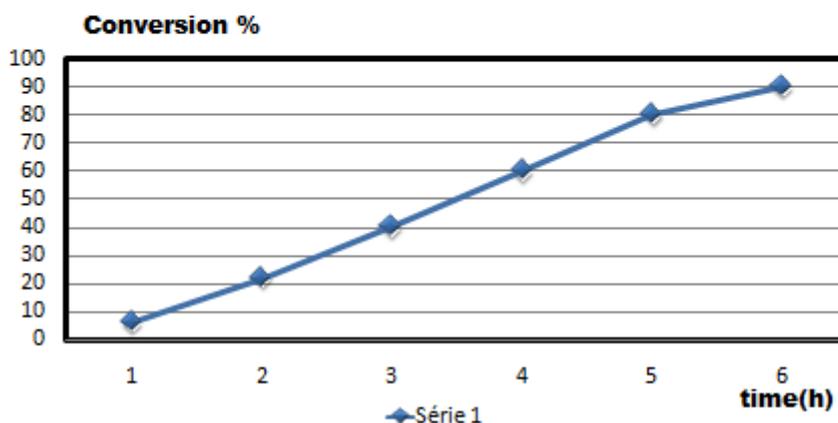


Fig.6 Gel effect Bz2O2-XRARNRX

It's generally agreed that conversion of the monomer should be limited. This can be accomplished by controlling nature and chemical structure of the catalyst, initiator concentration, polymerization time, and polymerization temperature. However, an optimum combination of these parameters is not known. Gel effect or Trommsdorff effect is the main parameter which be able to predict the best conditions for controlled polymerization. We have investigated the correlation between conversion degree and polymerization time, first by using ethanolamine MEA, diethanolamine DEA, triethanolamine TEA, as co-catalysts, and second by using XRARNRX an alkylaryl functionalized amine as co-catalyst. The results are shown in figures 1 and 2. Gel effect decreases from MEA to DEA to TEA. Beginning from 10% of conversion, this phenomenon entrave la cinétique de polymérisation presque jusqu'à sa fin. Par contre, lors de l'utilisation de TEA, et particulièrement pour une proportion TEA :Bz2O2=3 :1 l'effet de gel disparaît jusqu'à un taux de conversion de 70%.

Gel effect is nearly completely deleted by use of the complex Bz<sub>2</sub>O<sub>2</sub>-XRARNRX as shown in Fig.6. Suppression of Trommsdorff effect enhance molecular weight and reduce branching by decreasing polydispersity indice as proved by GPC results.

### 6.4 Gel Permeation Chromatography GPC

Molecular weights and molecular weight distributions were determined by gel permeation chromatography (GPC), using a Waters 510 HPLC equipped with a 410 differential refractometer and UV detector, using THF as eluent with a flow rate of 1.0 mL·min<sup>-1</sup> and

with three ultrastyrigel columns (100 Å°, 500 Å°, and Linear) in series. The molecular weight calibration curve was obtained using standard polystyrenes.

Tab.1 Experimental conditions

|             |       |             |      |             |        |
|-------------|-------|-------------|------|-------------|--------|
| RUN TIME    | 00:25 | INJ. TEMP.  | 30°C | INJ. VOL.   | 120    |
| SENSITIVITY | -0.25 | PUMP. TEMP. | 30°C | EQUIL.DELAY | 00:05  |
| FLOW RATE   | 1.0   | INJ.REMAIN  | 1    | MAX PRESS   | 200    |
| DEGAS TEMP. | OFF   | SOLVENT     | THF  | CHART       | 1CM/MN |

Samples subject to analysis by GPC Waters are : E1 , E2 , E3 , E4 , E5 , E6 ,with retention times RT as indicated by table 2.

### 6.4.1. Results of GPC

Tab.2.Results of GPC

| RT    | Area E1 | AreaE2   | AreaE3  | AreaE4  | AreaE5  | AreaE6  | Mw      |
|-------|---------|----------|---------|---------|---------|---------|---------|
| 11,14 | 74397   | 72485    | 74215   | 76533   | 74767   | 68814   | 990307  |
| 11,29 | 319587  | 316195   | 321159  | 329149  | 326385  | 308330  | 781204  |
| 11,74 | 1035820 | 1038900  | 1089380 | 1107090 | 1107410 | 1081080 | 404001  |
| 11,89 | 1039990 | 1041860  | 1094730 | 1110990 | 1106660 | 1087890 | 329211  |
| 12,34 | 875458  | 868324   | 925977  | 937800  | 945329  | 929180  | 185867  |
| 12,49 | 715570  | 707784   | 758821  | 767446  | 777967  | 764365  | 155482  |
| 13,09 | 185898  | 189094   | 200536  | 196689  | 205119  | 205622  | 80439   |
| 13,24 | 133990  | 138534   | 145430  | 141315  | 149119  | 150130  | 69019,6 |
| 13,84 | 49588   | 55754    | 57845   | 51988   | 57739   | 58852   | 38750,1 |
| 13,99 | 36920   | 41653    | 44949   | 39543   | 44359   | 45530   | 33783,2 |
| 14,74 | 8050    | 13441    | 10246   | 9199    | 10439   | 9960    | 17441,4 |
| 15,46 | 184     | 4,91E+02 | 162     | 233     |         |         | 9323,49 |

Tab.3.Results of GPC

|            | E1     | E2     | E3     | E4     | E5     | E6     |
|------------|--------|--------|--------|--------|--------|--------|
| <b>Mn</b>  | 181942 | 174601 | 176656 | 182127 | 177815 | 176587 |
| <b>Mw</b>  | 305123 | 303310 | 301413 | 303812 | 300847 | 298820 |
| <b>I.P</b> | 1.67   | 1.73   | 1.7    | 1.66   | 1.69   | 1.69   |

We have distributed the different samples E<sub>i</sub> from beginning of polymerization until end of polymerization .Data of GPC are in good reproductibility and the narrow difference between the values of Mn,Mw,IP,clearly indicate the failing of branching phenomenon (Tab 2 and 3) .

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## RELIGIOUS OR SECULAR FACTORS: WHAT DRIVES THE DECISION TO SWITCH TO ISLAMIC BANKING?

Dr. Anamitra Shome (corresponding author)

Dept. of Accounting, Brock University, 500 Glenridge Avenue, St. Catharines, ON L2S 3A1, Canada.

Email: [ashome@brocku.ca](mailto:ashome@brocku.ca)

Office: +1-905-688-5550 ext. 3544

Fax: +1-905-688-9779

Dr. Fauzia Jabeen

College of Business Administration, Abu Dhabi University, P.O. Box 59911, Abu Dhabi, United Arab Emirates.

Email: [fauzia.jabeen@adu.ac.ae](mailto:fauzia.jabeen@adu.ac.ae)

Office: +971-2-501-5562

Dr. Rajesh Rajaguru

Solbridge International School of Business, 151-13 Samsung 1-dong, Dong-gu, Daejeon, 300-814, South Korea.

Email: [rajeshrajaguru@solbridge.ac.kr](mailto:rajeshrajaguru@solbridge.ac.kr)

Office: +82-42-630-8538

### Abstract:

**Research question:** Islamic banking has witnessed remarkable growth in the last few years. This study asks the following question: What factors—religious or secular—are more important in the decision of consumers to switch to an Islamic bank?

**Period of study, methodology or model used:** A sample of 390 students at Abu Dhabi University in 2011 were asked to complete a survey on consumer attitudes towards Islamic banking. Specifically, they were asked to rank several factors (either religious or secular) that would influence their decision to switch to Islamic banking. Responses were analyzed using descriptive statistics, analysis of variance as well as regression analysis.

Results indicate that superior customer service, reputation, ability to survive, geographical proximity, and personal familiarity with Islamic banking concepts do not have a significant influence on the decision to switch to Islamic banking. Expectations of financial security, social responsibility, and Arab-language skills are significant factors. Interestingly, though, the single most significant factor influencing the decision to open an account at an Islamic bank was found to be expectations regarding the bank's conformance to Islamic principles. This finding has important implications for Islamic banks operating in a predominantly Islamic environment.

**Keywords:** Islamic banking and finance, conventional banking, consumer attitudes, switching behavior, religious factors, secular factors.

# REMOVAL OF CATIONIC DYE FROM TEXTILE INDUSTRY WASTEWATER WITH USING ENZYME, FUNGUS AND POLYMER

Mithat Celebi<sup>a, b</sup>, Mehmet Arif Kaya<sup>c</sup>, Melda Altikatoglu<sup>c</sup> and Huseyin Yildirim<sup>a, c</sup>

[mithat.celebi@valova.edu.tr](mailto:mithat.celebi@valova.edu.tr)

<sup>a</sup> Yalova University, Faculty of Engineering, Department of Polymer Engineering, Yalova, Turkey, 77100

<sup>b</sup> Yıldız Technical University, Faculty of Chemistry Metalurgy, Department of Bioengineering, Davutpaşa, İstanbul, Turkey, 34210

<sup>c</sup> Yıldız Technical University, Faculty of Arts and Sciences, Department of Chemistry, Davutpaşa, İstanbul, Turkey, 34210

**Abstract:** It was used significant amount of water in various processes such as dyeing, desizing and bleaching in textile industry. Thus companies have to be faced wastewater problems. Especially in dyeing process different type of colourants -for instance acidic, reactive, basic, disperse, azo, diazo, antraquinone- based and metal complex based - were applied to textiles and as a result it was obtained a huge amount of colourful wastewater from dye process. Due to treatment for these colourful wastewaters it can be applied many different methods such as adsorption, chemical oxidation, coagulation, membrane filtration. In this study, decolorization of cationic dye (Basic Blue 41) from local textile mill was investigated by using Horseradish peroxidase enzyme and sulfonated polymers at different pHs. In addition, removal of the cationic dye also carried out by using *Trametes versicolor* from white root fungus for pH 3,6. Decolorization efficiency was high (90 %) with *Trametes versicolor* for 7 days, whereas little decolorization was observed with Horseradish peroxidase enzyme. It was achieved quicker total treatment of cationic dye with using sulfonated polymers in comparison to enzyme and fungus.

**Key words:** Cationic dye, Horseradish peroxidase, *Trametes versicolor*, decolorization, sulfonated polymer, adsorption.

## Introduction

The textile industry consumes huge volumes of water in different wet processes and as a result it was obtained significant amount of colourful wastewater from dye process. In dying process, various dyes can be used such as acidic, reactive, basic, disperse, azo, diazo, antraquinone-based and metal complex dyes according to fabric types (Tuba et al., 2010).

Dyes present a potential human health risk as some of them have been shown to be carcinogenic. Traditionally wastewater treatment methods can be classified as physical, chemical and biological. Various chemical and physical methods, such as chemical coagulation and adsorption on activated carbon, are being used. However, these traditional methods mainly transfer the contaminants from wastewater to solid wastes, which may lead to a new kind of pollution (Chen and Zhu, 2007; Harazona et al., 2003; Onder et al 2011, Gupta and Suhas, 2009; Crini, 2006).

Medium-size factories can prefer physical and chemical techniques by using coagulants and/or flocculates because of economical concerns. However, in spite of biological methods are more complex and unfortunately costly ways, they are most convenient and efficient methods, because total treatment of wastes can be achieved. In addition, to get good results/total treatment and cheapening of costs, various methods can be used together according to characteristic of wastewaters. These combining methods are useful and eligible for non-profit public purposes especially municipalities.

The use of enzymes is currently a possibility for application in environmental engineering, however their purification procedures are too expensive. Enzymes from various sources (fungus and plant based) have been applied for the treatment of dye based compounds. Fungal extracted enzymes have been mostly studied in dye removal processes (Chen and Zhu, 200); Onder et al, 2011; Harazona, 2003).

**Table 1:** Treatment of some basic dyes by using different methods

| Dye/Solution | Method | References |
|--------------|--------|------------|
|--------------|--------|------------|

|   |   |                            |
|---|---|----------------------------|
| Basic red 46  | Electrocoagulation  | Daneshvar et al., 2006     |
| Basic Yellow 28   | Electrocoagulation  | Daneshvar et al., 2006     |
| Basic dye textile effluent                                    | Electrocoagulation  | Zaroual et al. 2006        |
| Basic Red 46  | Photocatalytic (immobilized TiO <sub>2</sub> nanoparticles)   | Khataee, 2009              |
| Crystal violet  | Adsorption (activated carbon)   | Prasad et al., 2012        |
| Methylene blue  | Biosorption ( <i>Trichoderma viride</i> fungus)   | Asma et al 2009            |
| Methylene blue  | Superabsorbent hydrogel   | Alexander, 2006            |
| Crystal violet, Bismarck brown Y                              | Adsorption (modified chitosan)  | An-Chong Chao et al., 2004 |
| Methylene blue  | Lignin peroxidase enzyme  | Viridiana et al., 2007     |
| Methylene blue  | Adsorption (Hydrogels)  | Bajpai et al., 2012        |
| Basic violet 3<br>Basic red 9                                 | <i>P. Ostreatus, S. Commune, S. Rolfsii, N. Crassa, Polyporus sp., T. Villosa and M. Thermohila</i> | Elias et al., 2000         |
| Crystal violet, Basic fuchsin, Brilliant gren, Malachite gren | <i>Aeromonas hydrophila</i> strain DN322  | Ren et al., 2006           |
| Methyl violet   | Adsorption (perlite)  | Mehmet and Mahir, 2003     |

Basic dyes are cationic soluble salts of coloured bases. Basic dyes are applied to substrate with anionic character where electrostatic attractions are formed. Basic dyes are powerful colouring agents. It's applied to polyacrylonitrile, modified nylons, modified polyesters, paper. They are generally water soluble (Gupta and Suhas, 2009).

In the present work, an attempt has been made to examine the efficiencies of various waste treatment methods (enzyme based, microorganism based and polymer based) for colour (Basic Blue 41) removal at different conditions.

## Materials and Method

The cationic dye were provided from a local textile mill. Horseradish Peroxidase (E.C. 1.11.1.7) (Mw ~ 40.000 Da) (Fluka), D (+) glucose (Fluka), malt extract (Merck), acetic acid (Fluka), sodium phosphate dibasic (Riedel-de Haen), monobasic sodium phosphate (Riedel-de Haen) and *Trametes versicolor* were analytical reagent grade and used as received without further purification. In all experiments ultra pure water was used obtained from Millipore MilliQ system. Sulfonated polymers that used in experiments were obtained from Du Pont or synthesized in our lab (Kaya, 2012).

### Removal of Basic Blue 41 by Horseradish Peroxidase

Decolorization of Basic Blue 41 (B 41) dye using Horseradish peroxidase was carried out directly in the spectrophotometer cuvette. The reaction was started by adding buffer solution at different pHs, B 41 dye, HRP enzyme and finally H<sub>2</sub>O<sub>2</sub> (3 %) as the initiator in the reaction cuvette (Onder et al, 2009). The final volume of the reaction cuvette was 3.0 mL. Dye decolorization was measured with temperature controlling UV-Vis spectrophotometer (Model UV-1700 Pharmaspec Shimadzu) based on the maximum absorbance at 608 nm in the visible range, at different pHs (5.0, 6.0, 7.0, 8.0) and 30 °C temperature.

### Removal of Basic Blue 41 by *Trametes Versicolor* from White Root Fungi

Culture Medium and conditions: *Trametes versicolor* Strain T (DSM 11309) was maintained on 2% (w/v) malt agar plates. Three cubes of 0.5 × 0.5 cm were transferred to 500-mL Erlenmeyer flasks, which contained 150 mL liquid medium (25,0 g malt extract, 2,0 g KH<sub>2</sub>PO<sub>4</sub>, 0,4 g K<sub>2</sub>HPO<sub>4</sub>; deionized H<sub>2</sub>O ad. 1,000 mL, pH 5.5) and were grown in static culture for 14 day under at 30 °C (Borchert and Libra, 2001).

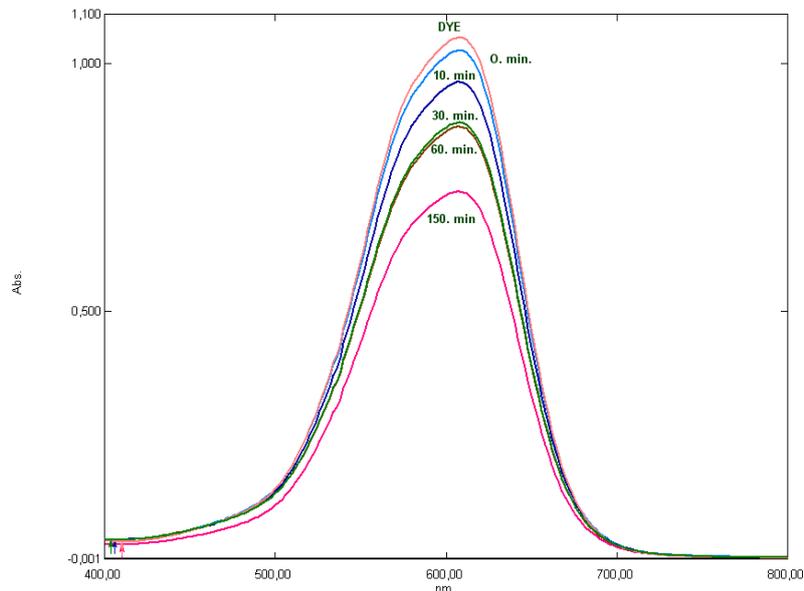
Media for dye decolorization: 2,50 g malt extract and 0,10 g glucose dissolved in 100 mL deionized H<sub>2</sub>O then pH was adjusted to 3,6 and sterilization at strilazator for 15 min. at 1,2 atm and 121 °C (Borchert and Libra, 2001). All steps were performed aseptically with sterile media.

### Removal of Basic Blue 41 by Sulfonated Polymers

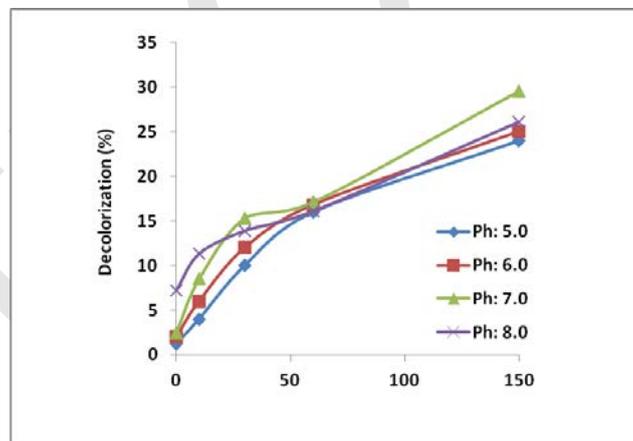
Basic blue 41 dye was prepared in distilled water. The pH of dye solution was adjusted with 0.1 N NaOH and HCl solution. The pH of solutions was measured with a pH meter. The study was performed in 15 mL tubes with a working volume 5 mL of dye solution different pHs. Tubes were placed in on shaker at 300 rpm at room temperature.

## Results and Discussion

Dye decolorization values were calculated according to decreasing of maximum absorbans (608 nm) of the basic blue 41 dye at different incubation times (Figure 1).



**Figure 1:** Decolorization of Cationic (basic) dye B 41 by using Horseradish Peroxidase enzyme at pH: 7.0 and 30 °C for different incubation time.



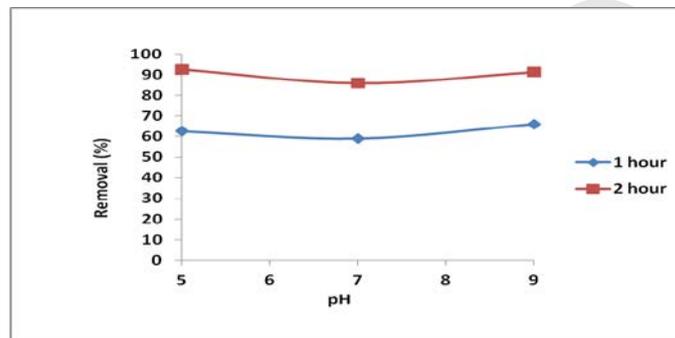
**Figure 2:** Decolorization (%) of Cationic (basic) dye B 41 by using Horseradish Peroxidase enzyme at different pHs and 30 °C.

In our previous study, acidic pHs were more effective for decolorization of Naphtol Blue Black (acid dye). Optimum pH of the Horseradish peroxidase enzyme was 5.0 for decolorization of acid dye (Onder et al, 2011). In this study, decolorization values of basic dye was low according to our previous study (acid dye) with the Horseradish Peroxidase enzyme.

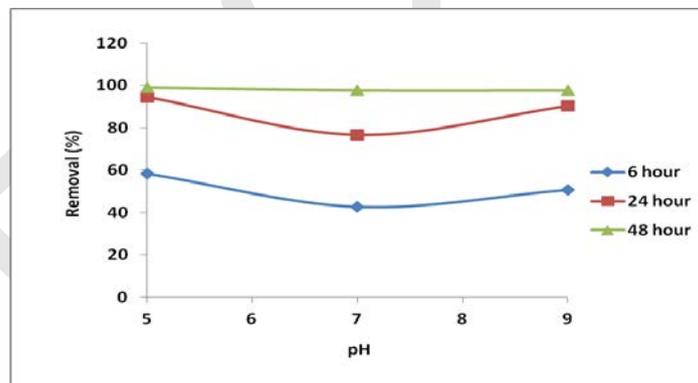


**Figure 3:** Removal of B 41 dye by using *Trametes Versicolor* from White Root Fungi at pH: 3,6 and 30 °C.

B 41 dye was removed 90 % after 7 days by using *Trametes Versicolor* from White Root Fungi. The microorganism was high removal values at acidic pHs. For this, it was studied at pH: 3,6. Decolorization of Basic Blue 41 was continued for 7 days under shaking conditions at 30 °C and pH 3,6 using *Trametes versicolor* from White root fungi.



**Figure 4:** Removal of Basic Blue 41 by using commercial sulfonated polymer at different pHs.



**Figure 5:** Removal of Basic Blue 41 by using our synthesized sulfonated polymer at different pHs.



**Figure 6:** Removal of Basic Blue 41 by using commercial sulfonated polymer after 3 hour.



Figure 7. Removal of Basic Blue 41 by using our synthesized sulfonated polymer after 6 hour.

Sulfonated polymers can easily and quickly adsorb cationic dyes due to carrying structural negative charges. Both sulfonated polymers (commercial and synthesized) exhibit superior removal efficiency relatively in a short time in comparison to other methods (enzyme based and microorganism based). In view of total treatment time, it has to be noted commercial sulfonated polymer is quicker than synthesized sulfonated polymer.

## Conclusions

In the light of experiments, results can be summarized following;

- Dye removal process from wastewaters is strictly depend on pH value.
- Synthetic dye solutions were decolorized in short time (2 h.) by commercial sulfonated polymer. On the other hand our synthesized sulfonated polymer removed dyes after 2 days.
- Decolorization efficiency was high (90 %) with *Trametes versicolor* for 7 days, whereas little decolorization was observed with Horseradish peroxidase enzyme.
- Using sulfonated polymers is most convenient and efficient method in among other methods for decolorization of the cationic dye, because of their shorter treatment time and high efficiency.

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## ROLE OF CONSTRUCTION INDUSTRY WASTES ON THE PROPERTIES OF MORTARS

Niyazi Ugur Kockal  
Department of Civil Engineering  
Akdeniz University  
Turkey  
ukockal@yahoo.com

**Abstract :** This study investigated the performance of cement mortars prepared by substituting 30% and 60% of crushed calcareous fine aggregate (CNA) with waste fine aggregates namely, crushed brick aggregate (CBA), crushed marble aggregate (CMA) and crushed ceramic aggregate (CCA). For this purpose, absorption, unit weight, compressive strength, flexural strength, resistance to high temperature up to 400 °C and resistance to freeze-thaw cycles were determined for these mortars. In addition, XRF analysis was performed on cement and waste aggregates. From the experimental results, it is found that CBA mortars exhibited the lowest strength values and worst durability properties. However, CBA and especially CCA mortars were more effective in relative strength gain at 56 days.

**Key words:** Strength, high temperature, freeze-thaw, morphology.

### Introduction

More than 25 billion tons of concrete are produced each year all around the world. Aggregates, usually provided from natural resources, occupy up to 80% of volume of concrete. Unfortunately, the available natural aggregate used in concrete and mortar production will soon remain insufficient to supply all the demands of the construction industry. Therefore, construction industry is seeking for other alternatives in order to meet the needs in concrete manufacturing.

Using construction based waste materials in cementitious mixtures have been seen revived interest in recent years. Many researchers (Böke, Akkurt, İpekoğlu, & Uğurlu, 2006; Bektas, Wang, & Ceylan, 2009; Gonçalves, Tavares, Toledo Filho, & Fairbairn, 2009; O'Farrell, Sabir, & Wild, 2006) analyzed some properties mainly strength and durability of mortars containing different types of ground brick (calcined clays) subjected to various treatments. The properties of mortars and/or concretes containing ceramic waste aggregates were examined in some investigations (Higashiyama, Sappakittipakorn, Sano, & Yagishita, 2012; Medina, Sánchez de Rojas, & Frías, 2012; Pacheco-Torgal, & Jalali, 2010; Senthamarai, Devadas Manoharan, & Gobinath, 2011). Mortars and concretes containing marble waste were also studied by evaluating their fresh and hardened state properties (Aruntas, Guru, Dayı, & Tekin, 2010; Belaidi, Azzouz, Kadri, & Kenai, 2012; Hebhoub, Aoun, Belachia, Houari, & Ghorbel, 2011).

The main aim of this work is to compare the mortars manufactured with common construction wastes and evaluate the effects of wastes on performance employing mortar specimens. Knowing these effects will aid in assessing the physical–mechanical performance and the resistance of mortars to different treatments and also their compatibility with other building materials.

### Materials and Method

Cement used in the mixtures was CEM II/A-M (P-L) 42,5N complying with TS EN 197-1 with a specific gravity of 3.05. All wastes (brick, marble and ceramic) were collected from construction sites [Figure 1] and ground until a similar grading as of natural crushed sand was obtained. Natural crushed fine aggregate utilized in the study was calcareous sand provided from Dirmil, Burdur. Chemical admixture used for providing consistency of mortars

constant was a modified lignin sulphonate based water reducing/plasticizer admixture consistent with TS EN 934-2.



**Figure 1:** Wastes disposed in the construction site

As fundamental physical material characteristics, water absorption, specific gravity, rodded and loose bulk density of crushed aggregates were determined by following the test procedures in the relevant standards [Table 1].

**Table 1:** Physical characteristics of waste materials.

| Materials | Water absorption (%) | Specific gravity (Dry) | Rodded bulk density (Dry) | Loose bulk density (Dry) | Void content (%) |
|-----------|----------------------|------------------------|---------------------------|--------------------------|------------------|
| Sand      | 2.24                 | 2.71                   | 1741                      | 1589                     | 35.63            |
| Brick     | 14.08                | 2.57                   | 1093                      | 1210                     | 57.39            |
| Marble    | 2.96                 | 2.63                   | 1571                      | 1399                     | 40.15            |
| Ceramic   | 2.57                 | 2.49                   | 1196                      | 1305                     | 51.87            |

Specific gravity and water absorption of fine aggregates were determined according to ASTM C 128. Aggregates were tested in oven-dry condition utilizing the shoveling and rodding procedure to determine the unit weight (loose and rodded) and void content according to ASTM C 29-97. Chemical compositions of cement and waste aggregates are given in Table 2.

**Table 2:** Chemical compositions of materials used in mortar preparation by weight (%).

| Materials | Na <sub>2</sub> O | MgO  | Al <sub>2</sub> O <sub>3</sub> | SiO <sub>2</sub> | K <sub>2</sub> O | CaO   | Fe <sub>2</sub> O <sub>3</sub> |
|-----------|-------------------|------|--------------------------------|------------------|------------------|-------|--------------------------------|
| Cement    | 1.25              | 2.33 | 6.38                           | 21.77            | 1.06             | 56.66 | 2.68                           |
| Brick     | 2.00              | 6.51 | 14.92                          | 54.24            | 2.27             | 8.79  | 5.82                           |
| Marble    | 0.58              | 1.10 | 0.35                           | 1.62             | 0.06             | 52.94 | 0.15                           |
| Ceramic   | 2.73              | 5.07 | 15.14                          | 63.99            | 1.68             | 4.88  | 2.33                           |

Cement: water: aggregate proportions in mixes were 1: 0.50: 3, respectively. Natural crushed sand was replaced with waste aggregates in a ratio of 30 % and 60 %. All substitutions were made in volume. The flow diameter values of fresh mortar mixtures were remained constant as  $210 \pm 14$  mm by adjusting the percentage of plasticizer used. All sample preparations were processed in a similar manner, according to European Standard EN 196-1. The mortars were cast into 40x40x160 mm prismatic moulds and kept for 24 h. The hardened mortar specimens were then demoulded and maintained under lime-saturated water at  $20 \pm 2$  °C until the age of testing.

40x40x160 mm prismatic specimens were subjected to temperature of up to 400 °C at an incremental rate of 10 °C per minute from room temperature, using an electrically-heated furnace and exposed to a treatment involving freeze in air and thaw in water in a cabinet from -20 C to +20 C for 10 cycles completed in 2 days.

The consistency test involves placing the mould in the center of the flow table and filling it in two layers each layer being tamped 20 times with the tamper according to ASTM C 270. The table was then jolted 25 times, and the diameter of the spread mortar was measured in two directions at right angles to each other using callipers.

The bulk density, water absorption and porosity values were obtained by testing 100 mm cube specimens according to ASTM C 642. The flexural and compressive strength of hardened mortar specimens were determined in accordance with EN 1015-11. The flexural strength of a hardened mortar was evaluated by three point loading of a 160x40x40 mm prism specimen, subsequent to the failure and breakage of this specimen the compressive strength was determined on each half of the prism specimen. Three specimens of each formulation were prepared for each test.

## Results and Discussion

The bulk density, water absorption and porosity test results are shown in Table 3. In contrast to CNA mortars, CBA mortars had the highest porosity and thus water absorption. However, the lowest apparent bulk density and dry bulk density were obtained by CCA and CBA mortars, respectively. The corresponding values dropped while the replacement ratios increased due to the high porosity of brick and ceramic aggregates.

**Table 3:** Bulk density, absorption and porosity of mortars.

| Age     | Specimen | Dry bulk density | Water absorp. (% wt.) | Apparent bulk density | Apparent porosity (%) |
|---------|----------|------------------|-----------------------|-----------------------|-----------------------|
| 28 Days | CNA      | 2.09             | 5.72                  | 2.37                  | 11.93                 |
|         | CBA30    | 1.96             | 7.98                  | 2.32                  | 15.61                 |
|         | CMA30    | 2.03             | 6.28                  | 2.32                  | 12.73                 |
|         | CCA30    | 2.02             | 5.96                  | 2.30                  | 12.07                 |
|         | CBA60    | 1.88             | 10.50                 | 2.34                  | 19.76                 |
|         | CMA60    | 2.05             | 6.08                  | 2.34                  | 12.47                 |
|         | CCA60    | 2.01             | 5.26                  | 2.24                  | 10.56                 |
| 56 Days | CNA      | 2.08             | 5.48                  | 2.35                  | 11.42                 |
|         | CBA30    | 1.94             | 7.96                  | 2.29                  | 15.41                 |
|         | CMA30    | 2.10             | 6.04                  | 2.40                  | 12.66                 |
|         | CCA30    | 2.04             | 5.61                  | 2.30                  | 11.42                 |
|         | CBA60    | 1.94             | 8.78                  | 2.34                  | 17.03                 |
|         | CMA60    | 2.07             | 5.71                  | 2.34                  | 11.79                 |
|         | CCA60    | 2.01             | 4.09                  | 2.19                  | 8.24                  |

Table 4 gives the mechanical properties of 28 and 56-day mortars with and without treatments. The strength loss ratios due to the various treatments were higher for flexural strength than those for compressive strength. Generally, for all situations, CBA mortars exhibited the lowest mechanical properties and these properties

worsened with the substitution level owing to the high water absorption and open porosity percentages of brick aggregates. Although other mortars prepared with CNA, CCA and CMA showed close values, the best performance was observed by CCA mortars when considering reduction in strength values at overall situations. The resistance to high temperature was high for the CCA mortars when analyzing the relative residual compressive strength values. Besides, analyzing the relatively residual flexural strength values presented the superiority of CBA mortars. This fact can be attributed to the higher temperatures experienced by the bricks and ceramics previously in the manufacturing process. In addition, generally one face of ceramic aggregates was glazed, thus the proper adherence could not be achieved leading to lower flexural strength compared to CBA mortars. Exposing the freeze-thaw cycles to mortars weakened CBA mortars mostly rather than the other mortars. Despite similar behavior could be expected for CCA mortars, CCA mortars deteriorated less than CBA mortars. The reason of this result could be the structure of voids in the aggregates.

In contrast to CBA, CCA had mostly closed porosity seen also in SEM images (not presented in this study). The strength gain was more pronounced in the case of CBA and especially CCA mortars as relevant to the pozzolanic behavior of these mentioned aggregates containing amorphous silica and alumina phases. As compared to test results of specimens subjected to high temperature, the strength loss ratios of specimens exposed to freeze-thaw cycles were lower. The reason of this result could be the less number of cycles applied on specimens.

**Table 4:** Flexural and compressive strength values of mortars with and without treatments.

| Age     | Specimen | Flexural Strength (MPa) |                  |             | Compressive Strength (MPa) |                  |              |
|---------|----------|-------------------------|------------------|-------------|----------------------------|------------------|--------------|
|         |          | No treatment            | High Temperature | Freeze-Thaw | No treatment               | High Temperature | Freeze -Thaw |
| 28 Days | CNA      | 8.6                     | 5.8              | 8.0         | 43.8                       | 36.2             | 42.3         |
|         | CBA30    | 7.7                     | 6.2              | 6.7         | 39.0                       | 33.1             | 34.2         |
|         | CMA30    | 8.1                     | 5.6              | 7.4         | 42.1                       | 34.2             | 40.4         |
|         | CCA30    | 8.5                     | 6.3              | 7.8         | 43.0                       | 38.1             | 41.2         |
|         | CBA60    | 6.8                     | 5.7              | 5.8         | 37.4                       | 32.4             | 32.5         |
|         | CMA60    | 7.8                     | 5.1              | 7.2         | 40.2                       | 34.7             | 37.4         |
|         | CCA60    | 7.9                     | 5.6              | 7.5         | 42.8                       | 38.9             | 41.7         |
| 56 Days | CNA      | 8.8                     | 6.3              | 8.2         | 46.4                       | 38.6             | 44.9         |
|         | CBA30    | 8.1                     | 6.6              | 7.0         | 44.1                       | 37.6             | 39.0         |
|         | CMA30    | 8.3                     | 6.1              | 7.6         | 42.9                       | 35.5             | 41.5         |
|         | CCA30    | 8.6                     | 6.7              | 8.3         | 45.1                       | 40.4             | 43.4         |
|         | CBA60    | 7.6                     | 6.4              | 6.8         | 41.1                       | 37.9             | 37.6         |
|         | CMA60    | 8.1                     | 5.5              | 7.4         | 41.4                       | 37.2             | 39.1         |
|         | CCA60    | 8.3                     | 6.3              | 8.0         | 44.2                       | 42.1             | 42.9         |

## Conclusions

Following conclusions can be drawn from the experimental results:

Strength loss ratios after high temperature exposure tests of CCA and CBA mortars were lower than those of CMA and CNA mortars. However, particularly CBA had highest strength loss in the case of freeze-thaw cycle exposure due to the open void structure allowing high penetrability of water. Strength development was higher for CCA and CBA mortars at later age probably owing to the pozzolanic reactions resulting from high glassy phase content produced by sintering during manufacturing process.

## Acknowledgements

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## SAKARYA UNIVERSITY ACADEMIC EVALUATION AND QUALITY DEVELOPMENT APPLICATIONS

**Prof. Dr. Muzaffer ELMAS**  
President, Sakarya University  
[elmas@sakarya.edu.tr](mailto:elmas@sakarya.edu.tr)

### Abstract

In this study, to explain Sakarya University academic evaluation and quality development applications is the main purpose. Within the framework of this objective The Chronology of Sakarya University Quality Steps and Awards, Sakarya University Academic Evaluation and Quality Improvement Committee, Sakarya University Strategic Management, Sakarya University Business Process Management, Sakarya University Enterprise Risk Management are expressed.

**Keywords:** Quality, Strategic Management, Process Management, Enterprise Risk Management

### Introduction

Sakarya University has the purpose of the “Give your future direction” principle from its establishment. Sakarya University is always progressive for social, cultural and sporting activities addition to scientific progress. For this characteristic, with the web page studies started in 1996, the quality work and policy were being set up. Now Sakarya University has TS-EN-ISO 9001:2000 certificate of quality in all administrative units.

SAU, inspired by EFQM Excellence Model, received “3 and 4 Star Competence in Excellence” award rewarded by KALDER in 2006 and 2008, respectively. All administrative units of SAU hold “ISO 9001-2000 Quality Management System Certificate”. National Quality Award in Educational Services Category was given to SAU in 2010. Bachelor’s Degree Programmes in Faculty of Engineering holds EUR-ACE (European Accreditation of Engineering Programmes) Label. SAU uses ECTS as a credit transfer system especially for the Student’s Mobility Programmes.

Diploma Supplement, which includes courses and their ECTS credits, is being issued in English, and it is given automatically and free of charge to every student of SAU upon graduation since 2004. Prestigious awards of “Diploma Supplement Label” and “ECTS Label” were given to SAU by the European Commission in 2009 and 2010, respectively.



Within the framework of this development, Sakarya University created its quality policy. The main quality policy items are below:

- Increase motivation and raise performance in management by participatory and collaborative management approach,
- Provide faster service to staff and students by using IT technology, Perform the desired goals during the process with an effective and efficient use of time,

- Raise in fulfilment of the beneficiaries by measuring their satisfaction, Maintain the quality, comply with the terms of service and continue to improve in activities and services and be a leader in quality following the Quality Management System.

In this innovation of Sakarya University, the terms of quality, strategic management, process management, enterprise risk management come forward. Quality is defined differently for different purpose. According to Chowdhury(), quality is a characteristic for combining people power and process power. In an another definition by American Society for Quality, quality is a subjective term which can have two meanings in technical usage. When quality is described as “The characteristics of a product or service that bear on its ability to satisfy stated or implied needs” in one of the definition, another definition characterizes the quality is “A product or service free of deficiencies”. Moreover quality is qualified as “value to some person” (Weinberg, 1991).

Institutions have different quality management techniques for provide quality. Strategic management, process management, enterprise risk management are some quality management techniques. In this study, these quality management techniques used by Sakarya University and development of this process is explained.

### 1. The Chronology of Sakarya University Quality Steps and Awards

| Year | Quality Steps/Award   |
|------|---|
| 2001 | At the level of General Secretary and Head Of Departments TS-EN-ISO 9002:1994 Quality Assurance Certificate         |
| 2003 | Total Quality Management Works started from all academic and administrative units.                                  |
|      | At the level of General Secretary and Head Of Departments TS EN ISO 9001-2000 Quality Management System Certificate |
| 2004 | Institutional Self-Assessment and Strategic Plan studies; 2004,2005, 2007- 2011, 2009-2013                          |
| 2005 | Academic Evaluation and Quality Improvement in Higher Education (YÖDEK)'s works started.                            |
| 2006 | Extending the scope of the TS EN ISO 9001-2000 Quality Management System Certificate                                |
|      | The cooperation with KALDER and participation to National Quality Movement  |
|      | Recognized for Excellence with 3*   |
| 2007 | The integration of YÖDEK and Strategic Planning approach by reviewing the effectiveness                             |
| 2008 | Recognized for Excellence with 4*   |
| 2009 | All administrative units TS EN ISO 9001-2008 Quality Management System Certificate                                  |
|      | Diploma Supplement (DS) Label   |
|      | SAÜ Foreign Languages Department 2009 European Language Label Award   |
|      | Association for Evaluation and Accreditation of Engineering Programs (MÜDEK) Accreditation Certificate              |
| 2010 | EUR-ACE LABEL   |

|      |   |
|------|---|
|      | ECTS Label Excellence Award   |
|      | 2010 EFQM National Excellence Award in Public Sector Organizations Education Category       |
| 2011 | Awarded 3rd place in Informatics Service Award in the Category of Best Educational Web site |

## 2. Sakarya University Academic Evaluation and Quality Improvement Committee

On March 2003 Sakarya University with all staff has decided to execute on a regular basis to Total Quality Management movement and for the conduct of these works Sakarya University Academic Evaluation and Quality Improvement Committee (SAUDEK) was established. To coordinate and carry out the work SAUDEK Executive Board was established and Quality Ambassadors were assigned to all faculties, colleges and vocational schools.

Nowadays within the SAUDEK Coordinatorship studies carried out under the following four commission;

1. Strategic Planning and Monitoring Commission,
2. Quality Improvement Committee,
3. Management Process Commission,
4. Survey Development and Evaluation Commission.

## 3. Sakarya University Strategic Management

Institutions, under various constraints in order to use resources efficiently in accordance with their objectives, need Strategic Management approach. Therefore, Strategic Management was the first application of the Total Quality Management works launched in March 2003. As an approach of Sakarya University Strategic Management Figure 1 is expressed as follows YÖDEK process.

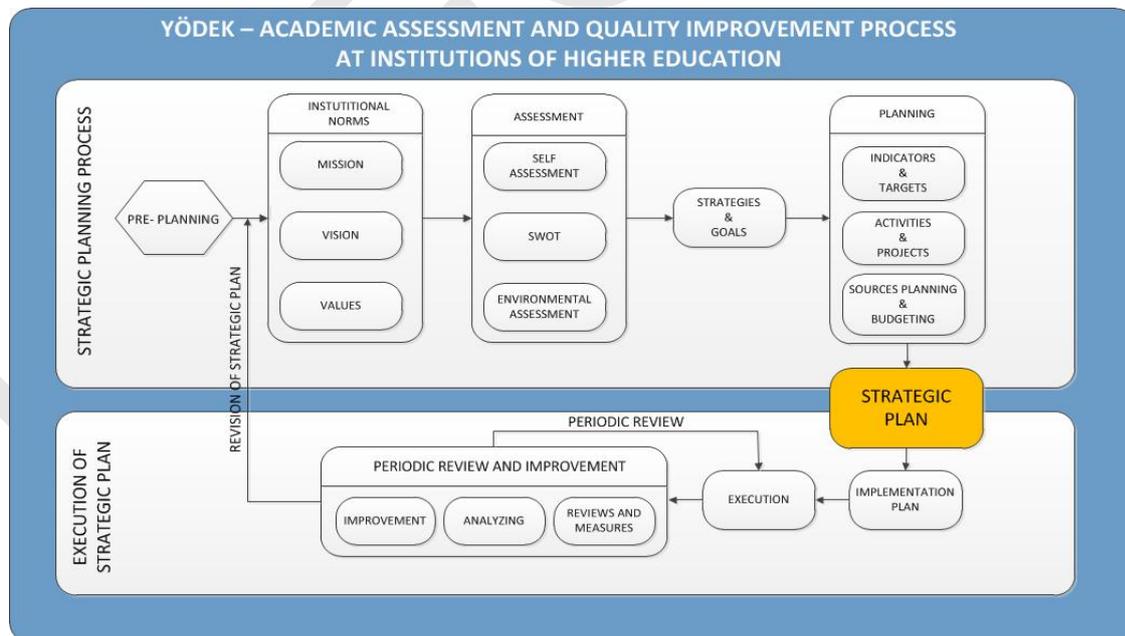


Figure 1. The Process of Academic Assessment and Quality Improvements at Institutions of Higher Education (YÖDEK, 2007)

This process firstly started by determining the organization's reason for being and the point of wants to reach, in order to get to this point which principles and policies organization will follow. For this purpose, Sakarya University's **Mission, Vision, Policies** and **Fundamental/Core Values** were determined with the participation of all employees. The **Mission** of Sakarya University is

*“to create a participatory and a contemporary learning/teaching and academic environment equipped with aesthetic values which encourages lecturers to produce a universal knowledge and technology and to educate students to be competent professionals who respect social values.”*

The **Vision** of Sakarya University is to

- *be of the first rank in Turkey and the world in terms of the quality of the education offered and research activities conducted;*
- *have a participatory and a cooperative administrative board which encourage team work;*
- *try to solve the regional and national problems and play a leading role in the realization of collaboration of university, industry and community;*
- *extensively to carry out and provide service for the Internet based teaching at the associate degree, graduate and post graduate levels;*
- *create permanent, modern and unique works of arts while preserving the core of our traditional arts;*
- *respect national values, internalize the principles of Total Quality Management and improve its processes continuously.*

**Core values** of Sakarya University are

- to be committed to the principles of Ataturk,
- to obey universal laws and regulations,
- to believe in the universality of science,
- to encourage innovation and creativeness,
- to make no concessions to be honest and accurate,
- to pay importance to harmony and cooperation in the university,
- to strive to achieve excellence,
- to value the time,
- to do unique research,
- to love our job.

Sakarya University has set policies in the following areas;

1. Quality Policy,
2. Education and Research Policy,
3. Human Resources Policy,
4. Environmental Policy,
5. Promotion Policy,
6. Community Oriented Policy,

It is also within the scope of the Strategic Management university identified and prioritized stakeholders as follows;

- Students
- Private Sector Organizations
- Civil Society Organizations
- Graduates
- Academic and Administrative staff
- Council of Higher Education
- Interuniversity Council
- The national and international universities to be agreed
- National and International Universities
- Governor's office and other public institutions in the region
- National Official Institutions (DPT, Ministry of Finance, MEB, Development Agency, TÜBİTAK and so on)
- Member of the current domestic and international organizations
- National and International Other Education and Research Institutions

The next stage of self-assessment work to be done within the scope of Strategic Management was firstly built in Sakarya University in 2004 and is repeated every year. **Self-assessment** works, is repeated every year for the YÖDEK directory represented by Figure 2.



Figure 2. YÖDEK Self-Assessment Model.

Thus, with the approach applied in this Strategic Management targets are set and performance is monitored from Institutional Basis to individual (Figure 3).

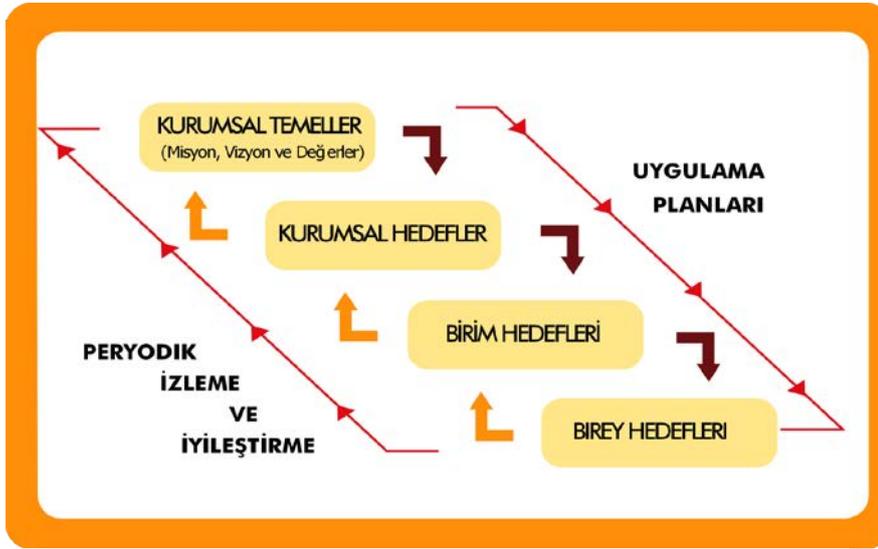


Figure 3. YÖDEK Strategic Planning Approach.

At the end of all these studies, Sakarya University, was prepared the first Strategic Plan in 2004. The latest Sakarya University's Strategic Plan, in accordance with the regulations and related guidance of YÖDEK published by the Council of Higher Education will be revised and has been published as 2007-2013 Strategic Plan. This strategic plan consists the university's 10 pieces strategy, , 61 pieces objectives and 107 sub-target for setting in order to realize these strategies. These targets are monitored by 180 pieces performance indicators. However, the scope of the strategic plan for achieving strategies there are 236 units planned activity.

At Sakarya University, in order to provide the spread and participation of the Strategic Management activities to units, in 2009 Strategic Management Information System (Figure 4) has been developed. Strategic Management Information System consists 10 main themes (Strategies, Objectives, Sub-Objectives and Performance Indicators, Activity-Projects) in accordance with the model of YÖDEK. Performance of the units and the university is monitored by Red Area Charts (Figure 5) produced by this system. By units, performances are evaluated with the performance reports to the Senate at the end of the year.

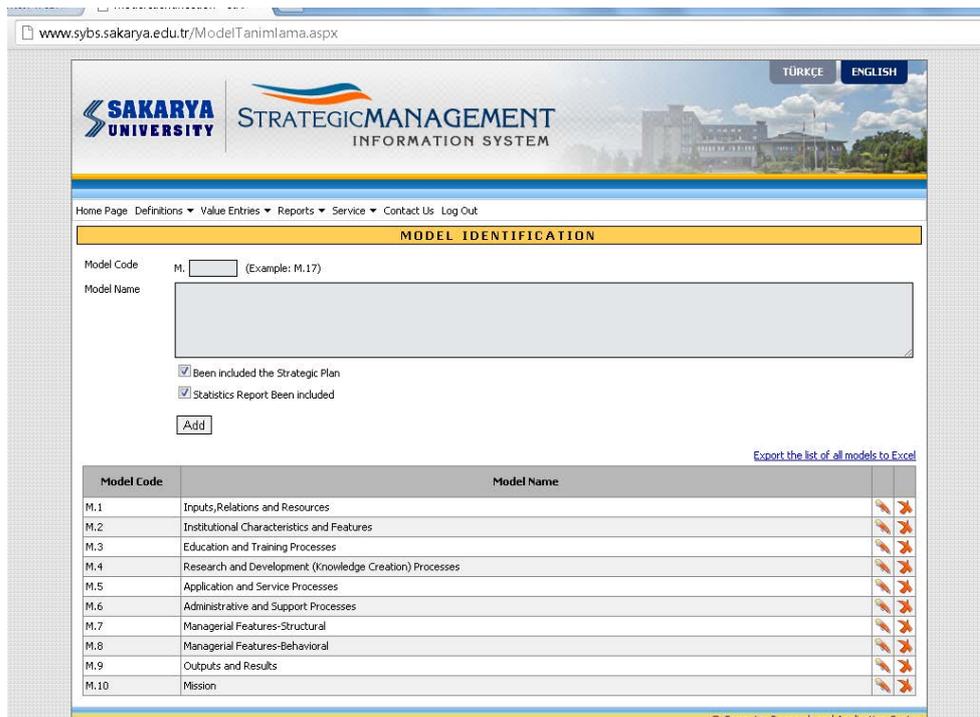


Figure 4. Sakarya University Strategic Management Information System.

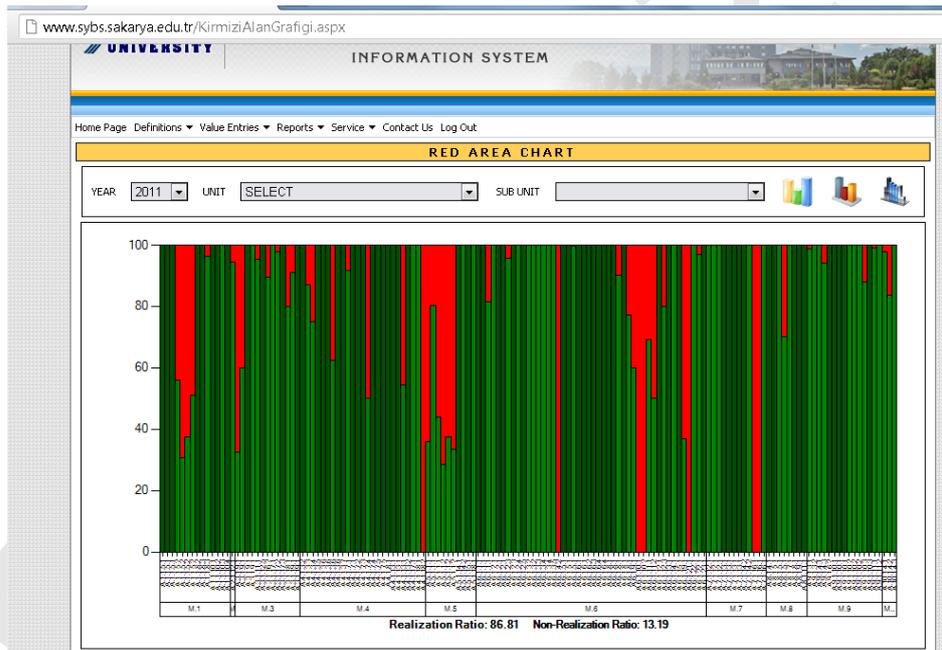


Figure 5. Red Area Chart.

In 2006, in collaboration with KALDER, Sakarya University, participating in the national quality movement, was passed to External Assessment according to the EFQM Excellence Model in 2006 and 2008 by KALDER. After these assessments respectively 3 \* and 4 \* were taken for Excellence. Self-assessment studies within the scope of the strategic management process are integrated with the results of EFQM External Assessment for 2006 and 2008 and the results of EFQM Self-Assessment for 2010. At the end of progress made with a view to Continuous Improvement, in 2010, Sakarya University has been awarded the National Quality Award in the category of public.

#### 4. Sakarya University Business Process Management

In order to successfully implement the Strategic Management, Sakarya University Stratejik Yönetimi başarılı şekilde uygulayabilmek amacıyla adopted management approach with processes. For this purpose, all the processes described in 2004 and the first handbook of Process Management has published. Later in parallel with improvements in processes, includes university's 5 Main Process and 38 sub-process.

Sakarya University, 5 Main Process is;

- Education and Training,
- Research and Development,
- Applications and Services,
- Administrative and Support,
- Managerial.

In accordance with this approach, the principals also is designed on the basis of each major process units (Figure 6).

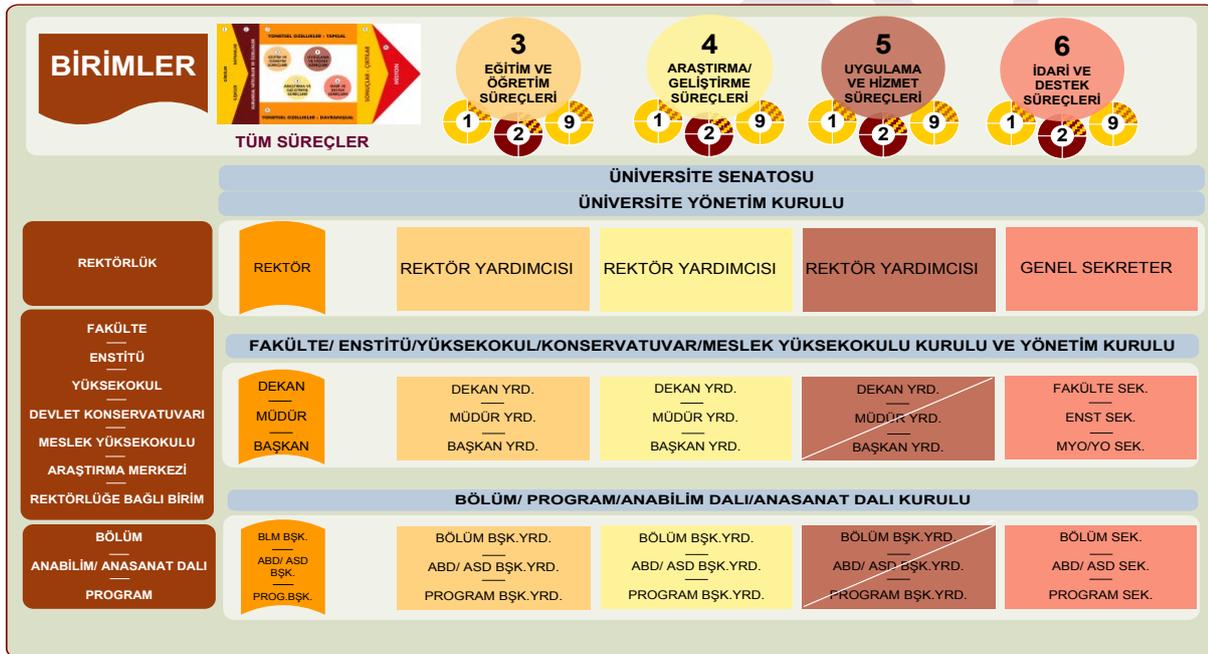


Figure 6. Sakarya University Management with Processes Approach.

All these processes at Sakarya University are measured and monitored in relation to the objectives in the strategic plan.

#### 5. Sakarya University Enterprise Risk Management

Sakarya University implements Enterprise Risk Management in order to, to identify, analyze and manage risks, faced or may face in the future periods of the university's day to day activities, to prevent realizing its goals or to create opportunities in order to ensure to minimize the negative effects of risks. Enterprise Risk Management process is summarized in the figure below applies Sakarya University.

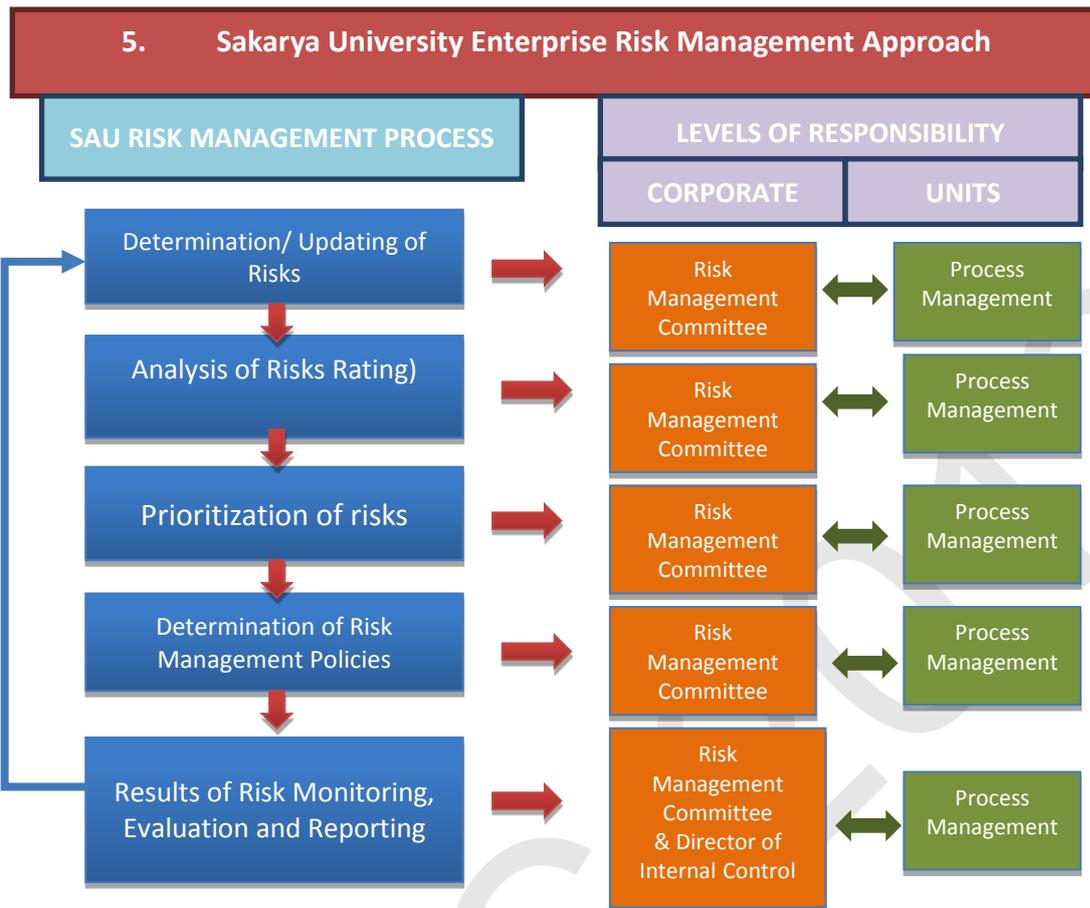


Figure 7. Sakarya University Enterprise Risk Management Approach.

Within the scope of Enterprise Risk Management, Sakarya University, identified the risks under the following main headings;

- a. Corporate risks,
- b. Risks related to education and to teaching,
- c. Risks associated with research and development,
- d. Risks associated with the application and the service,
- e. Risks associated with administrative and support.

### Conclusion

Quality is increasingly important term for institutions. Sakarya University has been aware of this since 1996 with the study of web page. Since that time, Sakarya University developed itself and founded quality management services and give quality awards. This study aims to give the information of this innovation, development and progress of process and revealed them.

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## SAKARYA UNIVERSITY ONLINE ACADEMIC SYSTEMS

**Prof. Dr. Muzaffer ELMAS**  
**President, Sakarya University**  
[elmas@sakarya.edu.tr](mailto:elmas@sakarya.edu.tr)

### **Abstract**

Nowadays, everything is changed; every person and system keeps pace with the innovation. Starting from here, with the innovation and development of technologies this study aims to explain online systems. Moreover examples of online academic systems are shown. These systems belong to Sakarya University and now every system is alive. These systems facilitate the students and staffs lives with providing opportunities to manage and use online academic systems easily and affectively.

**Keywords:** Online Academic Systems, Performance System

### **Introduction**

Communication technologies have developed very fast. This development has affect education system. For example, performance system has changed with internet. Academicians can see their performance system on internet.

Performance systems are important for academicians and staff in universities. These help for facilitating the life in order to manage all activities in universities. Thus this increases the performance of academicians and staff in their duty. With the innovation and development of technologies, performance systems are electronic and online now.

Inside of the innovation and rapidly developed technology, a complex workflow is included. Performance system is reducing the workload of academicians and staff. Performance systems to be online with the developing technology are another factor in making our lives easier. Furthermore these systems simplify maintenance, processes, choices, implementation and delivery. Besides these, performance systems strengthen communication and computer infrastructure, knowledge base, facilitate knowledge management and increase usability (Maughan, 2005).

Traditional systems cannot sufficiently prepare academicians and staff for today's complex workplace. Thus new and more effectively systems are needed. With this need, in order to achieve a successful performance, and to increase productivity information technologies are used (Lee and Lui, 2006; Gottfredson and Mosher, 2010).



Figure 1. Sakarya University's Web Site Home Page

Thanks to its strong communications infrastructure and knowledge base, Sakarya University aims to provide information technology services to students and staff. Sakarya University has different information technology systems for managing and increasing the performance. These systems are:

- Sakarya University Academic Information System (Sakarya Üniversitesi Akademik Bilgi Sistemi-SABİS)
- Educational Information System (Eğitim Öğretim Bilgi Sistemi- EBS)
- Strategic Management Information System (Stratejik Yönetim Bilgi Sistemi- SYBS)
- Sakarya University Campus Automation Web Information System (CAWİS)

## SAKARYA UNIVERSITY ACADEMIC INFORMATION SYSTEM - SABİS

Sakarya University Academic Information System (Sakarya Üniversitesi Akademik Bilgi Sistemi- SABİS) is a new system and its web site is <http://www.sabis.sakarya.edu.tr/> . In this system, it is aimed to manage the academic activities for academicians. Moreover for guest users SABİS offer the chance to look at the course programs, contents and teaching staff.

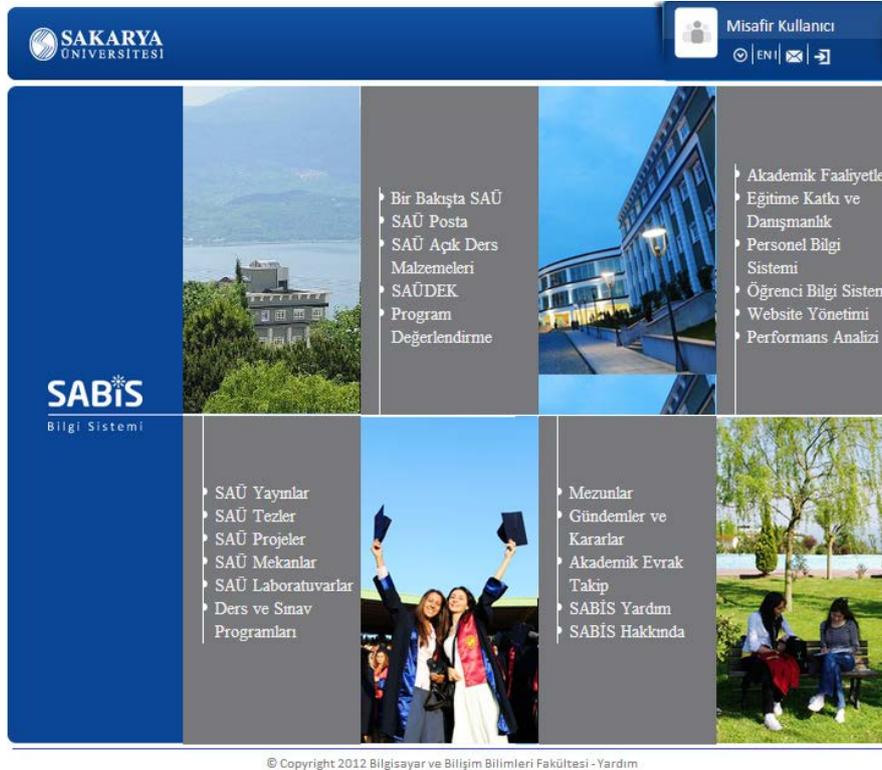


Figure 2. Sakarya University Academic Information System - SABİS

With SABİS, it is accessed to open course materials, the Sakarya University Academic Evaluation and Quality Improvement Committee (Sakarya Üniversitesi Akademik Değerlendirme ve Kalite Geliştirme Kurulu- SAÜDEK) decisions, academic activities, consultancy services, personal information services, student information services, website management, performance analyses, Sakarya University publications, thesis, projects, locations, laboratories, course and exam programs, graduates system, agendas and decisions, academic documents tracking system. On the other hand SABİS permit the university staff access their mail from this site.



Figure 3. SABİS Mail Service User Login

In SABİS from the part of the website management, there is access and management panel for web sites which is haven by each university staff, each academic and administrative unit on behalf of institutional identity.

SAKARYA ÜNİVERSİTESİ  
Website Yönetimi

Kullanıcı: [Kullanıcı Adı] Çıkış

Ana Sayfa Duyurular Slider

PAGES

Görünen Kayıt Sayısı: 10 Search: [Ara]

| ID   | BASLIK          | YAYIN TARİHİ | DİL    | İŞLEM     |
|------|-----------------|--------------|--------|-----------|
| 7685 | Yeni Web Sitesi | 2012-03-01   | Türkçe | [X] [Sil] |

Toplam 1 kayıttan 1 ile 1 arası gösteriliyor

First Previous 1 Next Last

(c) 2012. Bilgisayar ve Bilişim Bilimleri Fakültesi

Figure 4. SABİS Web Site Management

## EDUCATIONAL INFORMATION SYSTEM - EIS

The mission of Sakarya University is to maintain a contemporary academic tradition that enhances and produces information and technology at universal standards and to be keen on research, to be participative, sharing and innovative and appreciative of aesthetic values. For this mission, Sakarya University founded different systems like (Educational Information System).

Bologna Process urges all EU higher education institutions to evaluate competencies of their educational programs and to maintain a common perception of quality. Through EIS (Educational Information System), Sakarya University aims at describing its curricular activities within a constantly evolving and transparent framework. What makes EIS a remarkable software is its integrity and compatibility with Sakarya University's other information systems that are currently operating.

EIS includes documents regarding university's academic program competencies and objectives, lesson plans, relations between courses and program competencies, course outcome, evaluation criteria, documents for teaching staff to share, questionnaires evaluating educational processes, in-service training documents for the initiative of updating educational programs that commenced in December 27, 2007. EIS contains 9.223 different described courses that are still being processed.



Figure 5. Sakarya University Educational Information System

### Degree Programmes:

### ***Doctorate Degree (Third Cycle Programmes)***

- 
- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>▪ <b>Institute of Natural Sciences</b></li> <li>▪ Mechanical Engineering</li> <li>▪ Civil Engineering</li> <li>▪ Industrial Engineering</li> <li>▪ Electrical and Electronics Engineering</li> <li>▪ Metallurgical and Materials Engineering</li> <li>▪ Computer and Information Engineering</li> <li>▪ Environmental Engineering</li> <li>▪ Mathematics</li> <li>▪ Chemistry</li> <li>▪ Physics</li> <li>▪ Electronical and Computer Education</li> <li>▪ Machine Education</li> <li>▪ Metal Education</li> <li>▪ Geophysics Engineering</li> <li>▪ Biology</li> </ul> <ul style="list-style-type: none"> <li>▪ <b>Institute of Educational Sciences</b></li> <li>▪ Physical Education and Sports</li> <li>▪ Instructional Technology and Computer Education</li> <li>▪ Educational Science</li> <li>▪ Science Education</li> <li>▪ Turkish Language Education</li> </ul> | <ul style="list-style-type: none"> <li>▪ <b>Institute of Social Sciences</b></li> <li>▪ Economics</li> <li>▪ Public Administration</li> <li>▪ Business Management</li> <li>▪ Labour Economics and Industrial Relations</li> <li>▪ Public Finance</li> <li>▪ International Relations</li> <li>▪ Basic Islamic Sciences</li> <li>▪ History of Islam and Islamic Arts</li> <li>▪ Philosophy and Theological Sciences</li> <li>▪ Turkish Language and Literature</li> <li>▪ History</li> <li>▪ Sociology</li> <li>▪ German Language and Literature</li> <li>▪ Philosophy</li> <li>▪ Tourism Management</li> <li>▪ Interpretation and Translation</li> </ul> |
|---|---|

Figure 6. Sakarya University Doctorate Degree (Third Cycle Programmes)

### ***Master's Degree (Second Cycle Programmes)***

- 
- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>▪ <b>Institute of Natural Sciences</b></li> <li>▪ Mechanical Engineering</li> <li>▪ Civil Engineering</li> <li>▪ Industrial Engineering</li> <li>▪ Industrial Engineering</li> <li>▪ Electrical and Electronics Engineering</li> <li>▪ Metallurgical and Materials Engineering</li> <li>▪ Computer and Information Engineering</li> <li>▪ Computer and Information Engineering</li> <li>▪ Environmental Engineering</li> <li>▪ Mathematics</li> <li>▪ Mathematics Education</li> <li>▪ Chemistry</li> <li>▪ Chemistry Education</li> <li>▪ Physics</li> <li>▪ Physics Education</li> <li>▪ Electronical and Computer Education</li> <li>▪ Machine Education</li> <li>▪ Metal Education</li> <li>▪ Geophysics Engineering</li> <li>▪ Structural Education</li> <li>▪ Biology</li> <li>▪ Food Engineering</li> <li>▪ ?</li> <li>▪ Information Systems</li> <li>▪ Information Systems</li> </ul> <ul style="list-style-type: none"> <li>▪ <b>Institute of Educational Sciences</b></li> <li>▪ Educational Science</li> <li>▪ Physical Education and Sports</li> <li>▪ Instructional Technology and Computer Education</li> <li>▪ Instructional Technology and Computer Education</li> <li>▪ Educational Science</li> <li>▪ Educational Science</li> <li>▪ Educational Science</li> <li>▪ Science Education</li> <li>▪ Primary Education</li> <li>▪ Primary Education</li> <li>▪ Turkish Language Education</li> <li>▪ Higher Education</li> <li>▪ Lifelong Learning</li> <li>▪ History Education</li> <li>▪ Mathematics Education</li> <li>▪ Educational Science</li> <li>▪ English Language Teaching</li> </ul> | <ul style="list-style-type: none"> <li>▪ <b>Institute of Social Sciences</b></li> <li>▪ Economics</li> <li>▪ Public Administration</li> <li>▪ Business Management</li> <li>▪ Labour Economics and Industrial Relations</li> <li>▪ Public Finance</li> <li>▪ International Relations</li> <li>▪ Basic Islamic Sciences</li> <li>▪ History of Islam and Islamic Arts</li> <li>▪ Philosophy and Theological Sciences</li> <li>▪ Turkish Language and Literature</li> <li>▪ History</li> <li>▪ Sociology</li> <li>▪ German Language and Literature</li> <li>▪ Painting</li> <li>▪ Philosophy</li> <li>▪ Tourism Management</li> <li>▪ Folklore and Musicology</li> <li>▪ Geography</li> <li>▪ Translation Studies</li> <li>▪ Ceramics and Glass</li> <li>▪ Business Management</li> <li>▪ Business Management</li> <li>▪ Public Administration</li> <li>▪ History of Republic of Turkey</li> <li>▪ Public Administration</li> <li>▪ Public Finance</li> <li>▪ Local Administration</li> <li>▪ Local Administration</li> <li>▪ Middle East Studies</li> <li>▪ Health Management</li> <li>▪ Health Management /Without Thesis</li> <li>▪ Middle East Studies /Distance Education</li> <li>▪ Finance and Economics/ Distance Education</li> <li>▪ Tourism Management/Distance Education</li> <li>▪ International Relations And European Union/Distance Education</li> <li>▪ Social Structure and Social Change Analysis / Distance Education</li> </ul> |
|--|--|

Figure 7. Sakarya University Master's Degree (Second Cycle Programmes)

### ***Bachelor's Degree (First Cycle Programmes)***

- **Faculty of Engineering**
  - Electrical and Electronics Engineering
  - Industrial Engineering
  - Civil Engineering
  - Mechanical Engineering
  - Metallurgical and Materials Engineering
  - Environmental Engineering
  - Geophysical Engineering
  - Food Engineering
- **Faculty of Economics and Administrative Sciences**
  - Economics
  - Public Administration Relations
  - Labour Economics and Industrial Relations
  - International Relations
  - Public Finance
- **Faculty of Technical Education**
  - Electronics Teaching
  - Automotive Teaching
  - Metal Teaching
  - Construction Teaching
  - Computer Teaching
- **Faculty of Fine Arts**
  - Carpet-Kilim
  - Tiles Design
  - Illumination
  - Painting
  - Ceramics and Glass
  - Visual Arts
  - Calligraphy
  - Calligraphy
- **School of Physical Education and Sports**
  - Physical Education and Sports
  - Recreation
  - Sports Management
  - Education of Coaching
- **Faculty of Computer and Informatics**
  - Information System Engineering
  - Computer Engineering
- **Faculty of Law**
  - Law
- **Faculty of Communication**
- **Faculty of Science and Letters**
  - Mathematics
  - Physics
  - Chemistry
  - Turkish Language and Literature
  - German Language and Literature
  - Sociology
  - History
  - Philosophy
  - Translation Studies
  - Geography
  - Biology
  - Social Work
  - History of Art
- **Faculty of Theology**
  - Theology
  - Religion and Ethics Education
- **Faculty of Education**
  - Classroom Education
  - Science Education
  - Early Childhood Education
  - Social Studies Education
  - Turkish Teaching Education
  - Instructional Technology and Computer Education
  - Physical Education and Sports
  - Psychological Counselling and Guidance
  - Mentally Handicapped Education
  - Mathematics Education
  - Religion and Ethics Education
  - English Education
- **Faculty of Technology**
  - Electrical and Electronics Engineering
  - Civil Engineering
  - Mechanical Engineering
  - Metallurgical and Materials Engineering
  - Computer Engineering
  - Mechatronic Engineering
- **School of Health**
  - Nursing
  - Midwifery
- **Faculty of Management**
  - Management
  - Tourism Management
  - Human Resources Management
  - İşletme (Uolp-Leeds Metropolitan)
- **The State Conservatory**
  - Basic Sciences
  - Turkish Music
  - Turkish Folk Dances
  - Music Technology

Figure 8. Sakarya University Bachelor's Degree (First Cycle Programmes)

## Associate's Degree (Short Cycle Programmes)

- **Vocational School of Sakarya**
  - Automotive
  - Construction
  - Machine Drawing and Construction
  - Business Management
  - Machine
  - Electrics
  - Ceramics
  - Accounting
  - Industrial Moulding
  - Environmental Pollution and Control
  - Natural Gas Heating and Installation
  - Computer Technologies and Programming
  - Industrial Electronics
  - Mechatronics
  - Office Administration and Secretary
  - Public Relations
  - Metallurgy and Materials
  - Logistics
  - Media and Press
- **Vocational School of Akyazi**
  - Business Management
  - Landscape and Gardening
  - Natural Gas Heating and Installation
  - Foreign Trade
  - Accounting
  - Furniture Decoration
  - Machine
  - Air Conditioning and Refrigeration
- **Vocational School of Sapanca**
  - Horticulture
  - Accounting
  - Landscape and Gardening
  - Public Relations
  - Banking
  - Foreign Trade
  - Assurance
  - Air Conditioning and Refrigeration
  - Customs Management
- **Vocational School of Adapazari**
  - Information Management
  - Computer Technologies and Programming
  - Business Management
  - Mechatronics
  - Industrial Electronics
  - ?
- **Vocational School of Ali Fuat Cebesoy**
  - Business Management
  - Accounting
  - Finance
  - Public Relations
  - Foreign Trade
- **Vocational School of Health Service**
  - Medical Inventory and Secretary
  - Medical Laboratory
  - Child Development
  - Elder Care Services
  - Optician
  - Physiotherapy
- **Vocational School of Kirkpinar**
  - Hosting
  - Tourism and Travel Management
- **Vocational School of Hendek**
  - Computer Technologies and Programming
  - Electrics
  - Construction
  - Business Management
  - Accounting
  - Machine
  - Machine Drawing and Construction
  - Industrial Electronics
  - Marketing
- **Vocational School of Geyve**
  - Textile
  - Accounting
  - Business Management
  - Foreign Trade
  - Computer Technologies and Programming
  - Landscape and Gardening
  - Estate and Estate Management
  - Banking
  - Office Administration and Secretary
  - Restoration and Conservation
- **Vocational School of Karasu**
  - Computer Technologies and Programming
  - Accounting
  - Machine
  - Hosting
- **Vocational School of Pamukova**
  - Food Technology
  - Dairy and Dairy Products
  - Marketing
  - Foreign Trade
  - Fruit and Vegetable Processing
  - Commerce and Management
  - Landscape and Gardening
  - Laboratory Technology
  - Food Quality Control Analysis
- **Vocational School of Ferizli**
  - Business Management
  - Accounting
  - Textile
  - Fashion Design
  - Clothing Production Technology
- **Vocational School of Kaynarca**
  - Business Management
  - Accounting
  - Computer Technologies and Programming
  - Finance
- **Vocational School of Arifiye**
  - Automotive
  - Auto Paint and Body
  - Rail Systems Technology
  - Map and Survey
  - Welding Technology

Figure 9. Sakarya University Associate's Degree (Short Cycle Programmes)

Any part of these programs lesson plan, curriculum, course content, documents can be accessed from EIS.

For example, if Bachelor's Degree (First Cycle Programmes), Faculty of Education, Department of Instructional Technology and Computer Education is chosen, menus of Goals & Objectives, Program Learning Outcomes, Teaching & Learning Methods, Course Struct.&ECTS Credits, Course&Program L. Outcomes, Course Categories, Level of Qualification, Admission Requirements, Occupational Profiles, Graduation Requirements, Assessment and Grading, Prog. Director & ECTS Coord., Polls Applied to Students are seen.

## Goals & Objectives



**sakarya Üniversitesi** educational information system  
eğitim öğretim bilgi sistemi

Home » Bachelor's Degree (First Cycle Programmes) » Instructional Technology and Computer Education » Goals & Objectives

Dil/Language : Türkçe | English Donem : 2012-2013

**Programme Information**  
**Instructional Technology and Computer Education**  
 Goals & Objectives  
 Program Learning Outcomes  
 Teaching & Learning Methods  
 Course Struct.&ECTS Credits  
 Courses&Program L. Outcomes  
 Course Categories  
 Level of Qualification  
 Admission Requirements  
 Occupational Profiles  
 Graduation Requirements  
 Assessment and Grading  
 Prog. Director & ECTS Coord.  
 Polls Applied to Students  
 2012-2013 Ders Plan Güncellemeleri  
 İntibak Esasları

**Site Information**  
 Home  
 Information on the Institution  
 Degree Programmes  
 - Doctorate Degree (Third Cycle Programmes)

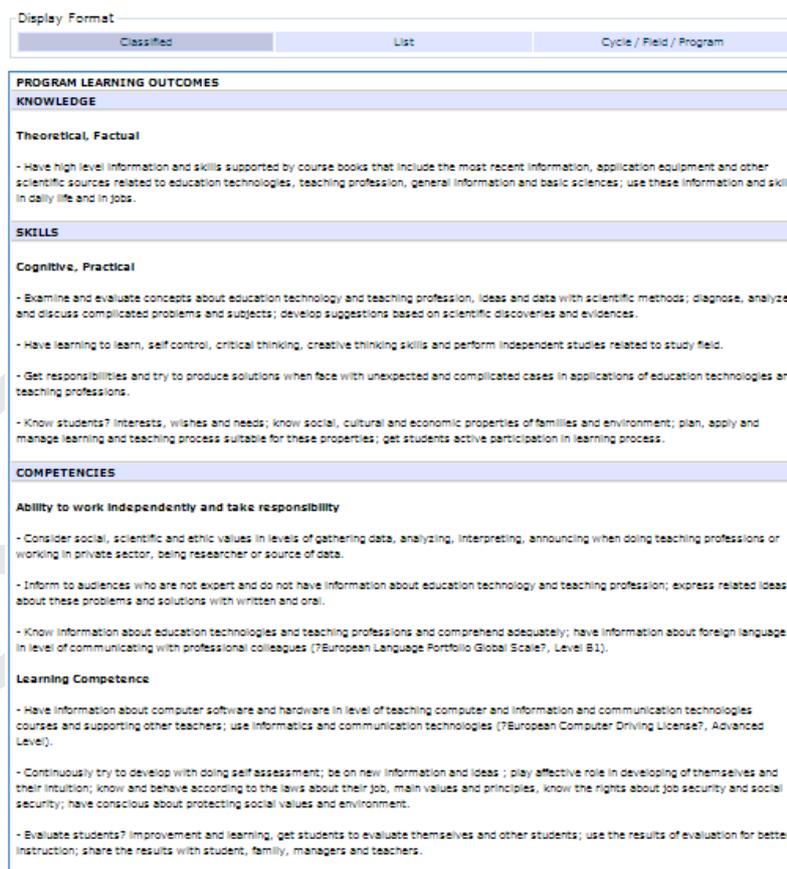
**Goals:**  
 This department train people who will work in primary and secondary level to cause students to gain information, skill and perfection about education technology; teachers who will support other teachers about information and communication technologies and usage of instructional materials in education. It is aimed that these teachers will be individuals who can work in private sector throughout designs and processes relevant to usage of technologies like distance education, e-learning, computer-based education.

**Objectives:**  
 Computer and Instructional Technologies Teaching Department aims to train individuals who:  
 - have sufficient information, skill and perfection about subjects relevant to teaching profession and performing this profession,  
 - have sufficient information, skill and perfection about hardware, operating systems, computer networks and computer languages,  
 - use education technology productively and effectively in the process of designing, planning, carrying on and directing education technology,  
 - know instructional technologies and materials and the usage of these in lessons; have a part in applications like educational software, e-learning, distance education and support the others,  
 - have an advanced problem-solving skill,  
 - have a critical thinking skill,  
 - work as a group  
 - express themselves orally and written,  
 - know ways of reaching information, generate information and use information,  
 - have characteristics of creativity and being innovative,  
 - are responsible to subjects about profession and ethics,  
 - are respectful to values of society and useful for society in situations they can create solutions, aims to train active teachers and in order to carry out this it aims to provide necessary human resources, environment and teaching-learning processes.

Figure 10. Goals & Objectives

## Program Learning Outcomes

Program learning outcomes may be displayed with classified, list or cycle/field/program format.



Display Format

Classified List Cycle / Field / Program

**PROGRAM LEARNING OUTCOMES**

**KNOWLEDGE**

**Theoretical, Factual**

- Have high level information and skills supported by course books that include the most recent information, application equipment and other scientific sources related to education technologies, teaching profession, general information and basic sciences; use these information and skills in daily life and in jobs.

**SKILLS**

**Cognitive, Practical**

- Examine and evaluate concepts about education technology and teaching profession, ideas and data with scientific methods; diagnose, analyze and discuss complicated problems and subjects; develop suggestions based on scientific discoveries and evidences.
- Have learning to learn, self control, critical thinking, creative thinking skills and perform independent studies related to study field.
- Get responsibilities and try to produce solutions when face with unexpected and complicated cases in applications of education technologies and teaching professions.
- Know students' interests, wishes and needs; know social, cultural and economic properties of families and environment; plan, apply and manage learning and teaching process suitable for these properties; get students active participation in learning process.

**COMPETENCIES**

**Ability to work independently and take responsibility**

- Consider social, scientific and ethic values in levels of gathering data, analyzing, interpreting, announcing when doing teaching professions or working in private sector, being researcher or source of data.
- Inform to audiences who are not expert and do not have information about education technology and teaching profession; express related ideas about these problems and solutions with written and oral.
- Know information about education technologies and teaching professions and comprehend adequately; have information about foreign language in level of communicating with professional colleagues (7European Language Portfolio Global Scale?, Level B1).

**Learning Competence**

- Have information about computer software and hardware in level of teaching computer and information and communication technologies courses and supporting other teachers; use informatics and communication technologies (7European Computer Driving License?, Advanced Level).
- Continuously try to develop with doing self assessment; be on new information and ideas; play effective role in developing of themselves and their intuition; know and behave according to the laws about their job, main values and principles, know the rights about job security and social security; have conscious about protecting social values and environment.
- Evaluate students' improvement and learning; get students to evaluate themselves and other students; use the results of evaluation for better instruction; share the results with student, family, managers and teachers.

Figure 11. Program Learning Outcomes Classified Display Format

| Display Format  |      |                         |
|---|------|-------------------------|
| Classified  | List | Cycle / Field / Program |
| <b>PROGRAM LEARNING OUTCOMES</b>  |      |                         |
| Have high level information and skills supported by course books that include the most recent information, application equipment and other scientific sources related to education technologies, teaching profession, general information and basic sciences; use these information and skills in daily life and in jobs.   |      |                         |
| 1 Examine and evaluate concepts about education technology and teaching profession, ideas and data with scientific methods; diagnose, analyze and discuss complicated problems and subjects; develop suggestions based on scientific discoveries and evidences.   |      |                         |
| 2 Inform to audiences who are not expert and do not have information about education technology and teaching profession; express related ideas about these problems and solutions with written and oral.  |      |                         |
| 3 Have learning to learn, self control, critical thinking, creative thinking skills and perform independent studies related to study field.   |      |                         |
| 4 Get responsibilities and try to produce solutions when face with unexpected and complicated cases in applications of education technologies and teaching professions.   |      |                         |
| 5 Know students' interests, wishes and needs; know social, cultural and economic properties of families and environment; plan, apply and manage learning and teaching process suitable for these properties; get students active participation in learning process.   |      |                         |
| 6 Know information about education technologies and teaching professions and comprehend adequately; have information about foreign language in level of communicating with professional colleagues (7European Language Portfolio Global Scale7, Level B1).  |      |                         |
| 7 Have information about computer software and hardware in level of teaching computer and information and communication technologies courses and supporting other teachers; use informatics and communication technologies (7European Computer Driving License7, Advanced 8 Level).   |      |                         |
| 8 Consider social, scientific and ethic values in levels of gathering data, analyzing, interpreting, announcing when doing teaching professions or working in private sector, being researcher or source of data.   |      |                         |
| 9 Continuously try to develop with doing self assessment; be on new information and ideas; play effective role in developing of themselves and their intuition; know and behave according to the laws about their job, main values and principles, know the rights about job security and social security; have conscious about protecting social values and environment. |      |                         |
| 10 Evaluate students' improvement and learning, get students to evaluate themselves and other students; use the results of evaluation for better instruction; share the results with student, family, managers and teachers.  |      |                         |
| 11  |      |                         |

Figure 12. Program Learning Outcomes List Display Format

| Display Format  |  |   |
|---|--|---|
| Classified  | List   | Cycle / Field / Program   |
| <b>NATIONAL QUALIFICATIONS OF LEVEL 6. LEVEL (BACHELOR'S DEGREE (FIRST CYCLE PROGRAMMES))</b>   | <b>NATIONAL QUALIFICATIONS OF FIELD (14 - ÖĞRETİM YETİŞTİRME VE EĞİTİM BİLİMLERİ)</b>  | <b>PROGRAM LEARNING OUTCOMES</b>  |
| <b>KNOWLEDGE</b>  |  |   |
| <b>Theoretical, Factual</b>   |  |   |
| - Alanındaki güncel bilgileri içeren ders kitapları, uygulama araç-gereçleri ve diğer kaynaklarla desteklenen ileri düzeydeki kuramsal ve uygulamalı bilgilere sahip olma.  | - Ortaöğretimde kazandığı yeterliliklere dayalı olarak; alanıyla ilgili kavramları ve kavramlar arası ilişkileri kavrar.<br>- Bilginin doğası, kaynağı, sınırları, doğruluğu, güvenilirliği ve geçerliliğinin değerlendirilmesi konusunda bilgi sahibidir.<br>- Bilimsel bilginin üretimiyle ilgili yöntemleri tartışır.<br>- Alanı ile ilgili öğretim programları, öğretim strateji, yöntem ve teknikleri ile ölçme ve değerlendirme bilgisine sahiptir.<br>- Öğrencilerin gelişim, öğrenme özellikleri ve güçlüklerinin bilgisine sahiptir.<br>- Ulusal ve uluslararası kültürleri tanıır. | - Have high level information and skills supported by course books that include the most recent information, application equipment and other scientific sources related to education technologies, teaching profession, general information and basic sciences; use these information and skills in daily life and in jobs.   |
| <b>SKILLS</b>   |  |   |
| <b>Cognitive, Practical</b>   |  |   |
| - Alanında edindiği ileri düzeydeki kuramsal ve uygulamalı bilgileri kullanabilme.<br>- Alanında edindiği ileri düzeydeki bilgi ve becerileri kullanarak verileri yorumlayabilme ve değerlendirilme, sorunları tanımlayabilme, analiz edebilme, araştırmalara ve kânlara dayalı çözüm önerileri geliştirebilme. | - Alanıyla ilgili ileri düzeyde bilgi kaynaklarını kullanır.<br>- Alanıyla ilgili olay ve olguları kavramsallaştırır, bilimsel yöntem ve teknikleri inceler, verileri yorumlar ve değerlendirir.<br>- Alanıyla ilgili sorunları tanımlar, analiz eder, kânlara ve araştırmalara dayalı çözüm önerileri geliştirir.<br>- Öğrencilerin gelişim özelliklerini, bireysel farklılıklarını; konu alanının özelliklerini ve kazanımlarını sınıfta olarak en uygun öğretim strateji, yöntem ve tekniklerini uygular.<br>- Konu alanına ve öğrencinin gereksinimlerine uygun materyal geliştirir.     | - Examine and evaluate concepts about education technology and teaching profession, ideas and data with scientific methods; diagnose, analyze and discuss complicated problems and subjects; develop suggestions based on scientific discoveries and evidences.<br>- Have learning to learn, self control, critical thinking, creative thinking skills and perform independent studies related to study field.<br>- Get responsibilities and try to produce solutions when face with unexpected and complicated cases in applications of education technologies and teaching professions.<br>- Know students' interests, wishes and needs; know social, cultural and economic properties of families and environment; plan, apply and manage learning and teaching process suitable |

Figure 13. Program Learning Outcomes Cycle/Field/Program Display Format

### Teaching & Learning Methods

Teaching and learning methods and strategies are chosen to improve the student's skills such as self learning, life-long learning, observation, teaching others, presentation, critical thinking, teamworking and IT.

Also, to achieve a better learning with students having different learning styles, the program is supported by convenient methodologies.

| Teaching and Learning Methods      | Major Learning Activities   | Tools  |
|------------------------------------|---|--|
| Lecture                            | Listening and interpretation  | Classware, multimedia, data projector, computer, overhead projector                    |
| Lecture with Discussion            | Listening and interpretation, Observation/manipulation situations, critical thinking, question posing   | Classware, multimedia, data projector, computer, overhead projector                    |
| Tutorial / Structured Exercise     | Specific predetermined skill  |  |
| Role Play                          | Specific predetermined skill  | Classware, specific hardware   |
| Problem Solving                    | Specific predetermined skill  |  |
| Case Study                         | Specific predetermined skill  |  |
| Brainstorming                      | Observation/manipulation situations, critical thinking, question posing, creative teamwork  |  |
| Small Group Discussion             | Listening and interpretation, Observation/manipulation situations, critical thinking, question posing   | Classware, Multimedia, data projector, computer, overhead projector                    |
| Demonstration                      | Observation/manipulation situations   | Tools that allow observation followed by virtual application                           |
| Simulation                         | Observation/manipulation situations, IT Skills  | Tools that allow observation followed by virtual application                           |
| Seminars                           | Research skills, writing, reading, IT Skills, Listening and interpretation, Observation/manipulation situations, organizational skills  | Classware, multimedia, data projector, computer, overhead projector, specific hardware |
| Group work                         | Research skills, writing, reading, IT Skills, critical thinking, question posing, organizational skills, teamwork   | Web directories, database, e-mail, online discussion, web-based discussion forums      |
| Fieldwork                          | Observation/manipulation situations, Research skills, writing, reading  |  |
| Laboratory                         | Observation/manipulation situations, IT Skills, organizational skills, teamwork   | Specific hardware  |
| Homework                           | Research skills, writing, reading, IT Skills  | Web directories, database, e-mail  |
| Recitation                         | Research skills, manipulation situations, question posing, interpretation, presentation   |  |
| Worksheets/Surveys                 | Research skills, writing, reading   |  |
| Panel of Experts                   | Listening and interpretation, Observation/manipulation situations   | Classware, multimedia, data projector, computer, overhead projector, specific hardware |
| Guest Speaker                      | Listening and interpretation, Observation/manipulation situations   | Classware, multimedia, data projector, computer, overhead projector, specific hardware |
| Student Club Activities / Projects | Observation/manipulation situations, critical thinking, question posing, creative team work, Research skills, organizational skills, writing, reading, specific predetermined skill |  |

Figure 14. Teaching &amp; Learning Methods

### *Course Structure & ECTS Credits*

| Course Structure & ECTS Credits   |   |            |          |         |      |
|---|---|------------|----------|---------|------|
| To see the course details (such as objectives, learning outcomes, content, assessment and ECTS workload), click the relevant Course Title given in the table below. |   |            |          |         |      |
| 1. Semester Course Plan   |   |            |          |         |      |
| Code  | Course Title                                  | C/E        | L+P Hour | Credits | ECTS |
| DIL 101   | ENGLISH                                       | Compulsory | 4+0      | 4       | 4    |
| BTE 107   | COMMUNICATION                                 | Compulsory | 2+0      | 2       | 4    |
| BTE 101   | COMMUNICATION TECHNOLOGIES IN EDUCATION       | Compulsory | 4+0      | 4       | 8    |
| EBB 101   | INTRODUCTION TO EDUCATION SCIENCE             | Compulsory | 3+0      | 3       | 5    |
| BTE 103   | Mathematics and Logic in Computer Programming | Compulsory | 3+0      | 3       | 5    |
| BTE 105   | NEW LITERACIES                                | Compulsory | 3+0      | 3       | 4    |
| Total ECTS credits :  |   |            |          |         | 30   |
| 2. Semester Course Plan   |   |            |          |         |      |
| Code  | Course Title                                  | C/E        | L+P Hour | Credits | ECTS |
| TUR 102   | TURKISH LANGUAGE                              | Compulsory | 4+0      | 4       | 4    |
| BTE 102   | COMPUTER ASSISTED INSTRUCTION                 | Compulsory | 3+0      | 3       | 6    |
| EBB 102   | EDUCATIONAL PSYCHOLOGY                        | Compulsory | 3+0      | 3       | 5    |
| BTE 106   | History of Technology and Science             | Compulsory | 2+0      | 2       | 4    |
| EBB 108   | TEACHING PRINCIPLE AND METHODS                | Compulsory | 3+0      | 3       | 5    |
| BTE 104   | VISUAL DESIGN                                 | Compulsory | 3+0      | 3       | 6    |
| Total ECTS credits :  |   |            |          |         | 30   |

Figure 15. Course Structure &amp; ECTS Credits

### Course & Program Learning Outcomes

Course&Program L. Outcomes may be displayed with numerical relation level, verbal relation level or the presence of relationship format.

Display Format

Relation Level (Numerical)
  Relation Level (Verbal)
  The Presence of Relationship

| The Matrix for Course & Program Learning Outcomes |     |     |     |     |     |     |     |     |     |      |      |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| Course Title                                      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| APPLICATION OF TEACHING AT SCHOOL                 | 5   | 4   | 3   | 5   | 5   | 5   | 3   | 3   | 3   | 5    | 5    |
| CLASSROOM MANAGEMENT                              | 3   | 5   | 5   | 3   | 1   | 2   | 3   | 2   | 3   | 4    | 4    |
| COMMUNICATION                                     | 2   | 4   | 5   | 2   | 2   | 1   | 0   | 0   | 0   | 1    | 0    |
| COMMUNICATION TECHNOLOGIES IN EDUCATION           | 5   | 0   | 0   | 0   | 2   | 0   | 3   | 5   | 4   | 0    | 0    |
| COMPUTER ASSISTED INSTRUCTION                     | 5   | 4   | 3   | 3   | 5   | 2   | 3   | 2   | 1   | 1    | 2    |
| COMPUTER NETWORKS AND COMMUNICATION               | 4   | 3   | 2   | 4   | 5   | 3   | 2   | 5   | 0   | 0    | 3    |
| Current Educational Problems                      | 2   | 4   | 5   | 2   | 0   | 3   | 3   | 4   | 3   | 3    | 1    |
| DESIGNING EDUCATIONAL SIMULATION AND GAMES        | 4   | 3   | 3   | 2   | 4   | 1   | 3   | 2   | 2   | 1    | 2    |
| DISTANCE EDUCATION                                | 4   | 3   | 3   | 3   | 2   | 0   | 0   | 4   | 3   | 0    | 3    |
| EDUCATIONAL PSYCHOLOGY                            | 4   | 4   | 5   | 5   | 5   | 5   | 4   | 5   | 5   | 5    | 4    |
| EDUCATIONAL TELEVISION                            | 4   | 2   | 3   | 2   | 3   | 0   | 0   | 5   | 0   | 0    | 3    |
| ELECTIVE II (Server-based Programming)            | 1   | 2   | 0   | 5   | 5   | 3   | 3   | 5   | 5   | 4    | 0    |
| ELECTIVE III (DATABASE MANAGEMENT SYSTEMS)        | 2   | 2   | 0   | 4   | 5   | 2   | 2   | 5   | 5   | 2    | 0    |
| ENGLISH   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0    | 0    |

Figure 16. Course &amp; Program Learning Outcomes Relation Level (Numerical) Display Format

| Display Format                                    |     |     |     |     |     |     |     |     |     |      |      |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| Relation Level (Numerical)                        |     |     |     |     |     |     |     |     |     |      |      |
| Relation Level (Verbal)                           |     |     |     |     |     |     |     |     |     |      |      |
| The Presence of Relationship                      |     |     |     |     |     |     |     |     |     |      |      |
| The Matrix for Course & Program Learning Outcomes |     |     |     |     |     |     |     |     |     |      |      |
| Course Title                                      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| APPLICATION OF TEACHING AT SCHOOL                 | H   | H   | M   | H   | H   | H   | M   | M   | M   | H    | H    |
| CLASSROOM MANAGEMENT                              | M   | H   | H   | M   | L   | M   | M   | M   | M   | H    | H    |
| COMMUNICATION                                     | M   | H   | H   | M   | M   | L   |     |     |     | L    |      |
| COMMUNICATION TECHNOLOGIES IN EDUCATION           | H   |     |     |     | M   |     | M   | H   | H   |      |      |
| COMPUTER ASSISTED INSTRUCTION                     | H   | H   | M   | M   | H   | M   | M   | M   | L   | L    | M    |
| COMPUTER NETWORKS AND COMMUNICATION               | H   | M   | M   | H   | H   | M   | M   | H   |     |      | M    |
| Current Educational Problems                      | M   | H   | H   | M   |     | M   | M   | H   | M   | M    | L    |
| DESIGNING EDUCATIONAL SIMULATION AND GAMES        | H   | M   | M   | M   | H   | L   | M   | M   | M   | L    | M    |
| DISTANCE EDUCATION                                | H   | M   | M   | M   | M   |     |     | H   | M   |      | M    |
| EDUCATIONAL PSYCHOLOGY                            | H   | H   | H   | H   | H   | H   | H   | H   | H   | H    | H    |
| EDUCATIONAL TELEVISION                            | H   | M   | M   | M   | M   |     |     | H   |     |      | M    |
| ELECTIVE II (Server-based Programming)            | L   | M   |     | H   | H   | M   | M   | H   | H   | H    | H    |
| ELECTIVE III (DATABASE MANAGEMENT SYSTEMS)        | M   | M   |     | H   | H   | M   | M   | H   | H   | M    |      |
| ENGLISH   |     |     |     |     |     |     |     |     |     |      |      |

Figure 17. Course &amp; Program Learning Outcomes Relation Level (Verbal) Display Format

| Display Format                                    |     |     |     |     |     |     |     |     |     |      |      |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| Relation Level (Numerical)                        |     |     |     |     |     |     |     |     |     |      |      |
| Relation Level (Verbal)                           |     |     |     |     |     |     |     |     |     |      |      |
| The Presence of Relationship                      |     |     |     |     |     |     |     |     |     |      |      |
| The Matrix for Course & Program Learning Outcomes |     |     |     |     |     |     |     |     |     |      |      |
| Course Title                                      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| APPLICATION OF TEACHING AT SCHOOL                 | X   | X   | X   | X   | X   | X   | X   | X   | X   | X    | X    |
| CLASSROOM MANAGEMENT                              | X   | X   | X   | X   | X   | X   | X   | X   | X   | X    | X    |
| COMMUNICATION                                     | X   | X   | X   | X   | X   | X   |     |     |     | X    |      |
| COMMUNICATION TECHNOLOGIES IN EDUCATION           | X   |     |     |     | X   |     | X   | X   | X   |      |      |
| COMPUTER ASSISTED INSTRUCTION                     | X   | X   | X   | X   | X   | X   | X   | X   | X   | X    | X    |
| COMPUTER NETWORKS AND COMMUNICATION               | X   | X   | X   | X   | X   | X   | X   | X   |     |      | X    |
| Current Educational Problems                      | X   | X   | X   | X   |     | X   | X   | X   | X   | X    | X    |
| DESIGNING EDUCATIONAL SIMULATION AND GAMES        | X   | X   | X   | X   | X   | X   | X   | X   | X   | X    | X    |
| DISTANCE EDUCATION                                | X   | X   | X   | X   | X   |     |     | X   | X   |      | X    |
| EDUCATIONAL PSYCHOLOGY                            | X   | X   | X   | X   | X   | X   | X   | X   | X   | X    | X    |
| EDUCATIONAL TELEVISION                            | X   | X   | X   | X   |     |     |     | X   |     |      | X    |
| ELECTIVE II (Server-based Programming)            | X   | X   |     | X   | X   | X   | X   | X   | X   | X    | X    |
| ELECTIVE III (DATABASE MANAGEMENT SYSTEMS)        | X   | X   |     | X   | X   | X   | X   | X   | X   | X    |      |
| ENGLISH   |     |     |     |     |     |     |     |     |     |      |      |

Figure 18. Course &amp; Program Learning Outcomes The Presence of Relationship Display Format

### Course Categories

Course categories are varied as four parts: Supplementary Courses, Basic Occupational Courses, Expertise/Field Courses, Courses on Communication and Management Skills.

| Course Categories                  | ECTS      |
|------------------------------------|-----------|
| <b>Supplementary Courses</b>       |           |
| Current Educational Problems       | 4         |
| ENGLISH                            | 4         |
| ERGONOMY AND HEALTH IN INFORMATICS | 4         |
| HISTORY OF TURKISH EDUCATION       | 4         |
| History of Technology and Science  | 4         |
| Philosophy of Education            | 4         |
| PUBLISHING DESIGN                  | 4         |
| RESEARCH METHODS                   | 5         |
| SOCIAL SERVICE APPLICATIONS        | 4         |
| STATISTIC WITH COMPUTER            | 6         |
| <b>Total</b>                       | <b>43</b> |
| <b>Basic Occupational Courses</b>  |           |
| APPLICATION OF TEACHING AT SCHOOL  | 14        |
| CLASSROOM MANAGEMENT               | 5         |
| GUIDANCE                           | 5         |
| INTRODUCTION TO EDUCATION SCIENCE  | 5         |

Figure 19. Course Categories

### Level of Qualification

This is a first cycle degree program in the science of Computer and Instruction Technologies Education (240 ECTS).

You will be awarded, on successful completion of the programme and gain competencies, a degree of Bachelor in Computer and Instruction Technologies Education.

### ***Admission Requirements***

Students must comply with the legal and academic requirements to access the studies in The Sakarya University according to the process established by the ÖSYM (Higher Education Council Student Selection and Placement Centre) regulations. Students who have started studies in other universities within or outside of the country may apply for their recognition. The recognition record is unique for each student and therefore the procedure is carried out accordingly before the start of each academic year. More information about general admission requirements can be found in the catalogue of Information on the Institution.

Under an established exchanges program or one approved by the University, exchange students from abroad may be accepted for studies on the courses taught in English. Or, if they are confident in Turkish, they may then enrol any courses, running in Turkish, shown on the ?Course Structure? diagram.

### ***Occupational Profiles***

Upon a successful completion of the programme, student may continue with master and doctoral studies in the same or similar scientific areas, which may accept students from the science of Computer and Instruction Technologies Education.

### ***Graduation Requirements***

There is no final examination or examination period at the end of an academic year, or at the end of the study programme. There is, however, a final examination and examination periods, i.e., normally takes two weeks and starts immediately after at the end of each semester. Student is expected to have a successful completion of internship (60 working days) in industry before graduation. Internship is not credited in the programme though it is prerequisite for the graduation. However, the competences gained and workload needed with internship are ensured with the relevant courses' content, practice and workload in the programme. In addition to that student is required to complete a degree project and final year dissertation, (taken normally in 7th or 8th semester), which follows an oral presentation.

### ***Assessment and Grading***

Assessment and grading are specified in each course. When see the Course Structure for details, they are seen.

### ***Prog. Director & ECTS Coord.***

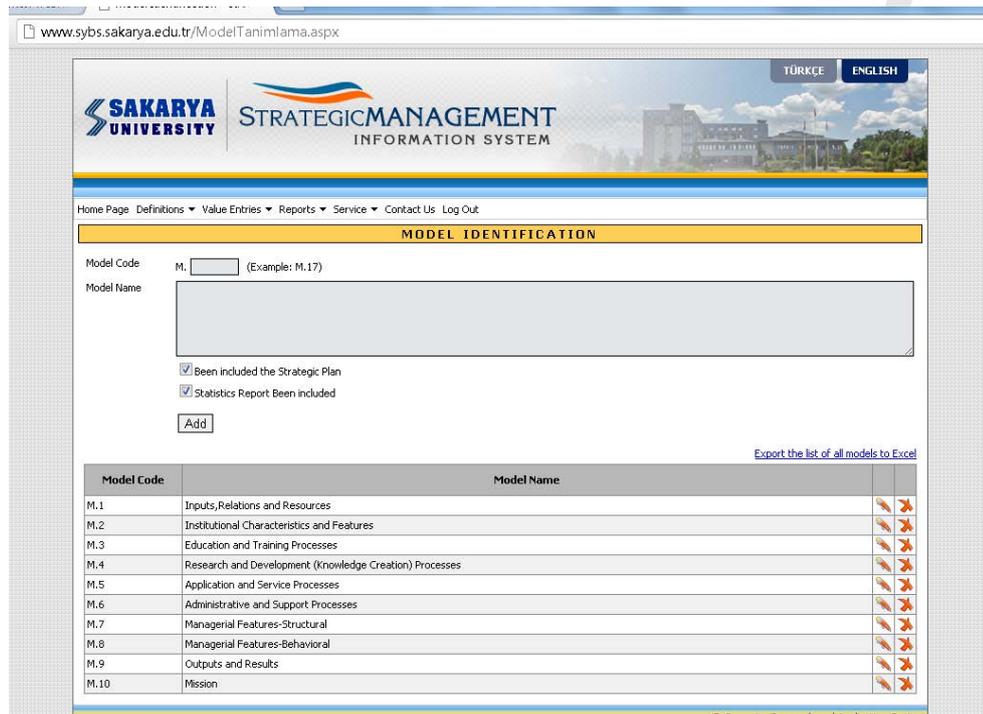
In this section programme director's and ECTS & Erasmus coordinator's information (mail address, phone number and fax number) are accessed.

### ***Polls Applied to Students***

Polls about "The Overall Evaluation of the Course", "The Evaluation of the Instructor", "Level of the Contribution Of Course Outcomes to Programme Competencies", "Workload Determination – ECTS" applied to students are seen from this section.

| Polls Applied to Students  |                       |                       |                       |                       |                       |                                  |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------------------|
| THE OVERALL EVALUATION OF THE COURSE   | Very Good             | Good                  | Average               | Poor                  | Very Poor             | No Idea                          |
| 1. Stating the content and objectives at the beginning of the course   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> |
| 2. Supplementing the course with current issues  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> |
| 3. The clarity of the exam questions and their appropriateness to the course   | <input type="radio"/>   | <input type="radio"/>   | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> |
| 7. The selection of the sources according to the objectives of the course  | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> |
|  |                       |                       |                       |                       |                       |                                  |
| THE EVALUATION OF THE INSTRUCTOR   | Very Good             | Good                  | Average               | Poor                  | Very Poor             | No Idea                          |
| 1. The way the instructor handles the course   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> |
| 2. The instructor's competence in answering the questions in the class   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> |
| 3. The instructor's encouragement to take part in the class by allowing different ideas and comments   | <input type="radio"/>   | <input type="radio"/>   | <input type="radio"/>   | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> |
| 8. The instructor's punctual and regular attendance  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> |
| 9. The instructor's rapport with the students  | <input type="radio"/> ufficiency of the time s/he allocates to you  | <input type="radio"/>   |                       |                       |                       |                       |                       |                                  |
| LEVEL OF THE CONTRIBUTION OF COURSE OUTCOMES TO PROGRAMME COMPETENCIES   | 5                     | 4                     | 3                     | 2                     | 1                     | X                                |
| 1. Have high level information and skills supported by course books that include the most recent information, application equipment and other scientific sources related to education technologies; teaching profession, general information and basic sciences; use these information and skills in daily life and in jobs. | <input type="radio"/>   | <input type="radio"/>  SYBS

At Sakarya University, in order to provide the spread and participation of the Strategic Management activities to units, in 2009 Strategic Management Information System has been developed. Strategic Management Information System consists 10 main themes (Strategies, Objectives, Sub-Objectives and Performance Indicators, Activity-Projects) in accordance with the model of YÖDEK. Performance of the units and the university is monitored by Red Area Charts produced by this system. By units, performances are evaluated with the performance reports to the Senate at the end of the year.



The screenshot shows the 'MODEL IDENTIFICATION' section of the SYBS system. It includes a form with the following fields and options:

- Model Code: M. (Example: M.17)
- Model Name: [Text Area]
- Been included the Strategic Plan
- Statistics Report Been included
- [Add] button
- Export the list of all models to Excel link

| Model Code | Model Name  |  |  |
|------------|---|--|--|
| M.1        | Inputs, Relations and Resources                         |  |  |
| M.2        | Institutional Characteristics and Features              |  |  |
| M.3        | Education and Training Processes                        |  |  |
| M.4        | Research and Development (Knowledge Creation) Processes |  |  |
| M.5        | Application and Service Processes                       |  |  |
| M.6        | Administrative and Support Processes                    |  |  |
| M.7        | Managerial Features-Structural                          |  |  |
| M.8        | Managerial Features-Behavioral                          |  |  |
| M.9        | Outputs and Results                                     |  |  |
| M.10       | Mission   |  |  |

Figure 21. Sakarya University Strategic Management Information System.

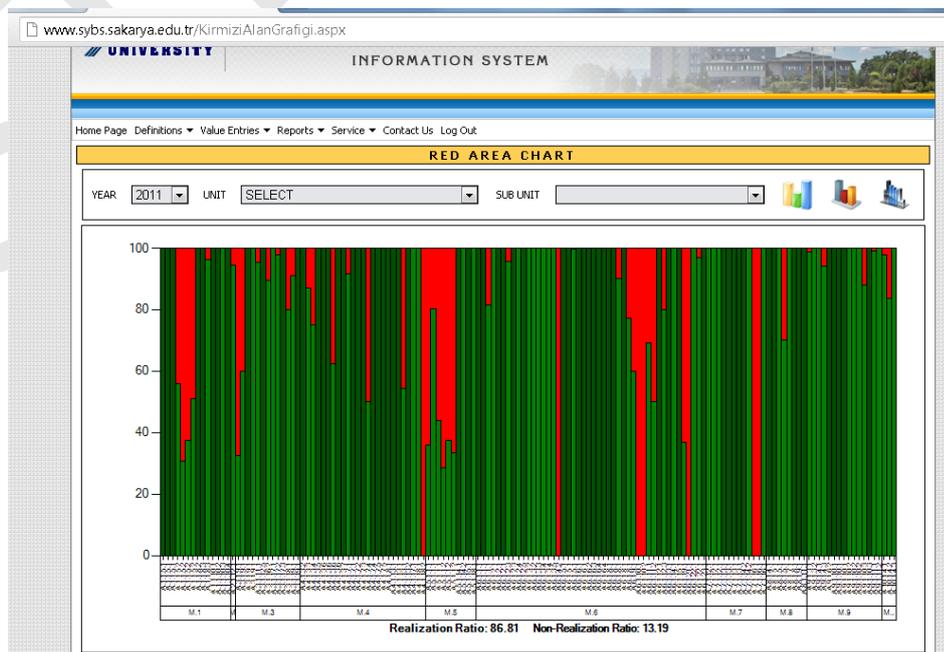


Figure 22. Red Area Chart.

ISTEC 2012

## CAMPUS AUTOMATION WEB INFORMATION SYSTEM - CAWIS

Campus Automation Web Information System (CAWIS) incorporates nine different systems. These have various tasks and contain different processes for several performance.

- **WebGate** - [ <http://www.gate.sakarya.edu.tr> ]
- **WebMail** - [ <http://www.mail.sakarya.edu.tr> ]
- **WebObis** - [ <http://www.obis.sakarya.edu.tr> ]
- **WebAbis** - [ <http://www.abis.sakarya.edu.tr> ]
- **WebPbis** - [ <http://www.pbis.sakarya.edu.tr> ]
- **WebMenü** - [ <http://www.menu.sakarya.edu.tr> ]
- **WebRehber** - [ <http://www.rehber.sakarya.edu.tr> ]
- **WebForm** - [ <http://www.form.sakarya.edu.tr> ]
- **WebAnket** - [ <http://www.anket.sakarya.edu.tr> ]

**WebGate** - [ <http://www.gate.sakarya.edu.tr> ]

WebGate is Campus Automation Web Information System (CAWIS)'s gate and interface to user processes.

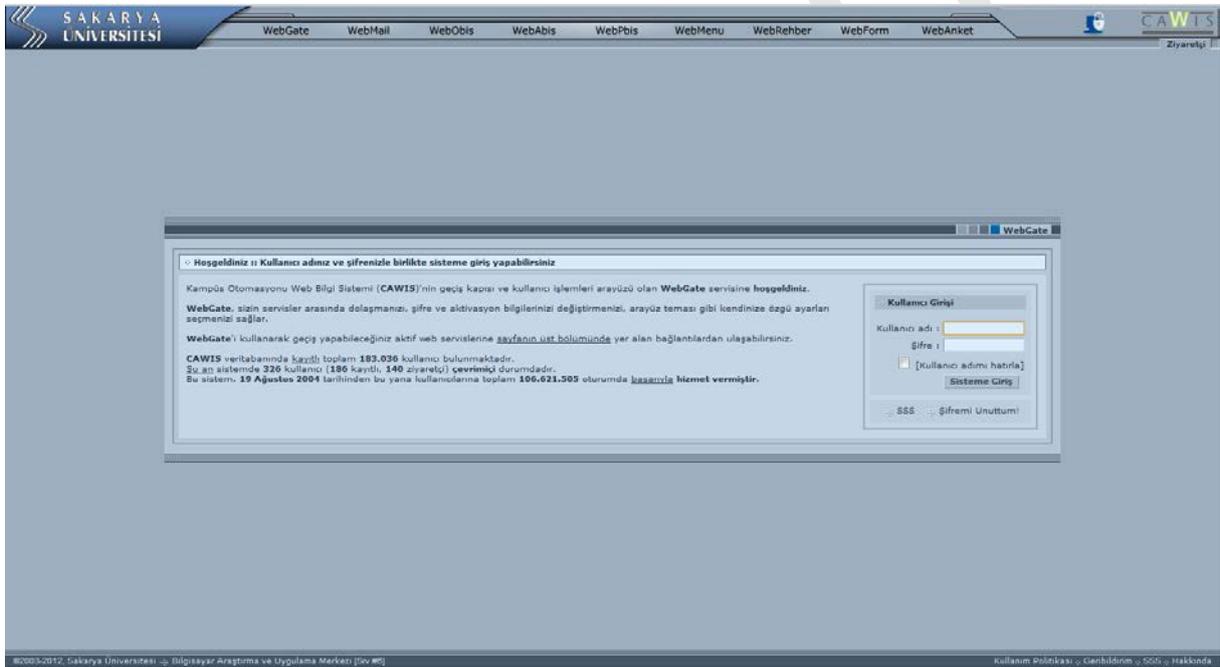


Figure 23. WebGate

**WebMail** - [ <http://www.mail.sakarya.edu.tr> ]

WebMail is CAWIS e-mail interface.

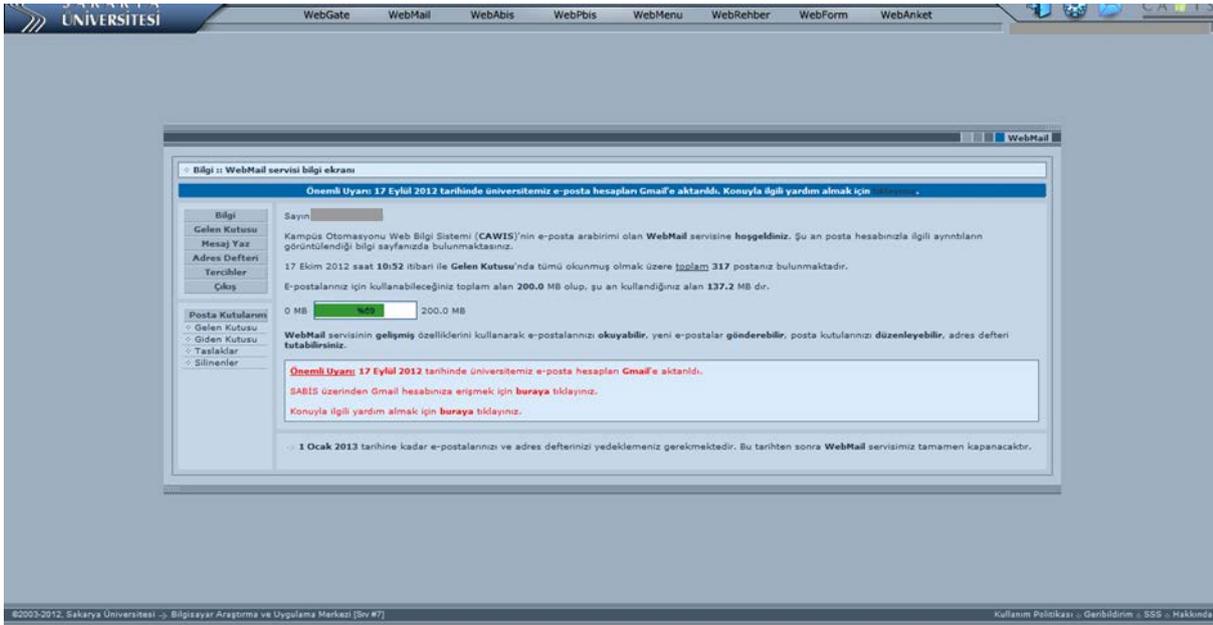


Figure 24. WebMail Information Page

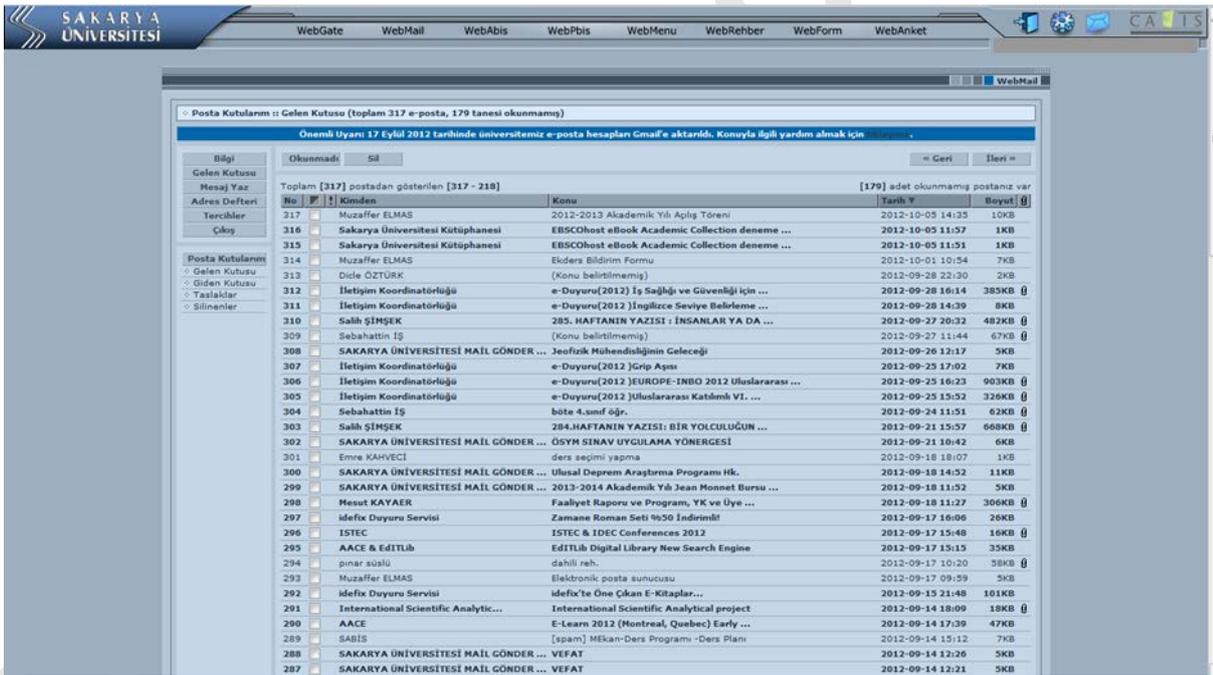


Figure 25. WebMail Inbox

On September 2012, webmail address was changed because Sakarya University made a deal with Google Mail-Gmail. Now academicians and staff access their mail from <http://www.posta.sakarya.edu.tr> address or SABİS page.



Figure 26. Mail Service User Login

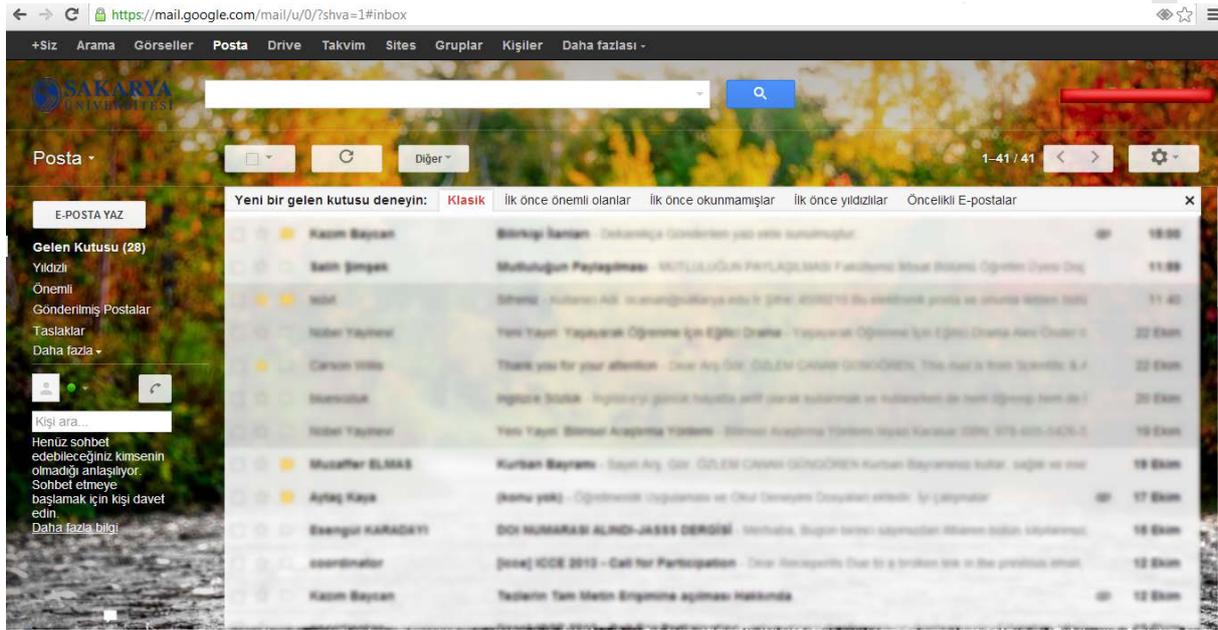
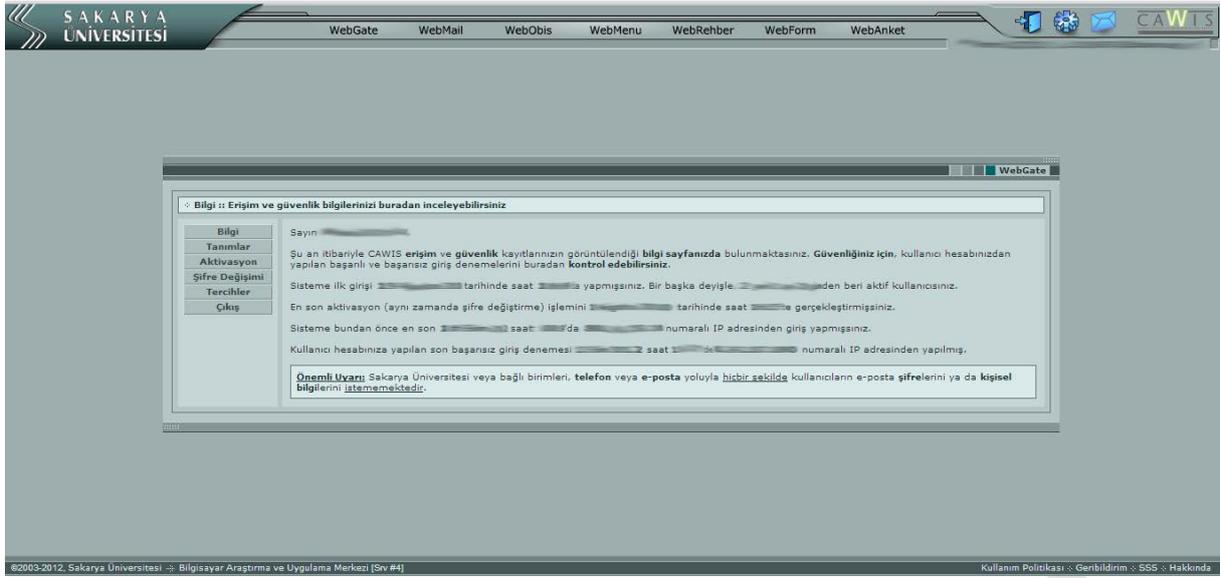


Figure 27. Mail Service Inbox

**WebObis** - [ <http://www.obis.sakarya.edu.tr> ]

WebObis is Student Information System and processes of course selection, viewing scores and transcript are done in this system.



SAKARYA UNIVERSİTESİ

WebGate WebMail WebObis WebMenu WebRehber WebForm WebAnket

WebGate

Bilgi :: Erişim ve güvenlik bilgilerinizi buradan inceleyebilirsiniz

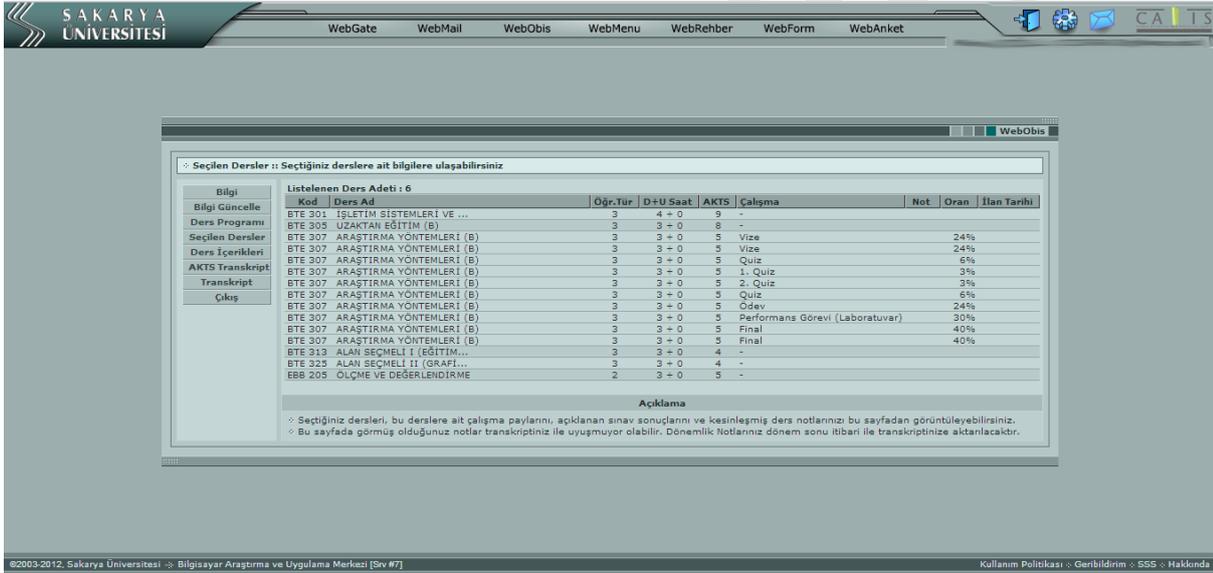
Bilgi  
Tanımlar  
Aktivasyon  
Sifre Değişimi  
Tercihler  
Çıkış

Sayın [...]  
 Su an itibarıyla CAWIS erişim ve güvenlik kayıtlarınız görüntülediği bilgi sayfanızda bulunmaktadır. Güvenliğiniz için, kullanıcı hesabınızdan yapılan başanlı ve başarısız giriş denemelerini buradan kontrol edebilirsiniz.  
 Sisteme ilk girişi [...] tarihinde saat [...] yapmışsınız. Bir başka deyişle [...] den beri aktif kullanıcısınız.  
 En son aktivasyon (aynı zamanda şifre değiştirme) işlemini [...] tarihinde saat [...] gerçekleştirmişsiniz.  
 Sisteme bundan önce en son [...] saat [...] da [...] numaralı IP adresinden giriş yapmışsınız.  
 Kullanıcı hesabınıza yapılan son başarısız giriş denemesi [...] saat [...] da [...] numaralı IP adresinden yapılmış.

**Önemli Uyarı:** Sakarya Üniversitesi veya bağlı birimleri, telefon veya e-posta yoluyla hiçbir şekilde kullanıcıların e-posta şifrelerini ya da kişisel bilgilerinizi istememektedir.

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Figure 28. WebObis Information Page



SAKARYA UNIVERSİTESİ

WebGate WebMail WebObis WebMenu WebRehber WebForm WebAnket

WebObis

Seçilen Dersler :: Seçtiğiniz derslere ait bilgilere ulaşabilirsiniz

Bilgi  
Bilgi Güncelle  
Ders Programı  
Seçilen Dersler  
Ders İçerikleri  
AKTS Transkript  
Transkript  
Çıkış

Listelenen Ders Adeti : 6

| Kod     | Ders Ad                   | Oğr.Tür | D+U Saat | AKTS | Çalışma                         | Not | Oran | İlan Tarihi |
|---------|---------------------------|---------|----------|------|---------------------------------|-----|------|-------------|
| BTE 301 | İŞLETİM SİSTEMLERİ VE ... | 3       | 4 + 0    | 9    | -                               |     |      |             |
| BTE 305 | UZAKTAN EĞİTİM (B)        | 3       | 3 + 0    | 8    | -                               |     |      |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | Vize                            |     | 24%  |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | Vize                            |     | 24%  |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | Quiz                            |     | 6%   |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | 1. Quiz                         |     | 3%   |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | 2. Quiz                         |     | 3%   |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | Quiz                            |     | 6%   |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | Ödev                            |     | 24%  |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | Performans Görevi (Laboratuvar) |     | 30%  |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | Final                           |     | 40%  |             |
| BTE 307 | ARAŞTIRMA YÖNTEMLERİ (B)  | 3       | 3 + 0    | 5    | Final                           |     | 40%  |             |
| BTE 313 | ALAN SEÇMELİ I (EĞİTİM... | 3       | 3 + 0    | 4    | -                               |     |      |             |
| BTE 325 | ALAN SEÇMELİ II (GRAFI... | 3       | 3 + 0    | 4    | -                               |     |      |             |
| EBB 205 | ÖLÇME VE DEĞERLENDİRME    | 2       | 3 + 0    | 5    | -                               |     |      |             |

Açıklama

- Seçtiğiniz dersleri, bu derslere ait çalışma paylarını, açıklanan sınav sonuçlarını ve kesinleşmiş ders notlarınızı bu sayfadan görüntüleyebilirsiniz.
- Bu sayfada görmüş olduğunuz notlar transkriptiniz ile uyumuyor olabilir. Donemlik notlarınızı dönem sonu itibarı ile transkriptinize aktarılacaktır.

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Figure 29. WebObis Course List Page

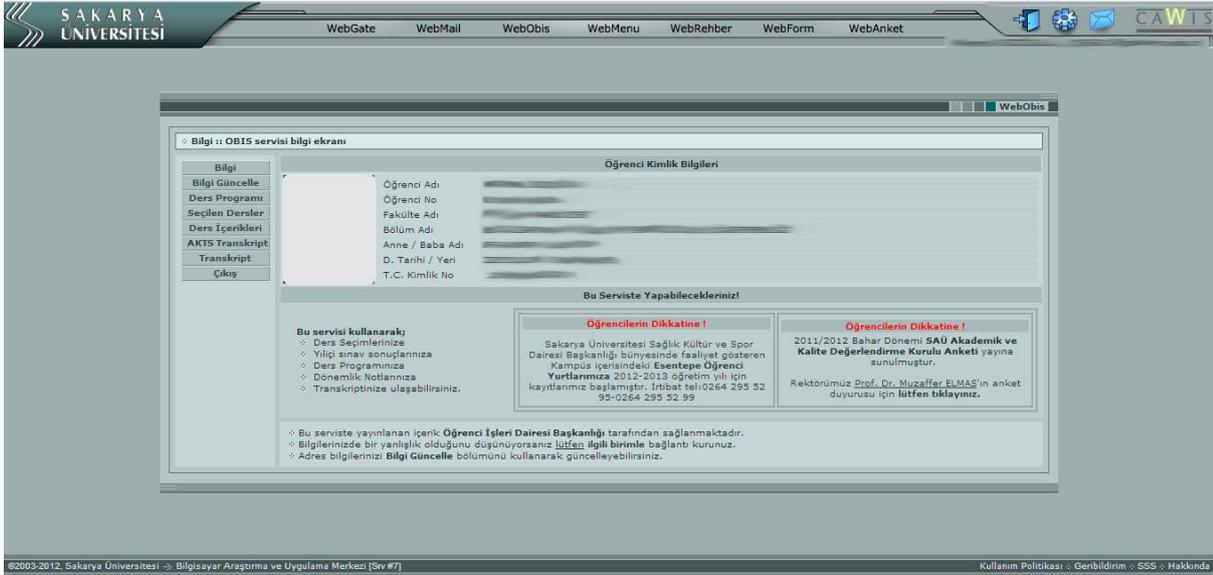


Figure 30. WebObis Student Information Page

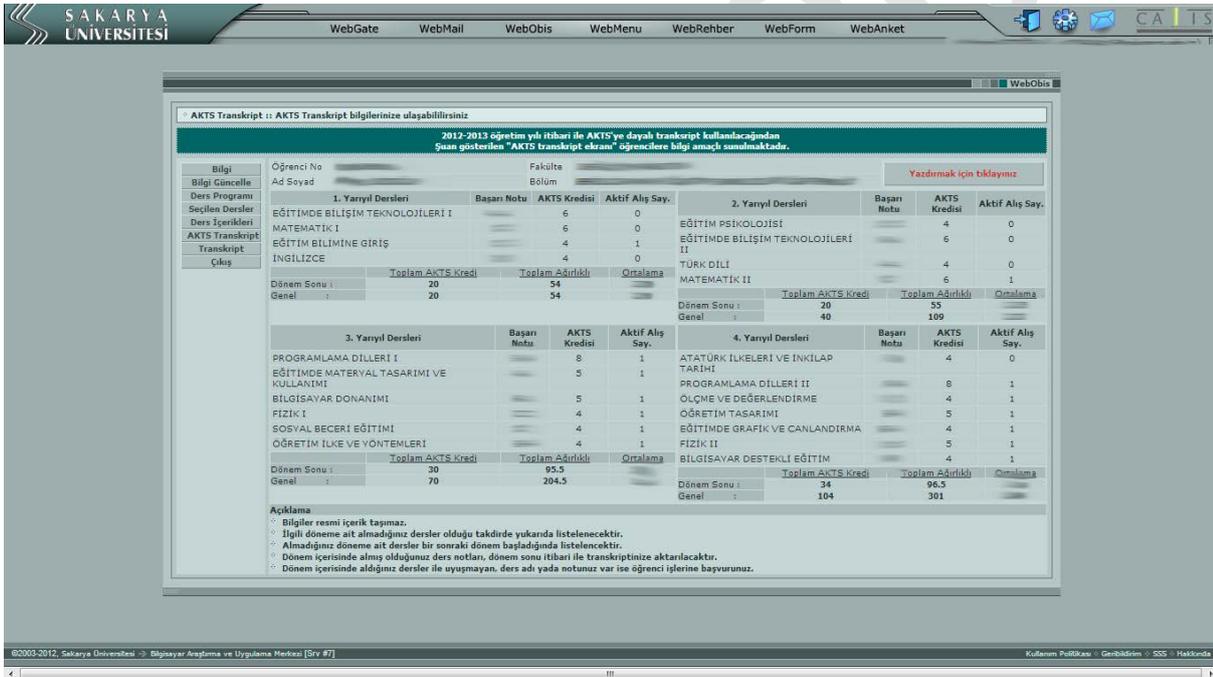


Figure 31. WebObis Transcript Page

**WebAbis** - [ <http://www.abis.sakarya.edu.tr> ]

WebAbis is Academic Information System. From there course selection, giving scores, sharing documents and viewing students lists processes are done.

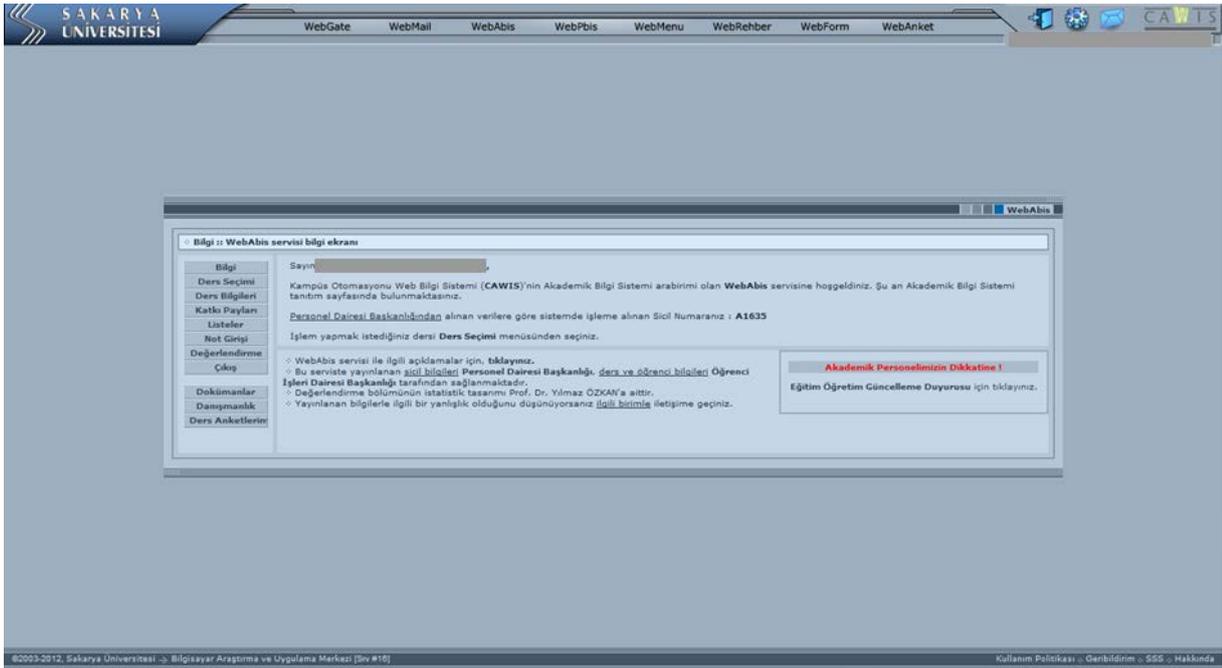


Figure 32. WebAbis Information Page

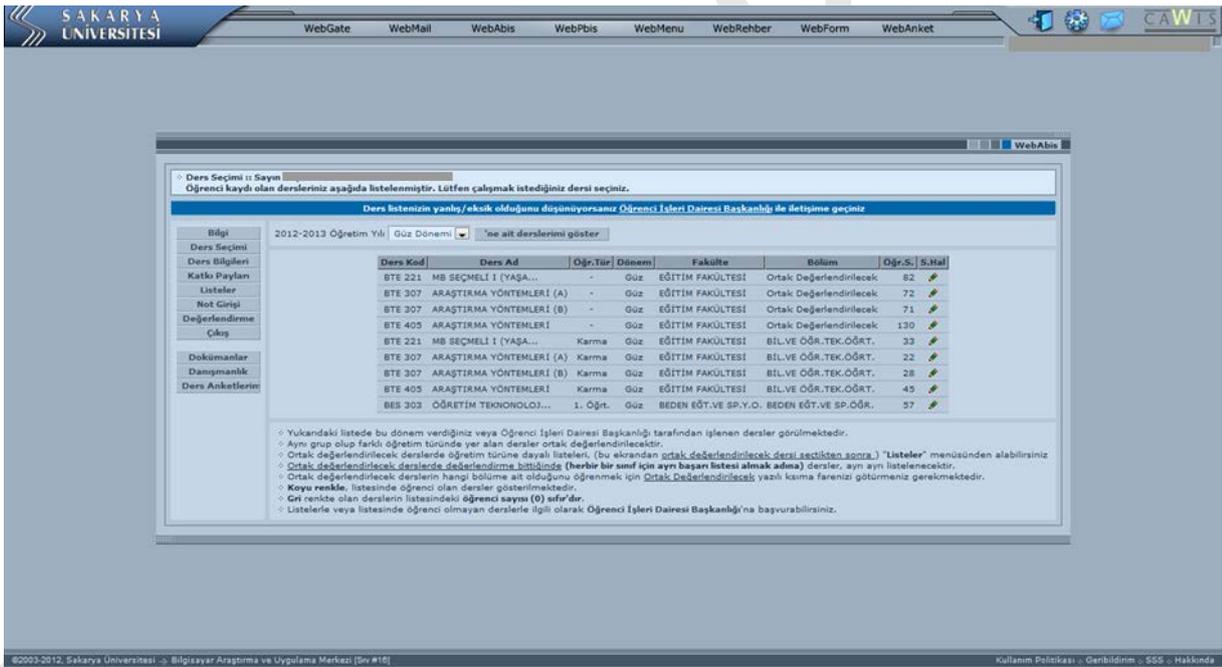
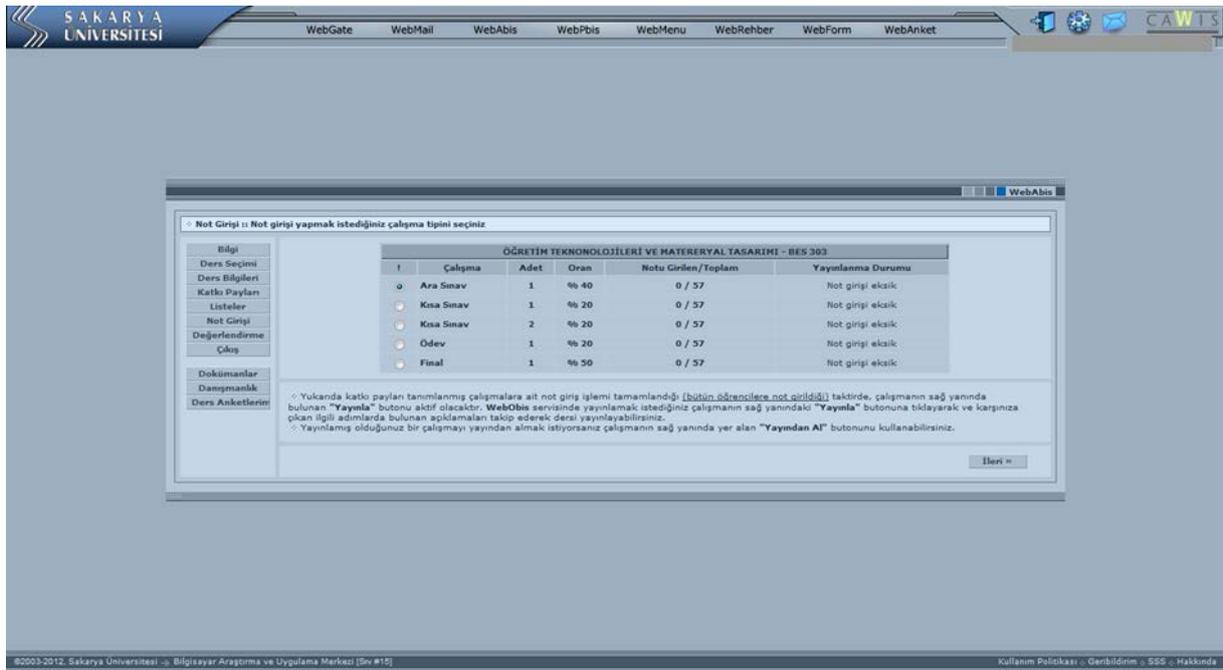


Figure 33. WebAbis Course Selection



SAKARYA UNIVERSİTESİ

WebGate WebMail WebAbis WebPbis WebMenu WebRehber WebForm WebAnket

WebAbis

Not Girişi 1: Not girişi yapmak istediğiniz çalışma tipini seçiniz

Bilgi  
Ders Seçimi  
Ders Bilgileri  
Katkı Payları  
Listeler  
Not Girişi  
Değerlendirme  
Çıkış  
Dokümanlar  
Danışmanlık  
Ders Anketleri

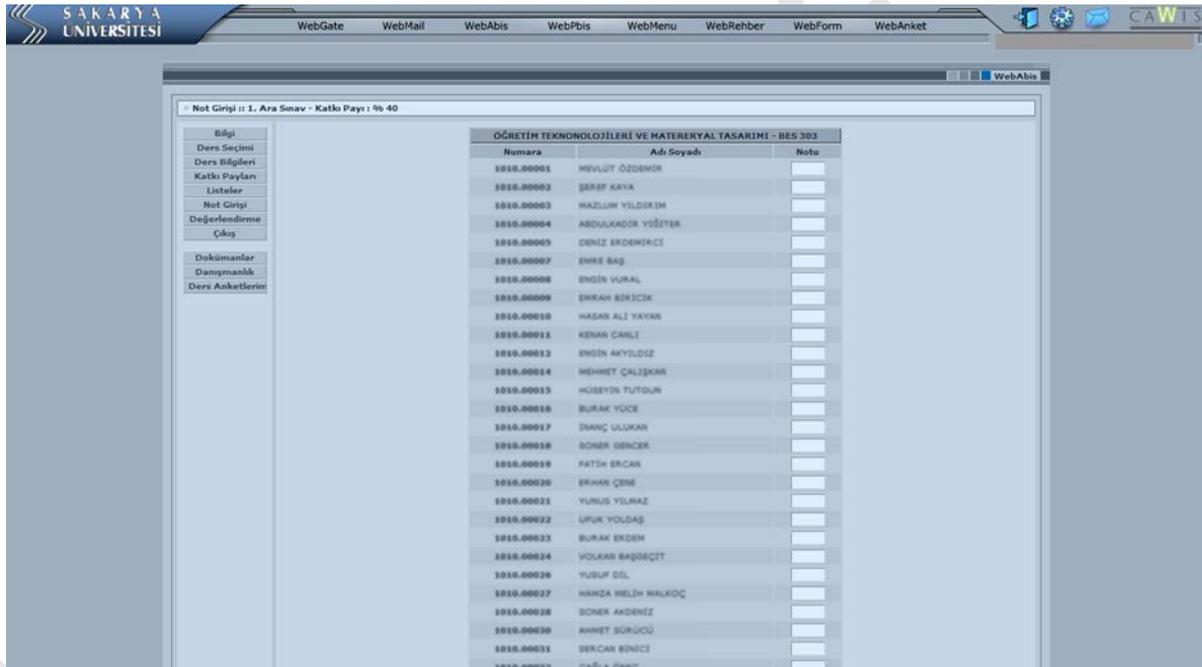
| ÖĞRETİM TEKNOLOJİLERİ VE MATERYAL TASARIMI - BES 303 |            |      |      |                     |                   |
|--|------------|------|------|---------------------|-------------------|
| T  | Çalışma    | Adet | Oran | Notu Girilen/Toplam | Yayınlanma Durumu |
| <input type="radio"/>                                | Ara Sınav  | 1    | % 40 | 0 / 57              | Not girişi eksik  |
| <input type="radio"/>                                | Kısa Sınav | 1    | % 20 | 0 / 57              | Not girişi eksik  |
| <input type="radio"/>                                | Kısa Sınav | 2    | % 20 | 0 / 57              | Not girişi eksik  |
| <input type="radio"/>                                | Ödev       | 1    | % 20 | 0 / 57              | Not girişi eksik  |
| <input type="radio"/>                                | Final      | 1    | % 50 | 0 / 57              | Not girişi eksik  |

Yukarıda katkı payları tanımlanmış çalışmalara ait not girişi işlemi tamamlandı. [\(bütün öğrencilere not girildi\)](#) takdirde, çalışmanın sağ yanında bulunan "Yayınla" butonu aktif olacaktır. WebAbis servisinde yayımlamak istediğiniz çalışmanın sağ yanındaki "Yayınla" butonuna tıklayarak ve karşınıza çıkan ilgili adımlarda bulunan açıklamaları takip ederek dersten yayımlayabilirsiniz.  
Yayımlanmış olduğunuz bir çalışmayı yayından almak istiyorsanız çalışmanın sağ yanında yer alan "Yayından Al" butonunu kullanabilirsiniz.

İleri »

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Figure 34. WebAbis Scores List



SAKARYA UNIVERSİTESİ

WebGate WebMail WebAbis WebPbis WebMenu WebRehber WebForm WebAnket

WebAbis

Not Girişi 1: 1. Ara Sınav - Katkı Payı: % 40

Bilgi  
Ders Seçimi  
Ders Bilgileri  
Katkı Payları  
Listeler  
Not Girişi  
Değerlendirme  
Çıkış  
Dokümanlar  
Danışmanlık  
Ders Anketleri

| ÖĞRETİM TEKNOLOJİLERİ VE MATERYAL TASARIMI - BES 303 |                    |      |
|--|--------------------|------|
| Numara   | Adı Soyadı         | Notu |
| 1010.00001   | MEVLUT ÖZDEMİR     |      |
| 1010.00002   | BERKAY KAYA        |      |
| 1010.00003   | HAZLUM YILDIRIM    |      |
| 1010.00004   | ABDULKADİR YİĞİTER |      |
| 1010.00005   | DENİZ ERDEMİRKEÇİ  |      |
| 1010.00007   | EMRE BAĞ           |      |
| 1010.00008   | ENGİN VURAL        |      |
| 1010.00009   | EMRAH BİRİCİK      |      |
| 1010.00010   | HASAN ALİ YAYAN    |      |
| 1010.00011   | KERAN CANLI        |      |
| 1010.00012   | ENGİN AKYILDIZ     |      |
| 1010.00014   | MEHMET ÇALIŞKAN    |      |
| 1010.00015   | HÜSEYİN TUTULUN    |      |
| 1010.00016   | BURAK YÜCE         |      |
| 1010.00017   | İNANÇ ULUKAN       |      |
| 1010.00018   | SONER GENCER       |      |
| 1010.00019   | FATİH ERCAN        |      |
| 1010.00020   | ERHAN ÇENE         |      |
| 1010.00021   | YURUS YILMAZ       |      |
| 1010.00022   | UFUK YILDAĞ        |      |
| 1010.00023   | BURAK ERDEMİR      |      |
| 1010.00024   | VOLKAN BAĞBOĞAÇI   |      |
| 1010.00026   | YUSUF DEL          |      |
| 1010.00027   | HANZA BELİN HALKOÇ |      |
| 1010.00028   | SONER ANDERİZ      |      |
| 1010.00030   | AHMET SÜRÜCÜ       |      |
| 1010.00031   | SERCAN BİNÖCİ      |      |
| 1010.00032   | ÇAĞLA ÖNÇ          |      |

Figure 35. WebAbis Course Scores Entrance

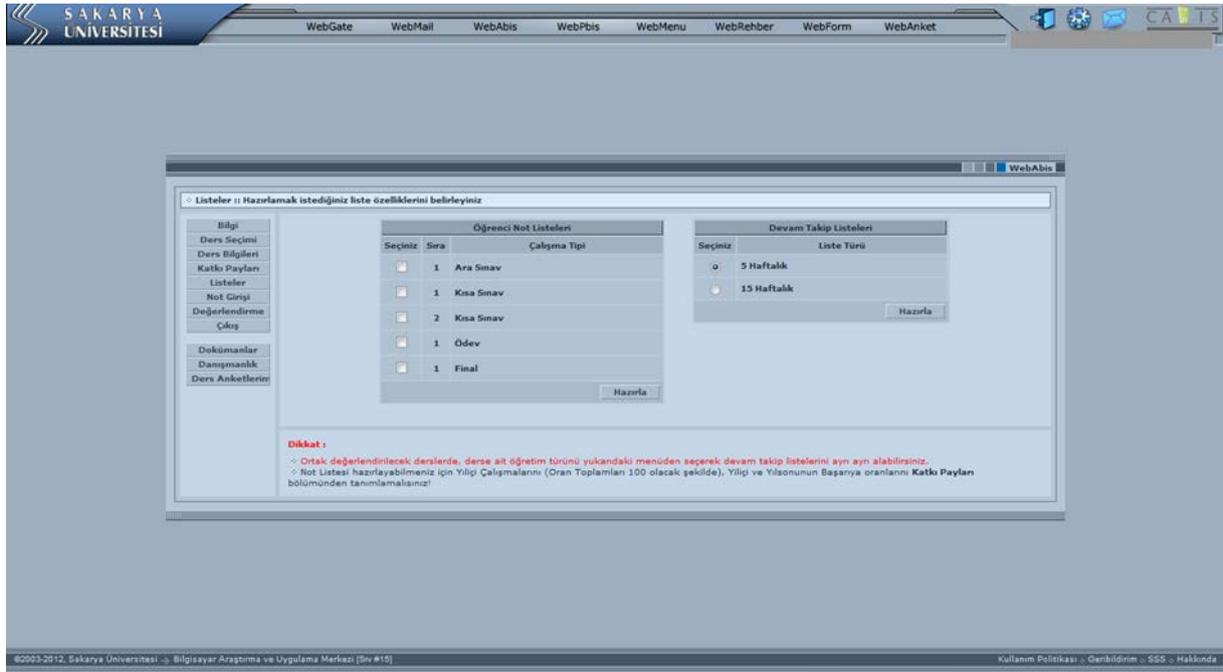


Figure 36. WebAbis Students List Page

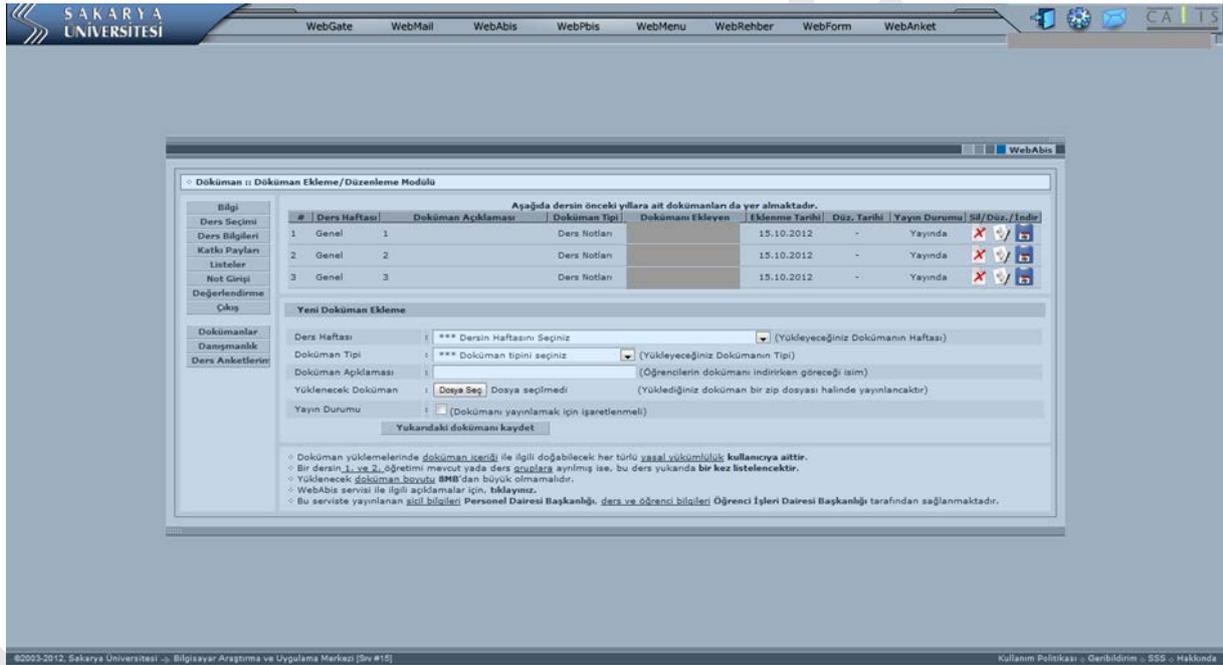


Figure 37. WebAbis Sharing Document

**WebPbis** - [ <http://www.pbis.sakarya.edu.tr> ]

WebPbis is Personal Information System and viewing monthly salary envelope and reports of embezzlement are accessed from this system.



Figure 38. WebPbis Information Page

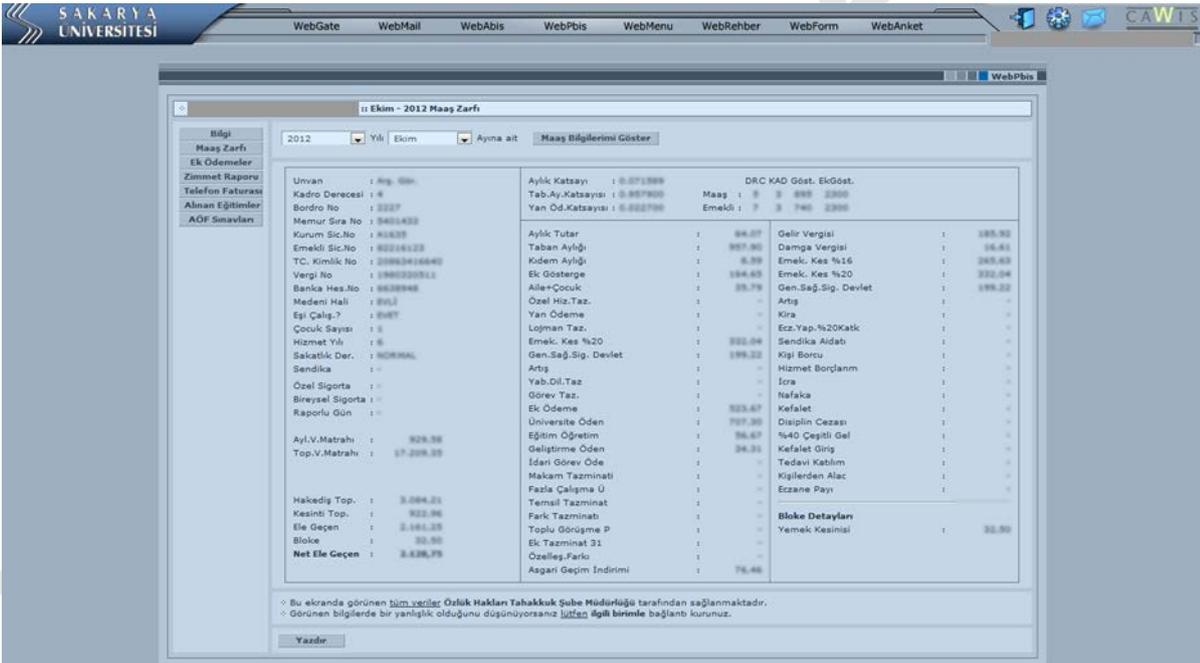


Figure 39. WebPbis Monthly Salary Envelope



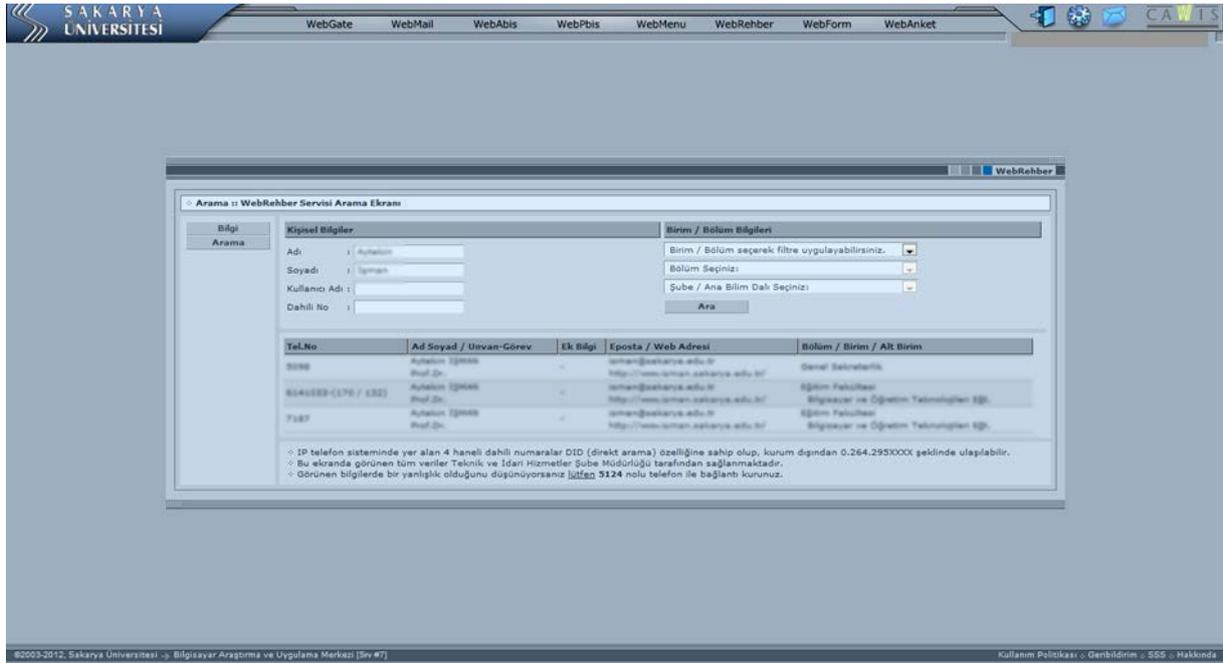


Figure 42. WebRehber Page

### WebForm - [ <http://www.form.sakarya.edu.tr> ]

WebForm is Web-Based Form Submission System and it is submitted desires, wishes and complaints.

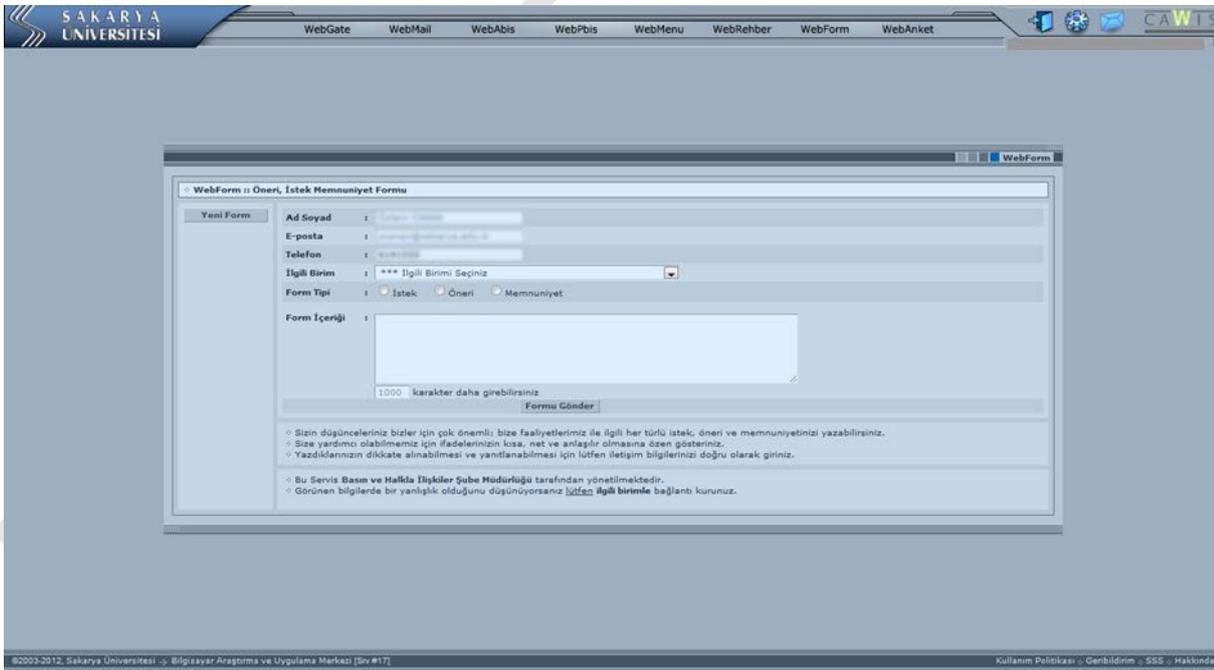


Figure 43. WebForm Page

### WebAnket - [ <http://www.anket.sakarya.edu.tr/> ]

WebAnket is Web-Based Survey Application System.

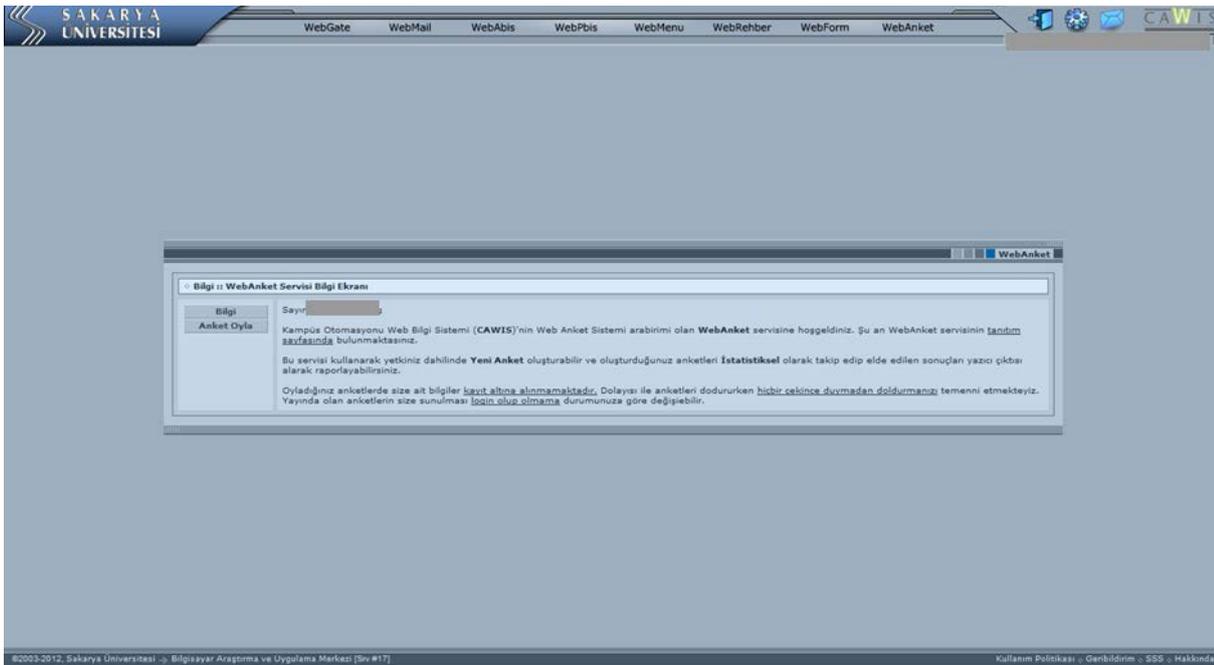


Figure 44. WebAnket Page

## Conclusion

Technologies have powerful affect in our life. Because of the innovation and development of technology, nowadays everybody use these. The place where technologies are effectively used more is universities. Universities apply these technologies in their activities as online performance systems. Sakarya University is one of the university utilize these technologies with different online systems with their all academicians, students and staff.

In this study Sakarya University's four different online system is introduced for details. These systems are Sakarya University Academic Information System, Educational Information System, Strategic Management Information System, Sakarya University Campus Automation Web Information System. These were founded by Sakarya University and now used effectively. These systems give university more power for managing and increasing the performance.

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# SAKARYA ÜNİVERSİTESİNDE YÜKSEK LİSANS-DOKTORA TEZLERİNİN ÜNİVERSİTE-SANAYİ İŞBİRLİĞİ KAPSAMINDA YÜRÜTÜLMESİNE YÖNELİK BİR MODEL ÖNERİSİ

Endüstri Mühendisliği  
Sakarya Üniversitesi  
Sakarya/Türkiye

Harun Taşkın, Berrin Denizhan, Ayten Yılmaz Yalçınır  
[taskin@sakarya.edu.tr](mailto:taskin@sakarya.edu.tr), [denizhan@sakarya.edu.tr](mailto:denizhan@sakarya.edu.tr), [ayteny@sakarya.edu.tr](mailto:ayteny@sakarya.edu.tr)

**Özet:** Üniversite Sanayi İşbirliği, süreç dahilindeki tüm paydaşlar tarafından özenle yürütülmesi gereken bir süreçtir. Bu süreçte üniversitenin, sanayinin ve destek olarak devlet ve toplum bileşenlerinin her biri kendi üzerine düşen görev ve fonksiyonları yerine getirmelidir. Bu çalışmada Sakarya Üniversitesi Fen Bilimleri Enstitüsü doktora ve/yüksek lisans tez çalışmalarının sanayi ile ortak yürütülebilmesine yönelik bir model önerilmektedir. Modelde Sakarya Üniversitesi Fen Bilimleri Enstitüsü bünyesinde yürütülmüş olan doktora tez çalışmaları incelenmiş ve sanayi işbirliği ile gerçekleştirilen tezler analiz edilmiştir. Bu tezlerin analizi ve anahtar kelimeler doğrultusunda tez konularının e-arşivi oluşturulması sağlanmaktadır. Aynı zamanda lisans düzeyinde yürütülen işbirliği çalışmaları da incelenerek ortak, interaktif bir e-platform oluşturulması önerilmiştir. Sakarya Ticaret ve Sanayi Odasına kayıtlı KOBİ'lerin ihtiyaç duyduğu çalışma alanları ile mevcut/önerilecek ortak konularda bu platformda buluşturularak proje olarak sonuçlandırılacaktır. Böylece Doğu Marmara sanayii ve Sakarya Üniversitesi işbirliğini güçlendirmek ve doktora tez çalışmalarına uygulama alanları oluşturmak hedeflenmiştir. Aynı zamanda sanayi ile yürütülen bu işbirliği faaliyetlerine de bilimsel nitelik kazandırarak bilgiyi değerli hale getirmesi beklenmektedir.

**Anahtar kelimeler:** Üniversite- Sanayi işbirliği, Sakarya Üniversitesi örneği, KOBİ'ler

## Sakarya'da Üniversite Sanayi İşbirliği: Mevcut Durum ve Beklentiler

Harun Taşkın, Ayten Yılmaz Yalçiner, Berrin Denizhan  
Sakarya Üniversitesi  
Endüstri Mühendisliği Bölümü  
Sakarya/Türkiye  
taskin, ayteny, denizhan @sakarya.edu.tr

**Özet:** Geçmişten günümüze üniversite sanayi işbirliği (ÜSİ) geliştirilmesi ve yürütülmesi en zor alanlardan biri olarak kabul edilebilir. İşbirliğinin geliştirilmesine yönelik ülke bazında çalışmalar yapılabileceği gibi bölgesel çalışmaların daha etkin çözümler sunacağı düşüncesiyle bu çalışmada Sakarya bölgesi ele alınmıştır. Sakarya Üniversitesi ile Sakarya Sanayisinin işbirliğini güçlendirmek amacıyla daha önce yapılmış olan çalışmalar irdelenerek mevcut durum analizi yapılmıştır. Bu kapsamda Sakarya Üniversitesi tarafından gerçekleştirilmiş olan Üniversite Sanayi İşbirliği Sempozyumları (ÜSİS'07, ÜSİS'09, YAEM'11 de gerçekleştirilen Üniversite Sanayi İşbirliği Paneli)'nda yapılan çalışmalar ve diğer kurum ve kuruluşlar tarafından yapılan çalışmalar ile SATSO'ya ait işbirliği raporları analiz edilmiştir. Sakarya Sanayisinde önemli rolü olan SATSO ve SAÜ Teknopark A.Ş.'nin bu işbirliğine olabilecek katkıları değerlendirilmiştir.

Anahtar Kelimeler: Üniversite-Sanayi İşbirliği, Sakarya Sanayi Bölgesi, Üçlü Sarmal Model

### Giriş

Üniversite-Sanayi İşbirliğinin (ÜSİ) geliştirilmesine yönelik ülke bazında çalışmalar yapılabileceği gibi bölgesel çalışmaların daha etkin çözümler sunacağı düşüncesiyle bu çalışmada Sakarya bölgesi ele alınmıştır. Sakarya Üniversitesi ile Sakarya sanayisinin işbirliğini güçlendirmek amacıyla daha önce yapılmış olan çalışmaları, yapılması planlanan gelecekteki faaliyetleri irdelenerek mevcut durum analizi yapılması hedeflenmiştir.

### Üniversite Sanayi İşbirliği: Genel Bir Bakış

Her türlü ekonomik çıktı, toplumsal fayda, yerel-ulusal kalkınmaya katkılar için, paydaşların birlikte gerçekleştirdiği tüm faaliyetleri ÜSİ faaliyetleri olarak tanımlamak mümkündür.

Günümüzde ülkelerin rekabet güçleri pazarlanabilir mal ve hizmet üretimlerinin ötesinde, bunların ne ölçüde ileri teknolojiye dayalı yüksek katma değer taşıdıklarına bağlı hale gelmiştir. Teknolojinin en temel girdisini oluşturan bilginin temelinde ise bilimsel araştırmalar yatmaktadır. Bilgiye sahip olmak ve bu bilgiyi teknoloji üretimine dönüştürmek, inovasyon yapabilmek için gerek üniversitelere, gerekse sanayiye önemli görevler düşmektedir. Üniversitelerin temel görevi eğitim ve öğretim hizmetidir. Buna ilaveten, üniversitelerin en önemli görevlerinden biri de temel ve uygulamalı alanlarda araştırma yapmaktır. Üniversite sanayi işbirliğinin birinci adımı, endüstrinin ihtiyaç duyduğu alanlarda üniversitelerin eğitim ve öğretime ağırlık vermesi gerekir. Bu durum ancak endüstrinin ihtiyaç duyduğu alanların tespit edilmesi ile mümkündür. Üniversite sanayi işbirliğinin ikinci adımı ise, endüstrinin sorunlarına üniversitelerin yakından ilgi göstererek bu sorunları çözecek çözüm önerileri getirebilmesidir. Endüstrinin mevcut sorunları çözülmeden, ürün geliştirme faaliyetlerinde bulunulması neredeyse imkânsızdır. (USİS07, pp. 321, K. Keleş, M. Karaçor)

Son yıllarda ülkemizde Bilim, Sanayi ve Teknoloji Bakanlığı, Maliye Bakanlığı, Kalkınma Bakanlığı ve Türk Patent Enstitüsü'nün katkılarıyla, Üniversite-Sanayi işbirliğini geliştirerek teknolojinin ticarileşmesi sürecini destekleyecek, akademik araştırmalara lojistik destek sağlayacak mekanizmalar oluşturulmasına yönelik çalışmalar hızlanmıştır. (ÜSİM Zirvesi, 2012)

### ÜSİ'nin Paydaşlar Açısından Gerekliliği

**Üniversite açısından;** üniversite sanayi işbirliği ile sanayinin ihtiyaç duyduğu doğrultuda eğitimine yön vermek ve öğretim elemanlarının kendini yenilemelerine yardımcı olmak, temel bilimlerin geliştirilmesi için

araştırma yaparak, yapılan araştırma sonuçlarını yayınlayıp bilme katkıda bulunmak ve son olarak, öğretim elemanlarının araştırma ve bilimsel çalışma yapmalarına olanak sağlamaktır.

- Güncel eğitim programları, içerikleri
- Öğrencilere staj imkanı
- Daha geniş laboratuvar ve ar-ge imkanları
- Akademik çalışmalar (yayın, proje yapmak)
- Ekonomik katkı
- Araştırmacılara spinoff şirketler kurma imkanı
- Akademisyen haklarını korunması

**Sanayi açısından;** Üniversite sanayi işbirliği sanayi açısından , pazara yönelik teknolojik bilgi ihtiyacının karşılanması, üretim ve uygulamadaki sorunların çözümü ve ürün kalitesinin gelişimi ve pazar payının artırılmasıdır

- Üniversite tarafından sunulan çözümlerle kalite artışı
- Pazara yönelik teknolojik bilgi ihtiyacının karşılanması
- Artan pazar payı, müşteri memnuniyeti, rekabet gücü
- Yeni ürünler, patentler sayesinde artan, değişen, yeni hedef kitle
- Yeni yöntemler, yeni ürünler, yeni teknolojiler ve adaptasyonu
- KOSGEB, TÜBİTAK gibi projelerle maddi destek almak ve aynı zamanda bu projeler sayesinde ortaklıklarla, farklı kuruluşlarla organik ilişkiler kurmak

**Devlet açısından;** Devlet için özellikle ar-ge faaliyetlerinin artması dolayısıyla da yerel ve ulusal kalkınma açısından ciddi bir öneme ve gerekliliğe sahip olduğu ifade edilebilir. Yeni iş imkânlarının ortaya çıkması, istihdam sağlanması gibi kazanımlar nedeniyle devlet için gerekliliği söz konusudur.

- ÜSİ =Ar-Ge = İnovasyon=Yerel/Ulusal Kalkınma
- Patent sayısı-Gelişmişlik düzeyi ilişkisi
- Ekonomik güç
- Evrensel pazarda rekabet edebilirlik
- Refah seviyesi

**Toplum açısından ise;**

- Yeni sanayiler, yeni ürünler sayesinde çalışan sayısında artış-istihdam
- Eğitim seviyesinde artış
- Kültürel, entelektüel birikim
- Refah seviyesinde artış
- Bilinçli çalışan ve iç huzuru gibi kazanımlar nedeniyle ÜSİ'nin gerekliliğinden bahsetmek mümkündür.

## Yaygın ÜSİ Modeli: Üçlü SARMAL MODEL

“Üçlü Sarmal Modeli”, söz konusu aktörlerin inovasyona yönelik kurumsal ilişkilerini, üstlenmeleri gereken işlevi ve bunu ne kadar yerine getirebildiklerini belirlemektedir.

Üçlü sarmal modeli, üç dünyanın üç faktörle temsil edileceklerini öngörmektedir. Aktörler faktörü; akademi, kamu ve iş alemini kapsamaktadır. Kurumsal yapılar aktörünün kapsadığı sistemler; yüksek teknoloji spin-off şirketleri ve risk sermaye yapıları, İnovasyon ara yüzleri (Teknoparklar, Bilim Parkları ve Araştırma Merkezleri), İnovasyon koordinatörleridir. (USIS07, 2007, p.188)



**Sekil 2:** Üçlü sarmal (Triple helix) (USIS07, 2007, p.188)

Ancak, artık günümüzde ÜSİ'ndeki paydaşlar sadece bu 3 aktörle sınırlı değildir. Geleneksel 3'lü sarmal yerine artık; "Üniversite, Sanayi, Devlet-Kamu kurumları, Toplum, Sivil Toplum Örgütleri" gibi çok sayıda alanlardan ve disiplinlerden paydaşların sarmal oluşturması kaçınılmaz hale gelmiştir. Nitekim, tanım olarak artık "disiplinler arası" kavramı da bu kapsamda yerini alacaktır.

## ÜSİ İçin Uygulayıcılar ve Aracı Oluşumlar ve Türkiye'de ÜSİ

Üniversite-Sanayi İşbirliği süreci boyunca çok önemli bir mesele olarak karşılaşılan paydaşlar arası iletişimi kurmada, kuvvetlendirmede ve sürdürmede etkili olabilecek aracı kurum, kuruluş ve kişiler çok önemlidir. Öyle ki sürecin başarısında en etkili faktör olduğu söylenebilir. Ülkemizde bu anlamda destek olan oluşumlara Üniversite-Sanayi İşbirliği Merkezleri, Teknoloji Geliştirme Bölgeleri, Teknoparklar, Teknokentler, Milli Produktivite Merkezi, Teknoloji Transfer Ofisleri, meslek odaları ve benzeri oluşumlar sayılabilir.

Teknoloji Geliştirme Bölgeleri, KOBİ'lere Ar-Ge ve teknoloji anlamında çeşitli imkanlar sunmaktadır. TGB'de teknolojik bilgiyi üretmek, ticarileştirmek, üretim maliyetlerini düşürmek, KOBİ'lerin yeni ve ileri teknolojilere uyumunu sağlamak gibi çalışmalar yapılmaktadır. TGB'ler sahip oldukları özelliklerden dolayı Ulusal İnovasyon Sistemi'nin önemli parçalarından biridir. Ülkemizde bu uygulama yeni olduğu için sonuçların hemen alınmasını beklemek yanlıştır.

MPM, üniversite ile sanayi arasında köprü niteliğinde bir kurumdur. Gerek endüstriyel konularda gerekse de sosyal alanda üniversite-sanayi ve MPM'nin içinde bulunduğu ağlar oluşturulması tarafların tamamı için fayda sağlayacaktır. Bu da nihai olarak ülkenin verimliliğini arttıracaktır.

Türkiye şartlarında üniversite-sanayi işbirliği değerlendirildiğinde, mevcut mekanizmalar aracılığıyla önemli çalışmalar yapmanın hedeflendiği görülmektedir. Türkiye'de üniversite-sanayi işbirliği kapsamında faaliyet gösteren uygulamalar; Teknoloji Geliştirme Bölgeleri, Teknoloji Geliştirme Merkezleri (TEKMER), Duvarsız Teknoloji İnkübatörleri ve Üniversite-Sanayi Ortak Araştırma Merkezleridir. Bu merkezler önemli politika mekanizmaları aracılığı ile işletmelere ulaşmaktadır. Türkiye Teknoloji Geliştirme Vakfı (TTGV), Türkiye Bilimsel ve Teknik Araştırma Kurumu (TÜBİTAK), Küçük ve Orta Ölçekli Sanayi Geliştirme ve Destekleme İdaresi Başkanlığı (KOSGEB) ile Yüksek Öğrenim Kurumu (YÖK) taraflara amaçları doğrultusunda yol göstermekle ve destek vermekle görevlidir. Üniversite-sanayi işbirliğine yönelik yapılan bu çalışmalar içerisinde, 1990'lı yıllardan bu yana hızla yayılan ve gelişen Teknoloji Geliştirme Bölgeleri dikkati çekmektedir.

Türkiye'de üniversite-sanayi işbirliğini sağlamaya yönelik yöntemlere, dünya uygulamalarından gecikmeli olarak, 1990'lı yıllarda ağırlık ve önem verilmeye başlanmıştır. Kamu otoritesi, KOBİ'lerin acımasız rekabet ortamına uyum sağlamasına yardımcı olma ve onları korumaya yönelik politikalar ve politika araçları geliştirme çabası içindedir. Bu çerçevede kurulan Teknoloji Geliştirme Merkezleri (TEKMER), Üniversite-Sanayi Ortak Araştırma Merkezleri (ÜSAM), Teknoloji Geliştirme Merkezleri ve Duvarsız Teknoloji İnkübatörlerinden bahsedilebilir. Bu kuruluşlar bölgesel yenilik sistemlerinin birer parçasıdır. Türkiye'de 6 adet Üniversite Sanayi Araştırma Merkezi (ÜSAM) bulunmaktadır. KOSGEB ile üniversiteler arasında bir protokole göre kurulan Teknoloji Geliştirme Merkezlerinde (TEKMER) yürütülen Ar-Ge projeleri KOSGEB tarafından desteklenmektedir. 1990 yılında kurulan İstanbul Teknik Üniversitesi Teknoloji Geliştirme Merkezi ile uygulamaya konan Teknoloji Geliştirme Merkezlerinden Türkiye'de 18 tane bulunmaktadır.27 Oluşturulan bu merkezler sayesinde işletmelerin dışarıdan elde ettikleri teknolojinin 'örtük bilgi' olarak ifade edilen bölümünün üretimine geçildiğinde dışa bağımlılık azalacak ve kaynaklar yurt içine yönlenecektir. (USİS07, 2007, 188)

Üniversite Sanayi İşbirliği ve rekabet gücünün elde edilmesi ile Ar-Ge faaliyetlerinin çok sıkı bir ilişkisi vardır. Bu nedenle ülkelerin Ar-Ge faaliyetleri, rekabetin sürdürülebilirliği açısından oldukça önemli bir faktördür. Ar-Ge'ye verilen önemin bir göstergesi Ar-Ge harcamalarının GSMH içindeki payını % olarak ifade eden Ar-Ge yoğunluğu'dur. Ar-Ge yoğunluğunun düşüklüğü ilgili ülkenin rekabet şansını gittikçe kaybettiğini gösterir.(USİS09, 2009, p.47)

Türkiye'de ÜSİ bilinci maalesef hala tam olarak yerleşmemiştir ve süreç etkin bir biçimde yürütülememektedir. Bu sürecin zorluklarının çok farklı sebepleri bulunmaktadır. Bunları farklı açılardan değerlendirmek mümkündür:

- Devlet politikaları, teşviklerde belirsizlikler-eksiklikler
- Karşılıklı önyargılar
- Gerçekleşmeye dair inanç ve güven eksikliği
- Yanlış yönlendirmeler
- Ar-Ge için altyapı eksiklikleri
- Motivasyon eksikliği
- Üniversitelerde eğitim odaklı çalışma düzeni, akademisyenlerin sıkıntıları

Bu yaşanan sıkıntılara ve zorluklara rağmen Türkiye'de de başarılı ile yürütülen ÜSİ süreci örnekleri bulunmaktadır. En başlıcaları olarak Adana ÜSAM , Ege Üniversitesi-EBİLTEM, Sabancı Üniversitesi, TOBB ETÜ, İTÜ, ODTÜ örnekleri verilebilir.

Dünyada ise bu anlamda öne çıkan ülkeler arasında İngiltere, Fransa, Japonya, Almanya, ABD, Hindistan, Çin'i saymak yerinde olacaktır.

### Yerel Kalkınma Yaklaşımı ve Sakarya'da ÜSİ

Yerel Kalkınma Yaklaşımı; bölgesel yerli dinamiklerin harekete geçirilerek, yerel topluluk veya bireylerin ekonomik, sosyal ve kültürel alanda kalıcı ve sürekli gelişimini sağlamayı hedeflemektedir. Yerel Kalkınma Yaklaşımı ile bölgesel anlamda yapılacak sürdürülebilir bir kalkınma sistemi oluşturulmaya çalışılmaktadır. Kalıcı Yerel Kalkınma Sisteminde yapılacak çalışmalar bilimsel veriler ile tespit edilmiş, bulunduğu seviye gerçekçi olarak ortaya koyulmuştur.

Ülkelerin kalkınması ve gelişmesinde öncelikli olarak sanayileşmesinin gerektiği, bunun temelinde de bilim ve teknolojinin üretilmesi ve üniversite-sanayi işbirliğinin yer aldığı açık bir şekilde bilinmektedir. Yeniliklere ve teknolojik gelişmelere ayak uydurmak sanayinin gelişmesi açısından son derece önemlidir. Bu amaçla firmaların Araştırma-Geliştirme (Ar-Ge) laboratuvarlarını oluşturarak, bu alanda çalışacak personel tahsisi yapması gereklidir. Üniversiteler yetişmiş elemanları ve bilgi birikimleri sayesinde firmaların Ar-Ge çalışmalarında yer alabilirler. Bu sayede hem üniversitelerin tecrübe ortamı elde etmeleri sağlanmış olur hem de işletmelerin gelişmelerden haberdar olarak yeniliklere ayak uydurmaları kolaylaşır. Üniversite-Sanayi işbirliğinin hızla yaygınlaştığı dünyada, ülkemizin de bu konuda gerekli hassasiyeti göstermesi kaçınılmazdır. (USİS07, 2007, p.273)

ÜSİ-Yerel Kalkınma Yaklaşımı ile üniversitenin teknolojik unsurlarının çevresinde yoğunlaşan işletmelerin endüstriyel ve teknik düzeylerini geliştirmek, rekabet edebilme oranlarını yükseltmek, performanslarını geliştirmek, işletme organizasyonları ve süreçlerini iyileştirmek, üretim ve istihdamın bölgesel düzeyde gelişmesini sağlamak üzere çalışmalar ele alınmaktadır.

Doğu Marmara Bölgesi yurdumuzun sanayi ağırlığının en yoğun bulunduğu endüstri merkezidir. Sakarya ili Avrupa'nın Anadolu'ya açılan kapıları olan önemli iki karayolu ve bir demiryolu bağlantı güzergâhı üzerinde olması ve Türkiye'nin lokomotifi olan İstanbul'a yakınlığı nedeni ile önemli bir potansiyele sahiptir. Yatırımcı için önemli olan bu şartların uygun oluşu yatırımcıyı bu bölgeye çekmekte, bölgede yatırımlar artarak devam etmektedir. Sakarya'da mevcut ve kurulmakta olan organize sanayi bölgeleri ve fabrikalar bu potansiyelin işaretleridir. Türkiye Vagon Sanayi ve Koreli ortağı Eurotem'le başta Marmaray projesinin vagonlarını üreten raylı ulaşım sanayi kuruluşlarını da barındıran Sakarya'da, son yıllarda özellikle otomotiv, tekstil ve gıda sektörlerinde büyük gelişmeler yaşanmaktadır. (Meyok, 2012)

### Sakarya'da ÜSİ Süreci

Sakarya'da ÜSİ sürecine ait gelişim aşağıda maddeler halinde, daha sonra da detayları ile verilmiştir:

- İTÜ-SMF-Koç Holding işbirliği
- Silikon Vadisi Projesi-Teknopark Kurulması hazırlıkları
- Kişisel gayretler
- Sempozyum-Kongre-Çalıştay faaliyetleri
- Teknopark kurulması ve Teknopark faaliyetleri
- Sakarya MYO 3+1 Modeli
- Diğer Faaliyetler

**SAÜ (İTÜ-SMF)-Koç Holding işbirliği:** Sakarya'da üniversite-sanayi işbirliğinin ilk adımı 1987 yılında o zamanki adıyla İstanbul Teknik Üniversitesi-Sakarya Mühendislik Fakültesi ile Koç Holding A.Ş. arasındaki protokol ile atılmıştır. Sakarya Meslek Yüksek Okulu Otomotiv Programı ve Döküm Programı öğrencileri ile Koç Holding'e bağlı Otosan A.Ş., Otoyol A.Ş., Demirdöküm A.Ş., Döktaş A.Ş. de atölye pratik çalışmalarını yaparak becerilerini geliştirmek ve firmaların ara teknik eleman ihtiyacını karşılamaya yönelik olarak yürütülmüştür. Bu süreç, 2000 yılında MEB-YÖK Meslek Yüksekokulları program geliştirme projesi ile sona ermiştir. Bu proje Sakarya Meslek Yüksekokulu otomotiv programı ile Koç Holding'e bağlı otomotiv fabrikalarında uygulanmıştır. Eğitim süresi içerisinde öğrencilere, motor teknolojileri, satış sonrası hizmet, otomotiv tasarım ve imalatı ile oto elektrik ve elektroniği konularında eğitim verilmiştir. Fabrikalarda atölye pratik eğitimini, okulda teorik eğitimini alan öğrenciler mezuniyet sonrası kolaylıkla iş bulma imkânını kazanmış olmaktadır. Böylece sanayicinin ihtiyacı olan nitelikli ara teknik eleman ihtiyacı da karşılanmış olmaktadır. 2000 yılında sona ermiştir. (USİS09, 2009, p.145)

**Silikon Vadisi Projesi-Teknopark Kurulması Hazırlık Aşamaları:** Sakarya Üniversitesi, kurulduğundan sonraki ÜSİ faaliyetlerine teknopark kurulması girişimleri ile devam etmiştir. 2000'li yılların başında Silikon Vadisi Projesi bu kapsamda yürütülmüştür.

Bu süreçler devam ederken, eş zamanlı olarak farklı bölümler ve kişiler aracılığıyla sanayi ile bireysel görüşmeler, yürütülen projeler ve danışmanlık faaliyetleri ile ÜSİ sürecine katkılar sürdürülmüştür.

**ÜSİ Sempozyumları:** İlki 2007 yılında Sakarya Üniversitesi Endüstri Mühendisliği ile Sakarya Sanayi ve Ticaret Odası ile birlikte gerçekleştirilen Üniversite Sanayi İşbirliği Sempozyumu “Yenilik, Patent, Marka ve Rekabet Stratejileri” ana temasında gerçekleştirilmiştir.

Hem sanayi hem de akademik dünyadan özel davetli konuşmacıların bilgi, deneyim ve tecrübelerini paylaştıkları özel oturumlar, fikir tartışmalarının yapıldığı odak grup toplantıları ve bildiri oturumları ile tamamlanan sempozyum neticesinde sonuçların yerel, bölgesel ve ulusal ekonomiye ve böylece küresel ekonomiye pozitif katkı yapması hedeflenmiştir

Toplamda 47 adet bildiri sunumu yapılmış olup, bunlardan 14 tanesi “Üniversite-sanayi işbirliği” anahtar kelimeleri ile yazılmış, diğer bildirimler ise yine ÜSİ ile bağlantılı olarak “rekabet stratejileri, marka-patent, kobi uygulamaları, yenilik” temel başlıklarında sunulmuştur.

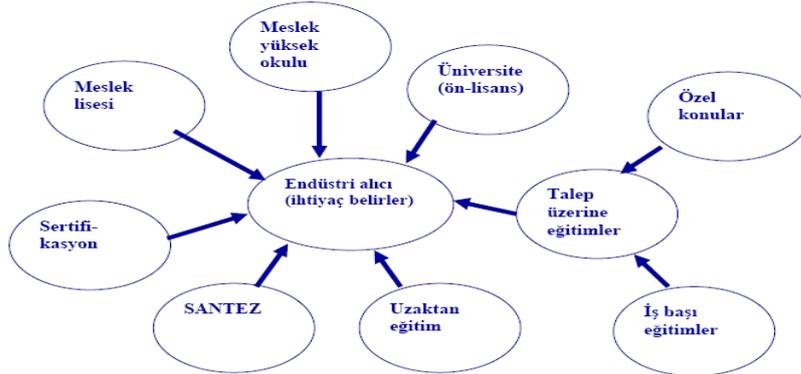
Odak gruplarında temel başlıklar ise, “Sanayi ve Eğitim”, “Teknoparklar”, “Üniversite Sanayi İşbirliği’nde Yeni Açılımlar”dır.

Bu odak grup çalışmaları neticesinde alınan sonuçlar aşağıda kısaca özetlenmiştir;

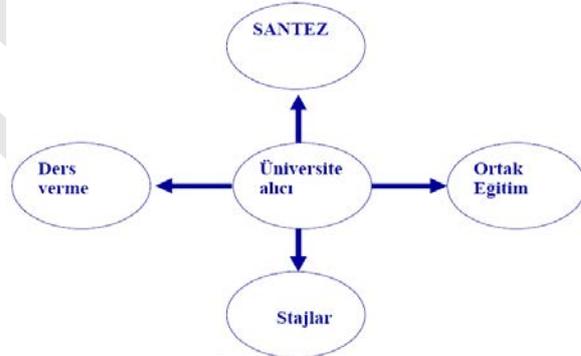
Odak 1 sonucunda;

- Karşılıklı ön yargının bulunması
- Beklentilerin farklı olması:
- Tek taraflı fedakârlık ve O bana önce gelsin beklentisi:
- Mesleki eğitimlerin yetersizliği:
- Meslek kuruluşlarının sahadaki etkinliği:
- İlişkilerin dostluk ve bireysel olgular ile yürütülmesi:
- Stajların yerinde denetlenmemesi:
- Öğrencilerin kurum kültürü ile uyumsuzluğu
- Üniversite ücretlerinin yüksek olması
- Endüstrinin en hızlı şekilde çözüm istemesi:
- SANTEZ uygulamalarının desteklenmemesi/Yeterli ilgi görmemesi:

Bu beyin fırtınası sonucu ortaya çıkan ÜSİ’de alıcı ve verici olma durumu modeli ise Şekil 1 ve Şekil2’de sunulmuştur.



Şekil1: ÜSİ2007 odak grubu sonuç modeli- Endüstrinin alıcı olduğu ÜSİ modeli



Şekil1: ÜSİ2007 odak grubu sonuç modeli- Üniversitenin alıcı olduğu ÜSİ modeli

Üniversitenin Alıcı Olduğu İlişki Modeli: Üniversitenin ihtiyacının karşılanması amacı ile endüstriden destek alması söz konusudur.

Endüstrinin alıcı olduğu ilişki modeli: Endüstrinin alıcı olarak eğitim ihtiyaçlarını ve üniversitelerden ihtiyaçlarını giderdiği modelin elemanları Şekil 1’de gösterilmektedir. Endüstrinin alıcı olduğu durumda kendi ihtiyaçlarını belirlemesi ve bu ihtiyacı karşılamak için üniversitelerden destek alması söz konusudur

Bu destekler şunları içerebilir:

- Meslek lisesi mezunlarını çalıştırabilir.
- Meslek Yüksek Okulu mezunlarını çalıştırabilir.
- Üniversite mezunlarını çalıştırabilir.
- Üniversitenin çalışanlara eğitimler yolu ile sertifikalar vermesini sağlayabilir.
- SANTEZ gibi uygulamalar ile sanayi ihtiyaçları doğrultusunda akademik çalışmaların yapılması söz konusu olabilir.
- Uzaktan eğitim gibi araçlar kullanarak sanayici ve çalışanları kendi buldukları yerlerden ayırmadan ve gerekirse aşamaları uzaktan eğiterek gerekli destek verilebilir. Böylece sanayici ve akademisyen zamanı en verimli şekilde kullanarak karşılıklı ilişkilerini sürdürebilir. Bu ayrıca maliyet etkin bir çözümde olacaktır. Özellikle internet teknolojilerindeki gelişmeler bu alanda önemli katkıların üretilmesini kolaylaştırmaktadır.
- Sanayici kendi ihtiyaçları doğrultusunda eğitim taleplerinde bulunabilir. Üniversite bu talepleri karşılayacak desteği üretir. Bu eğitimler genel olarak şu şekillerde gerçekleştirilir.;
- İş üstünde eğitimler: Çalışanın işini yürütürken ihtiyaçlarının iş üstünde görülerek çözülmesi
- Özel eğitimler: Toplam kalite yönetimi, performans yönetimi vb. gibi özel konularda gerçekleştirilecek olan eğitimler (USİS, 2007)

**ÜSİS’09:** Haziran 2009’da Kocaeli Sanayi Odasında, Sakarya Üniversitesi, Kocaeli Üniversitesi, Sakarya Ticaret ve Sanayi Odası (SATSO) ve Kocaeli Sanayi Odası (KOSANO) işbirliğiyle gerçekleştirilen ÜSİS’09’da ana tema “Kriz Dönemi Stratejileri, Çözüm Yöntemleri ve Teknoparklar” olmuştur.

Sempozyum programı; paneller, başarı öyküleri, özel oturum, odak grupları ve bildiri oturumları başlıkları altında hazırlanmıştır. Panel konuları; ‘Kriz Dönemi Stratejileri’ ve ‘ÜSİ’de Uygulamalar ve Teknoparklar’ olarak seçilmiş ve her biri alanında uzman davetli konuşmacıların katkılarıyla gerçekleştirilmiştir. Özel oturum; ‘Sanayiye Yönelik Uygulamalı Tez ve Proje Programları’ nı esas almıştır. Başarı öyküleri ise; gerçekleştirilmiş üniversite-sanayi işbirliği örneklerini sergilemektedir.

Bildiri oturumlarında sanayiye yönelik akademik çalışmalardan sunumlar gerçekleştirilmiştir. Odak Grupları çalışmaları da değerli akademisyenlerin, sanayicilerin ve kamudan uzmanların beyin fırtınaları neticesinde güzel sonuçlar ortaya çıkarmıştır. Odak grupları; ÜSİ’nin hukuksal, finansal ve stratejik, eğitim-öğretim, insan kaynakları ve teknik sorunlar boyutlarıyla ele alındığı çalışmalar olmuştur.

Odak Grubu 1: Hukuki ve Teknik Boyutuyla Endüstri Mühendisliğinin Sanayide Etkin Kullanımı

Odak Grubu 2: ÜSİ Kapsamında İşletmelerin Karşılaştığı Finansal ve Stratejik Problemler

Odak Grubu 3: ÜSİ’de Eğitim ve Öğretim Modelleri,

Odak Grubu 4: ÜSİ Kapsamında İşletmelerin Karşılaştığı İnsan Kaynağı Problemleri

Odak Grubu 5: ÜSİ Kapsamında İşletmelerin Karşılaştığı Teknik Problemler (USİS, 2009)

**YAEM2011-ÜSİ Paneli:** 2011 yılında Sakarya Üniversitesi’nde gerçekleştirilen Yöneyem Araştırması ve Endüstri Mühendisliği Kongresi’nde panel oturumu olarak “Üniversite Sanayi İşbirliğinde Sektörel Kümelenelemlerin Önemi” ele alınmıştır. Konusunda uzman katılımcılarla ÜSİ kapsamında özellikle Sakarya Bölgesinde kümelenelemlerin önemine değinilmiştir (YAEM’11, 2011)

**SAÜ Teknokent ve Faaliyetleri:** 2009 yılında ÜSİ anlamında en büyük adımlardan bir tanesi olan Sakarya Teknokent kurulmuştur. Sakarya Teknokent’te toplam 25 adet ar-ge firması bulunmaktadır. Bünyesinde yazılım, danışmanlık, internet teknolojileri sunumu, mühendislik, Ar-Ge alanında faaliyet gösteren firmalar bulundurmaktadır. SATSO ile hızlandırılmış faaliyetleri bulunan Teknokent, bu işbirliğinde arayüz olmanın sorumluluğunun farkındadır. (Teknokent, 2012)

**USİPORT Portalı:** Sakarya Teknokent’in başlangıç olarak Bilgisayar ve Bilişim Bilimleri Fakültesi ile başlatmış oldukları proje havuzu sistemidir. Benzer bir uygulama SAÜ FBE enstitüsü tarafından tez havuzu oluşturulması suretiyle tamamlanmıştır. İstenilen anahtar kelimelerle arama yapılarak ilgili lisansüstü tezlerin incelenildiği bir sistem oluşturulmuştur. Sanayi ile üniversitenin ortaklaşa yürüteceği lisansüstü tez çalışmaları için ilk adım olan bu çalışmada web tabanlı bir program sayesinde şimdilik günümüze kadar yürütülmüş olan ve lisansüstü tez çalışmalarının istenilen kriterle aratıldığı bir havuz sistemi bulunmaktadır. Fakat ilerleyen günlerde bu sisteme yapılacak olan ilavelerle olası uygulamalı yüksek lisans tez çalışmaları için de bir altyapı oluşturulacaktır. Bu çalışma ayrı bir çalışma olarak bu kongrede sunulacaktır.

**ÜSİ İçin Gerçekleştirilen Diğer Faaliyetler:** Bu başlık altında SAÜ, SAÜ Teknokent, SATSO aracılığıyla gerçekleştirilen farklı faaliyetlere değinilmiştir.

**SAÜ Bilgisayar Mühendisliği Bölümü ile Ford-Otosan Anlaşması- Kazan-Kazan-Kazan modeli:** Üniversite-sanayi işbirliğindeki sorunları çözebilecek bir model, 2008 yılında Bilgisayar Mühendisliği Bölümü ile Ford Otosan arasında Sakarya Üniversitesi'nde Yazılım Ofisi'nde uygulanmaya başlanmıştır. Üniversite-Sanayi İşbirliği 3 Kazan modelinin esas işbirliğini oluşturan 3 tarafın da (üniversite-öğrenciler ve sanayi) kazanç elde etmesidir. Sanayi tarafını temsil eden Ford Otosan "Düşük maliyetle ve yüksek verimlilikle şirket uygulama yazılımları geliştirme ve şirket standartlarına göre eğitilmiş, proje deneyimi kazanmış öğrencilerden mezuniyet sonrası eleman seçerek işe alma imkanı", elde etmekte, üniversite tarafını oluşturan Sakarya Üniversitesi Bilgisayar Mühendisliği Bölümü "Öğrencilerine henüz öğretim sırasında ve üniversite ortamının içinde gerçek sanayi projelerinde çalışma imkanı sağlamış olmak ve mezunlarının çabuk ve nitelikli işler bulma olasılığını yükseltmek" avantajına sahip olmakta ve öğrenciler de "Henüz öğrenciyken ciddi sanayi projelerinde çalışarak deneyim kazanma, eksik bilgilerini tamamlama, mesleklerinde erken ilerleme imkanı ve üniversite ortamında sigortalı ve maaşlı bir işte çalışarak kazanç sağlama imkanı" kazanmaktadırlar. Sakarya Üniversitesi-Ford Otosan arasında 3 yıldır uygulanan model ve etkileri açısından bir yenilik niteliğinde olup, üçlü bir "kazan-kazan-kazan" ortamı yaratmaktadır. (Kocacıbağ ve Çetintaş,2011)

**SAÜ-Sakarya Meslek Yüksek Okulu 3+1 Modeli:** Sakarya Üniversitesi ile SATSO arasında yapılan işbirliği protokolü ile Meslek Yüksekokulu öğrencileri, eğitimleri süresince kazandıkları bilgi ve deneyimlerini, "Mesleki Uygulamalar" dersi adı altında kamu/özel kurum ve kuruluşlarda uygulamalı eğitimle pekiştirme imkânı bulacaktır. Eğitim Öğretim dönemi içinde yapılacak olan mesleki uygulama eğitimi, akademik takvime uygun olarak 3. veya 4. dönem süresince 16 hafta ve tam zamanlı olarak yapılacaktır. (Sakarya, 2012). Sakarya Üniversitesi'nde öğrenim gören öğrencilerin bilgilerini pratikte de artırmaları ve istihdam edildiklerinde nitelikli eleman olmaları amacıyla imzalanan protokolün esaslarına göre, Üniversite-sanayi İşbirliği çerçevesinde Sakarya Üniversitesi Meslek Yüksekokullarında Eğitim-Öğretim gören öğrencilerin Sakarya Ticaret ve Sanayi Odasına bağlı işletmelerde bir dönem süreyle gerçekleştirilecek pratik eğitim ve çalışmaları" sağlanması mümkün kılınacaktır. (SATSO, 2012)

**Otomotiv çalıştay- Kümelenme faaliyetleri:** SAÜ- SATSO Otomotiv çalıştayı ile kümelenme ve üniversite sanayi işbirliği konuları önemi dikkat çekmiştir. Sakarya'nın gelişen sanayisi ve bulunduğu coğrafik konum nedeniyle bir sektörel kümelenme ile yerel ve ulusal kalkınmaya katkıları ele alınmıştır. Bu açılımda üniversite ile yapılacak işbirlikleri de tekrar gündeme getirilmiştir.

**Stratejik Planlama Faaliyetleri:** SAÜ ile Sakarya yerel yönetiminin ortaklaşa gerçekleştirdiği Stratejik Plan Oluşturma süreçleri de işbirliği anlamında söylenebilecek faaliyetlerdendir.

**SAGİEP:** SAÜ ile SATSO arasında üniversite-sanayi işbirliği çerçevesinde imzalan Sakarya İhracatını Geliştirme Projesi (SAİGEP) protokolüdür. İhracatı Geliştirme Etüd Merkezi (İGEME) tarafından uluslararası rekabetçiliğin geliştirilmesinin desteklenmesi hakkındaki tebliğ çerçevesinde kabul edilen ilk proje olmuştur İlk olarak makine ve metal imalat sektörüne yönelik uygulanacak SAİGEP projesi ile Sakarya'nın ihracatçı iller sıralamasında ilk 5 il içinde yer alması hedeflenmektedir. (SAGİEP, 2012)

ÜSİ kapsamında yürütülen faaliyetlerden sonuncusu da SAÜ Teknokent, Sakarya Üniversitesi, SATSO aracılığı ile 4 Aralık 2012'de Üniversite Sanayi İşbirliği Merkezleri Platformu' nun (ÜSİMP) katılımlarıyla gerçekleştirilen "*Üniversite Sanayi İşbirliği Süreçlerinde Karşılaşılan Darboğazlar*" konulu paneldir. Konusunda uzman akademisyenler ve sanayicilerin bir araya geldiği panelde Sakarya için rehber olabilecek nitelikte sunumlar gerçekleştirilmiştir.

Hem SATSO üyelerinden hem de akademik dünyadan değerli katılımcılarla gerçekleştirilen bu panelin neticesinde;

- Sakarya adına güzel adımlar atıldığı, daha güzel gelişmelerin gerçekleşmesi için bu tarz çalışmaların artırılması gerektiği
- Akademik dünyanın ve sanayinin birbirlerine yapabileceklerini, yeteneklerini, marifetlerini bir arayüz aracılığıyla anlatılması gerektiği, bu arayüzün ortak dili çok iyi konuşabilmesi ve anlayabilmesi gerektiği
- Akademik dünyada yayın hazırlama ağırlıklı bir yönlenme olduğu ve fakat bilimsel yayında artık bir doyuma olduğu ve teknoloji, işbirliği, patent, toplumsal yarar gibi hedef göstermelerin yapılmadığı ve bunların büyük eksiklik olduğu
- Bürokrasinin azaltılarak süreçlerdeki hızlanmanın sağlanması gerektiği
- Sakarya'nın coğrafik pozisyonu gereği ve karayollarının, limanların bulunması nedeniyle aslında çok avantajlı ve elverişli bir durumda bulunduğu, bunun değerlendirilmesi gerektiği
- Sanayinin üniversitelerde artık somut bir şeyler beklediği ve buna göre hareket edilmesi gerektiği, sanayiye bilmedikleri şeylerden aktarım yapılması gerektiğini
- YÖK yasaının tekrar ele alınması gerektiği, döner sermaye, laboratuvar ve cihaz kullanılmaya dair problemlerin aşılması gerektiği,
- Öğretim üyesinin sanayi açısından bir oryantasyondan geçmesi gerektiği, işbirliği kültürünün tam oturması gerektiği,

- Sanayinin hangi vasıflarda eleman ihtiyacı olduğunu üniversiteye bildirmesi gerektiği ve üniversitelerin de bunlara göre içerik, program belirlemesi gerektiği
- **Uzanma-kucaklaşma** mantığında bir yaklaşımın faydalı olacağı, üniversite, iş alemi ve topluma uzanma durumunda, iş alemi ve kamu, üniversiteleri kucaklama durumundaki bir modelin etkili olabileceği
- İşbirliği süreçlerinde bölgesel sorunların belirlenip, bu sorunların hangi yaklaşımlarla çözümlenebileceğinin ortaya konulması gerektiği,
- Yerel ihtiyaçlara ve yerel gündemlere göre farklı karar mekanizmalarına göre hareket edilmesi gerektiği
- Özellikle aracı olacak ekibin profesyonel olması, sabırlı, bilinçli ve inatçı olması gerektiği
- Ortak hedef belirlenmesi gerektiği, sonra buna göre stratejiler geliştirilmesi gerektiği ve özellikle üst yönetimin taraf olduğu kazan-kazan modelinde bir işbirliğinin gerçekleştirilmesi gerektiği sonuçlarına varılmıştır.

ÜSİ anlamında Sakarya'da faal olan bir diğer topluluk ise, üniversite bünyesinde kurulan, ÜSİ öğrenci topluluğudur.

## Sonuç

Tüm bu yapılan ve yapılması planlanan faaliyetler neticesinde açıkça söylenebilir ki Sakarya'da üniversite sanayi işbirliğinin önemi anlaşılmış ve bu işbirliğini daha etkin kılmak, mevcut durumundan daha ileriye götürmek için tüm paydaşlar, daha bilinçli bir şekilde katkılarını ortaya koymaya çalışmaktadır.

Ayrıca Sakarya için ÜSİ sürecinin daha başarılı sonuçlar verebilmesi için üniversitelerde özellikle lisans üstü programlarda uygulamalı tez çalışmalarının sayısının artırılması önemlidir. Bunun için de ortak bir web portalı kurularak, oluşturulacak veritabanı ve ihtiyaç-öneri havuzu aracılığı ile etkin bir sisteminin kurulması faydalı olacaktır. Ayrıca şehir genelinde belirlenecek lokomotif sektör seçimine göre üniversite teknik alt yapısının, laboratuvar donanımlarının yoğunlaştırılması, elemanların da bu hedefe göre eğitimlerinin düzenlenmesi ihtiyaca yönelik eleman yetiştirme imkanını sunacaktır. Bu da sanayiye yönelik gerçekleştirilecek ar-ge faaliyetlerinin hız alması beklenebilir.

Önerilecek diğer bir anahtar ise, üniversite içerisinde tüm paydaşlardan (kamu, sanayi, akademik dünya, iş dünyası, sivil toplumdan) kişilerin bulunduğu karşılıklı işbirliği faaliyetlerini yönlendirmek, hızlandırmak ve gerektiğinde müdahale etmek için "Endüstriyel İlişkiler Ofisi"nin kurulmasıdır. Ortak bir web portalı sadece Sakarya şehri için değil genel anlamda Türkiye'de ÜSİ için ısrarla tekrar edilecek konular ise, akademik yükselme ve atanma kriterlerinde işbirliği faaliyetlerinin de puanlandırmada esas alınması, teşvik edici başka maddeler eklenmesi, döner sermaye yasalarının değişmesi ve aracı kurum oluşumunun desteklenmesidir.

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# SAKLI MARKOV MODELİ İLE SES TANIMA KULLANILARAK BİLGİSAYAR KULLANIMI

Beyza Eken, M. Ali Öz, Serap Kazan, Gülizar Çit  
Bilgisayar Mühendisliği Bölümü,  
Bilgisayar ve Bilişim Bilimleri Fakültesi  
Sakarya Üniversitesi  
Türkiye

beken@sakarya.edu.tr, alioz12@gmail.com, scakar@sakarya.edu.tr, gulizar@sakarya.edu.tr

**Özet:** Bilgisayar yazılım ve donanım teknolojilerinin gelişimi ile bilgisayar kullanımı günlük yaşantımızın vazgeçilmez bir parçası olmuştur. İnsanlar günlük işlerini vücut hareketleri ve konuşma ile gerçekleştirirken bilgisayarlarda veri girişi için yaygın olarak klavye ve fare gibi giriş aygıtları kullanılmaktadır. Kullanıcılar bilgisayarlara da el, kol hareketleri ve sesle kullanmak istemektedirler. Bu çalışmada, insanlar için en doğal iletişim yöntemi olan konuşma ile bilgisayarın kontrolünü ve konuşma ile yazı yazımını sağlayan bir yazılım sistemi gerçekleştirilmiştir. Geliştirilen sistem üç ana modülden oluşmaktadır. Modüller sırası ile ses tanıma, Windows işletim sistemi pencere ve dosya yönetimi ve yazı yazma modülleridir. Sistem arayüzü C# programlama dili ile gerçekleştirilmiştir, ses tanıma ve sınıflandırmada Saklı Markov Modeli araç kiti kullanılmıştır. Geliştirilen sistem, engelli bireyler başta olmak üzere, tüm bilgisayar kullanıcıları için bilgisayar kullanımını kolaylaştıracaktır

**Anahtar kelimeler:** Saklı markov modeli, ses tanıma, ses ile bilgisayar kontrolü.

## Control the computer with speech recognition using hidden markov models

**Abstract:** With the growing software and hardware technologies, computers have become an indispensable part of our daily lives. People carry out their daily tasks using gestures and speech, when using computer input devices such as keyboard and mouse are usually needed for data entry. Users also want to use computers with gestures and speech. In this work, a software system has been developed that provides the user to control the computer using speech which is most natural communication method for people and provide translating speech to text. The developed system consist of three main modules, these are respectively speech recognition, Windows operating system file and window management, speech to text modules. System has been developed using C# programming language, Hidden Markov Model Toolkit (HTK) is used for speech recognition. Developed system will facilitate the use of computers for people especially people with disabilities.

**Key words:** Hidden markov model, speech recognition, control computer with speech recognition.

### Giriş

Bilgisayar yazılım ve donanım teknolojisi hayatımızın bir parçası haline gelmiştir. İşyerinde, evde sokakta sürekli bilgisayar kullanılmaktadır. İnsanlar günlük işlerini vücut hareketleri ve konuşma ile gerçekleştirirken bilgisayarlarda veri girişi için yaygın olarak klavye ve fare gibi giriş aygıtları kullanılmaktadır. Bilgisayarın standart giriş birimleri masaüstü bilgisayarlar için geliştirilmiştir ve yeni bilgisayar kullanımı alışkanlıklarına cevap veremez duruma gelmiştir (Sturman and Zelter, 2007, Oz and Ming, 2011). Kullanıcılar yürürken, otobüsteyken, dinlenirken kullandıkları bilgisayarları da standart giriş birimleri yerine el, kol hareketleri ve sesle kullanmak istemektedirler. Bu isteklerden doğan, kullanıcı ile bilgisayar sistemleri arasında doğal bir etkileşim ve iletişimi hedefleyen doğal kullanıcı arabirimi tasarlama günümüzde popüler araştırma konularından biridir.

Günümüzde oyun konsolları başta olmak üzere birçok bilgisayar sistemde bilgisayar görmesi ve ses tanıma sistemleri vasıtasıyla çalışan doğal kullanıcı arabirimleri geliştirilmiştir. Microsoft Kinect (Windows ve Xbox), Playstation hareket(move) kontrolör vb. sistemleri örnek verebiliriz. Bu ve benzeri sistemler sayesinde günümüzde sesle, el kol hareketleriyle bilgisayar ve elektronik aygıtlar kolaylıkla kullanılabilir.

Ses ile ilgili çalışmalar sırayla ses sentezleme, ses sinyali işleme ve konuşma tanıma üzerine yoğunlaşmıştır (Juang, Rabiner, 2005). Ses sentezleme için sırasıyla mekanik, elektro-mekanik ve elektronik sistemler kullanılmıştır

(Juang, Rabiner, 2005). Ses sinyali işleme tarihsel sırasıyla zaman boyutunda, frekans boyutunda ve keprtral özelliklerin elde edilmesi ile ilgilenmiştir. Konuşma tanıma konusunda ise tarihsel olarak şablon karşılaştırma, örüntü tanıma ve istatistikî modellerle ilgilenilmiştir (Furui, 2005, Anusuya, Katti, 2009). Çoğu ses tanıma sistemlerinde diğer yöntemlere nazaran daha iyi performans göstermesi sebebiyle saklı markov modelleri kullanılmakla (Rabiner, 1989, Niesler, 1997) birlikte, yapay sinir ağları, bulanık mantık ve diğer istatistiksel yöntemler de kullanılmıştır.

Bu çalışmada hedeflenen ise sözlü komutlar ile bilgisayar kontrolünün kolaylaştırılmasıdır. Ses ile Windows işletim sisteminde pencere yönetimi, programları çalıştırma, yazı yazma gibi işlemlerin gerçekleştirilebildiği bir yazılım sistemi gerçekleştirilmiştir. Ses tanıma modülünün gerçekleştirilmesinde Saklı Markov Modeli araç kiti kullanılmıştır.

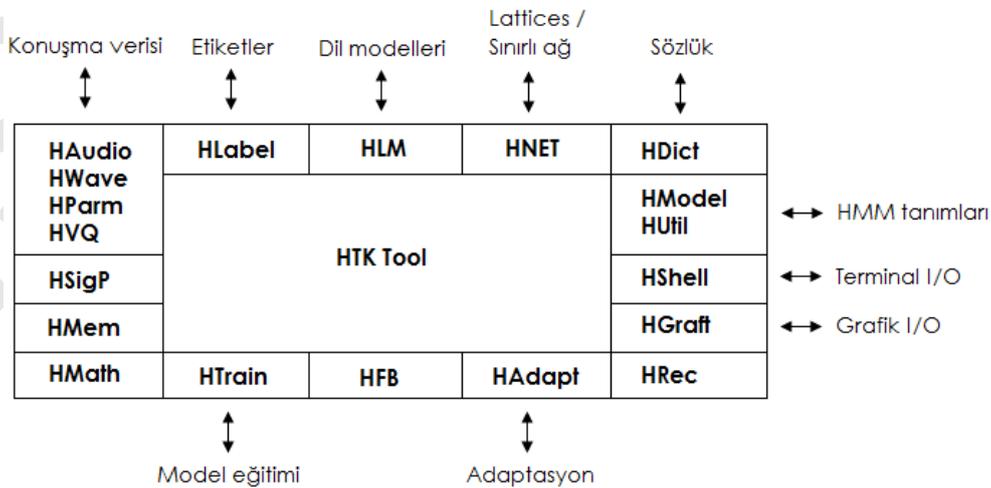
## Saklı Markov Modeli ile Ses Tanıma

Geliştirilen sistem üç ana modülden oluşmaktadır. Modüller sırası ile ses tanıma, Windows işletim sistemi pencere ve dosya yönetimi ve yazı yazma modülleridir. Program C# programlama dili ile gerçekleştirilmiş ses tanıma ve sınıflandırmada Saklı Markov Modeli araç kiti kullanılmıştır. Saklı markov modelleri stokastik prosesleri modelleyebilen sonlu durum ağlarıdır. Sahip olduğu zengin matematiksel yapısı ve ses sinyalini stokastik bir proses olarak iyi ifade edebildiği için 1958-90 yıllarında sesli ifade tanıma çok kullanılan bir yöntem olmuştur (Naik, 1989, Zheng, Yuan, 1988). Sesli ifade tanıma kullanılması kısaca, ardışık kısa süreli sesli ifade kesimlerinin birlikte ele alınması ile ardi ardına gelebilecek bu kesimler için bir model oluşturmak ve bu modelden yararlanarak uzun süreli sesli ifadelerin tanınmasıdır (Rabiner, 1989).

Markov işlemi kesikli bir t zamanındaki N tane durumdan biridir, birinci dereceden bir markov işleminde sistemin şu anki durumu sadece bir önceki durumuna bağlıdır, durumlar arasında zamandan bağımsız durum geçiş olasılıkları tanımlanabilir. Herhangi bir durum tarafından üretilen çıktı gözlem olarak adlandırılır. Eğer durum dizisi doğrudan gözlenemiyorsa buna saklı markov modeli denir. Saklı olan durumlara gözlemlerden dolayı olarak varılması söz konusudur. Sesli ifade tanıma bağlamında gözlemler akustik verilerden elde edilen özellik vektörleridir, SMM durumları ise temel alınan sesli ifade birimlerine (Ör: kelimeler, fonemler vb.) denk gelmektedir. Amaç saklı olan durum dizisini gözlemlerden yararlanarak bulmaktır, yani tanınması gereken ses sinyalinin akustik verilerinden yararlanarak ait olduğu durumun (kelimenin) bulunmasıdır.

Çalışmanın ana kısmını, ses verilerinin tanınması oluşturmaktadır. Konuşma tanıma sistemimizin alt yapısında Cambridge Üniversitesinde geliştirilen “Hidden Markov Model Toolkit” (HTK) adlı bir araç kiti kullanılmıştır (<http://htk.eng.cam.ac.uk>). Bu yazılım aracı ile konuşma tanıma işlemleri için gerekli işlevler (özellik çıkarımı, eğitim, tanıma, değerlendirme) yerine getirilebilmektedir. HTK, çok sayıda projede kullanılmış, başarılı sonuçlar elde edilmiş ve açık kaynak koduna sahip bir araçtır.

HTK işlevselliği yüksek kütüphane modüllerinden oluşmaktadır. Bu modüller, tüm araçların aynı şekilde dış dünyayla kesişmesini sağlar. Bunlar ayrıca ortaklaşa kullanılan işlevlerin merkez kaynağını oluşturur. Kullanıcı, girdi/çıkı ve işletim sistemiyle etkileşim, kütüphane modülü “HSHELL” tarafından kontrol edilir ve hafıza yönetiminin tümü “HMEM” tarafından kontrol edilir. Matematik desteğini “HMATH” sağlar ve konuşma analizi için gerekli sinyal işleme işlemleri “HSIGP” dedir. HTK’ in gerektirdiği dosya türlerinin tümünün kesişme modülü vardır. “HLABEL” etiketlendirme dosyaları, “HLM” dil modeli dosyaları, “HNET” ağlar, “HDICT” sözlükler, “HVQ”, “VQ” kod kitapları ve “HMODEL” SMM tanımları için kesişme sağlar (Young, Evermann, Kershaw, Moore, Odell, ve diğerleri, 2002). Şekil 1 de HTK yazılım mimarisi verilmiştir.



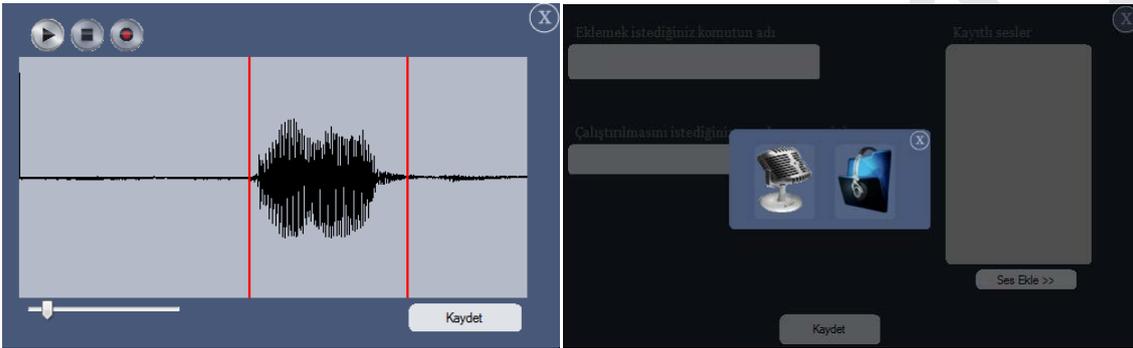
Şekil 1: HTK yazılım mimarisi

## Sistemin Çalışması

SMM' leri oluşturmak için çok sayıda konuşma verisi dosyası ve bunlarla ilgili dönüşümler gereklidir. Çoğunlukla konuşma verileri veri tabanı arşivlerinden elde edilir. Eğitimde kullanılmadan önce bunlar uygun parametrik forma dönüştürülür ve ilgili dönüşümlerle bu formatta hazırlanır ve gerekli sözcük adları kullanılır. Konuşmanın kaydedilmesi gerekirse "HSLab" aracı hem konuşmanın kaydedilmesi hem gerekli dönüşümlerle işaretlenmesi için kullanılabilir.

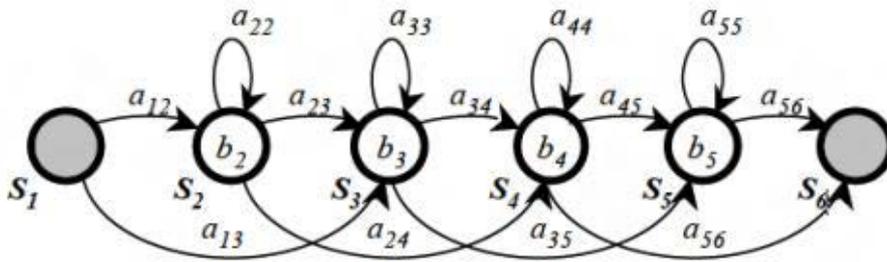
Sistemin çalışmasında temel kısım seslerin elde edilmesi ve etiketlenmesidir. Ses tanımda ana işlemler sırası ile, sözlükteki her kelime için bir kaç kez ses kaydı ve etiket dosyaları oluşturularak eğitim veritabanı oluşturulması, eğitimde kullanılan ses dalgalarının akustik analizlerinin yapılması ve katsayı vektörleri çıkarılarak akustik analiz gerçekleştirilmesi, sözlükteki her akustik öge için bir saklı markov modeli tanımlanması, elde edilen modellerin eğitilmesi, gramer tanımlamalarının ve performans testlerinin yapılmasıdır.

Eğitim verilerinin oluşturulması için C# programlama dili kullanılarak bir arayüz geliştirilmiştir. Bu arayüz ile veri elde etme ve eğitim/test veritabanı hazırlama kolaylaştırılmıştır. Belirlenen her komut için 10 adet ses verisi eklenmiş ve etiketlenmiştir. Ses girişi arayüz ile mikrofondan alınabileceği gibi mevcuttaki kayıtlı dosyadan da alınmaktadır. Şekil 2 de ses veri girişi ekranı verilmiştir.



Şekil 2: Ses kayıt aşaması ve etiketleme ekranları

HTK ses dosyalarını direk işleyemeyeceği için ses dosyalarının akustik özellikleri çıkarılır. Ses sinyali tipik olarak 20-40ms uzunluğunda, birbiriyle örtüşen ardışık çerçevelere ayrılır. Her bir çerçeve pencereleme fonksiyonu ile çarpılır. Her bir pencerelenmiş çerçeveden akustik katsayılar vektörü çıkarılır. Her akustik öge SMM ile modellenir. Bu model altı adet durum içerir fakat bu durumların sadece dördü (S2, S3, S4, S5) "aktif" durumdur. İlk ve son durumlar (S1 ve S6) sadece HTK tarafından bazı uygulama kolaylıkları için kullanılır.  $\square$  gözlem fonksiyonlarını,  $\square\square$  durumlar arası geçiş olasılıklarını temsil eder. SMM için belirlenen topoloji Şekil 3 deki gibidir.



Şekil 3: Saklı markov modeli için belirlenen topoloji

Daha sonra sözdizimsel kurallara göre dilbilgisi tanımlanır. Tanımlanan dilbilgisindeki tüm değişkenler (Ör: kelimeler) ile bir sözlük dosyası oluşturulur. Oluşturulan dilbilgisi ve sözlük bilgileri kullanılarak HTK yardımıyla görev ağ dosyası oluşturulur.

Kullanıcının konuşmasının tanınması aşamasında önce giriş olarak verilen ses sinyali akustik vektör dizisine dönüştürülerek saklanır ve eğitim amaçlı girilen ses verilerine ait modellerdeki eşleşen durumlar gözlemlenerek, sözlük

ve görev ađ dosyası yardımıyla karşılık geldiđi sesli komut bulunur, daha sonra veri tabanında karşılığı olan komut bulunarak yürütülür.

Geliştirilen uygulamada üç ana işlev yürütülmektedir. Birincisi uygulamaları (.exe dosyalarını) çalıştırmak, ikincisi metin yazdırmak, üçüncüsü ise klavye kısayolları ile yapabilecek işlemleri gerçekleştirmek. Şekil 4 de programın arayüz ve Şekil 5 de kısayol tanımlama ekranı verilmiştir.



Şekil 4: Program arayüzü



Şekil 5: Kısayol tanımlama ekranı

## Sonuçlar ve Öneriler

Bu çalışmada, başta Windows işletim sistemi dosya yönetimi olmak üzere yazı yazma ve bilgisayarı sesle yönetme yazılımı geliştirilmiştir. Sistem kayıtlı ses dosyalarını işleyebildiđi gibi, bilgisayara bađlı dâhili veya harici mikrofon dan gelen verileri de işlemektedir. Geliştirilen sistem saklı markov modeli araç kitini kullanmaktadır. Sisteme komut ve kelime eklemeleri yapılarak genişletilebilmektedir. Örnek sayısı artıka sistemin başarısı artmakta ve sistem gerçek zamanlı olarak çalışmaktadır.

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## “SCOREA” - ONLINE TUTORING PROGRAMME IN MALAYSIA

Husaina Banu Kenayathulla  
Mojgan Afshari  
Norlidah Alias  
Muhammad Faizal A. Ghani  
Mohammed Sani Bin Ibrahim  
[husaina@um.edu.my](mailto:husaina@um.edu.my)  
[afsharimojgan@gmail.com](mailto:afsharimojgan@gmail.com)  
[drnorlidah@um.edu.my](mailto:drnorlidah@um.edu.my)  
[mdfaizal@um.edu.my](mailto:mdfaizal@um.edu.my)  
[mohammedsani@um.edu.my](mailto:mohammedsani@um.edu.my)

Department of Educational Management, Planning and policy  
Faculty of Education, University of Malaya

**Abstract:** In many societies, parents are willing to provide additional resources to ensure that their children excel in their education. An example of such an investment is private tutoring, which has increasingly become an important component of educational investments. Unlike other countries that have attempted to ban private tutoring, it is legally allowed in Malaysia. “ScoreA” is an online tutoring programme that is endorsed by the Malaysian Ministry of Education. This is a fully interactive programme to help students prepare for the examinations and equips the younger generation with knowledge and skills in information technology. This paper describes the features of ScoreA programme as an online tutoring tool in education.

**Keywords:** online tutoring; impact on education; Malaysia

### Introduction

In many parts of the world, households are willing to spend a great deal for private tutoring. For instance, in Korea, household expenditures for private tutoring amounted to 2.9 percent of GDP in 1998 (Kim and Lee, 2001). Similarly, in Turkey, households spent more than 1.4 percent of GDP for private tutoring (Tansel and Bircan, 2006). Likewise in Singapore, households spent about S\$820 million (US\$680 million) on center and home-based private tutoring in 2008. This was an increase from the S\$470 million a decade earlier (Basu 2010). Private tutoring is often seen as an additional investment for their children’s education. Private tutoring is commonly defined as additional coaching in academic subjects that is given to students outside school hours for a fee (Foondun, 2006).

In Malaysia, private tutoring is becoming a common phenomenon. It is used not only for remedial purpose but it is often used to boost the performance of students who are already well-performing. Though parents do not have any strong evidence of the effectiveness of tutoring, there is a strong shared belief in the efficacy of tutoring. Tan (2011) surveyed 1,600 students in eight schools in Selangor and Kuala Lumpur and found that 88.0% had received tutoring during their primary schooling.

Unlike other countries in the world (such as South Korea and Mauritius) that have attempted to ban private tutoring on the premise that it fosters social inequalities, it is legally allowed in Malaysia. The Malaysian government has adopted a moderate approach to monitor and control the quality of private tutoring (Kenayathulla, 2012).

There are various forms of face-to-face tutoring: individualized, small group and large group tutoring. The payment differs according to the type of tutoring and the place of tutoring. If the tutoring is conducted in the student’s home, the fees will be higher since it includes tutor’s travelling fees. Another type of tutoring that is becoming famous is online tutoring. Such tutoring may be conducted live, using Skype and other softwares, or it may be in the form of self-service lessons. Online tutoring is not bounded by geographic locations. The tutors and their clients may be in different countries or even continents. For example, TutorVista, a new age consumer Internet company in education services space caters to over 20,000 students in US and UK and employs over 3000 tutors across India (Blakely 2007; Venture and Jang, 2010). Tutor Vista offers its services at US\$2.50 per hour of tutoring for a student opting for 2 hours a day and 5 days a week. The online tutoring is considered much cheaper compared to face-to-face tutoring. For instance, the typical face-to-face tutoring in the US is US\$100 per hour and online tutoring is US\$40 (which is offered in US) (Vora and Dewan, 2009).

In Malaysia, ScoreA programme was launched on the 3rd March 2006 by the former Malaysia’s Minister of Education, Dato Sri Hishammuddin Bin Tun Hussein. ScoreA programme is a fully interactive programme based on the official

government syllabus that helps students to learn at their own pace. It emphasizes both input and output based learning. The latest innovation is the i-teacher. The students are given option to choose their intelligent Avator. The i-teacher will help them to answer the questions. In addition, there are interactive diagrams, comprehensive notes as well as notes in the form of power points (KISB, 2012).

Previous studies both in Malaysia and international literature mainly focus on face-to-face tutoring. Not many studies have examined the online tutoring services and its impact on students learning. This paper describes the features of Scores A programme in Malaysia as the online tutoring tool.

## Literature Review on the effect of tutoring

There have been variations in the results of studies that focus on the effects of private tutoring on students' academic achievement. For instance, in Vietnam, Ha and Harpham (2005) find that attending private tutoring does not result in significant increases in 8-year-old children's writing and numeracy test scores; however, it doubles those same children's reading test scores. On the other hand, a seminal study in Singapore finds that private tutoring has a negative effect on secondary students' grades (Cheo and Quah, 2005). The authors claim that such a finding might be due to excessive studying in Singapore, which might result in diminishing returns.

The results from these two studies should be interpreted with caution as these studies did not explicitly test for the possible endogeneity of private tutoring. If unobserved factors, such as parental taste, concern for their children's education and students' motivation for studies, are not controlled in regression analysis, they will contribute to the error term, rendering inconsistent parameter estimates (Dang and Rogers, 2008; Ireson, 2004).

After controlling for community and school characteristics, Dang (2007) finds that for both primary and lower secondary students in Vietnam, higher spending on private tutoring decreased the probability that students performance would be in either the poor or average categories but increased the probability that the students would be in either good or excellent academic rankings.

Kuan (2011) examined the impact of private tutoring on mathematics achievement of 10,013 grade 9 students in Taipei, China. After controlling for students' socio-economic status, ability, and attitude, he found that student who had attended tutoring were more achieving and from higher social classes. But the gains in achievements were small. Bray (2012) contends that in this study, tutoring is treated as a single variable, and distinction was not made between one-to-one tutoring and large classes. In addition, he argues that the data that is used in that study was limited to a single semester of grade 9, and this prevents long term inferences.

On the other hand, studies have shown that supplemental tutoring programs can be effective at increasing academic achievement, especially for low income students and low achieving students (Zosky and Crawford, 2003). A report from the National Longitudinal Study of No Child Left Behind (2007) finds that, on average, across the seven districts examined, the average effect of supplemental education services in both reading and math are positive and statistically significant. The report also states that students participating in supplemental education for multiple years experienced gains twice as large as those experienced by students participating for a single year. In terms of specific subgroup populations, African-American students, Hispanic students, and students with disabilities also experienced positive gains in achievements (Zimmer et al, 2007).

## Online tutoring

Traditionally, tutoring is conducted in face-to-face settings in which the tutor and tutee meet at a specified place and time. However, with the advancement in communication and technology, and the increase in access to the internet, it is possible for tutoring to be conducted via the internet (Fleisher, 2006). In this case, tutoring is not limited to a particular place or time. The tutor can be any expert with online connections. Although both face-to-face and online tutoring enables interaction between the tutor and the tutee, online tutoring allows partial anonymity in communication.

Online tutoring supports both synchronous (real time) and asynchronous (delayed) communication. However, the nature of interactions and the type of instructor support permitted by those environments differ. In a synchronous environment, real-time interaction allows the simulation of a real classroom learning situation and immediate, interactive clarification of meaning (Goodyear, Jones, Asenio, Hodgson and Steeples, 2005). In contrast, asynchronous communication requires that the sender wait for a response in a time delayed fashion. Although there is ample research on face-to-face tutoring environments, research on online tutoring especially at the school level is scarce.

One key study examined the effect of online-tutoring (Kersent, Dogbey, Barber and Kephart, 2011) on college algebra students' outcome (achievement, attitude and retention). Students in the experimental groups were provided access to online tutoring unlike the students in the control group. Collected data included algebra content knowledge test, attitude survey, online tutoring logs, and retention data. The findings indicated that content knowledge gain scores of students in the experimental group who used the online tutoring service (*E-Users*) were significantly higher than the students in the experimental who did not use the service (*E-Non-Users*). *E-Users* reported better attitudes about help seeking than *E-Non-Users*. The findings suggest that more students in the experimental group persisted and remained in the course than the students in the control group.

## The features of ScoreA programme

ScoreA programme consists of various interactive features that helps to enhance students' understanding. It is expected that online tutoring such as ScoreA can help students who are weak and motivate them to study at their own pace. ScoreA programme is considered cheap compared to face-to-face tutoring. For a student in Malaysia, the charge is about RM66 per month for a family with two children. This is much cheaper compared to fees for a typical face-to-face tutoring which is RM50 per hour for each child (KISB, 2012).

ScoreA consists of various online evaluation mechanisms. **eTopic** is a revision module that allows students to do short regular exercises and provides instant Output Learning to assess a student's understanding of a particular topic taught in school. With eTopic, answers are corrected instantly to allow the student to learn from their mistakes. Each question allows the student four attempts to find the right answer. When the wrong answer is selected, the student will be informed instantly, thus the student is forced to re-read the question before his or her 2nd, 3rd or 4th attempt. This instills the habit of reading the question carefully and understanding it before attempting an answer. Parents will be able to monitor their children's academic progress and identify their children's strength and weaknesses so that timely measures can be taken to correct any shortcomings (KISB, 2012) (Appendix 1)

**eAssessment™** allows students to perform exercises as needed and provides instant Output Learning to assess children's understanding of a particular subject taught in school. Children can select a subject at any one time and instantly find out if they have understood what they have learnt and review their understanding of that subject. Parents will be able to identify their child's strength and weaknesses so that timely measures can be taken to correct any shortcomings before the actual examinations (KISB, 2012) (Appendix 2).

**ePastYearExam** consists of 13 years past examination questions for centralized examinations at the primary (UPSR), lower secondary (PMR) and secondary (SPM) level. This type of questions provides students the opportunity to practise on actual past years' examination papers. Students are trained to answer the questions within the allocated time (KISB, 2012) (Appendix 3).

**eTrial Exam™** module is designed to simulate actual exam environment for UPSR, PMR and SPM. It further enhances children's exam readiness. This module will train children to complete the questions under exam pressure and within the limited time. Students will have to submit it for correction or grading after they have completed it. The grading is instant (KISB, 2012)(Appendix 4)

**eProgress** is a monitoring chart that allows parents keep track of their children's performances on eTopic. This feature is an effective monitoring tool that is designed to keep parents informed of their children's work schedule; ensuring parents that their children eTopic exercises are done and completed accordingly. Parents would be updated on the number of attempts their children has done on each topic, thus specifically emphasizing the "difficult topics" faced by their children. This information will help parents identify specific topics in a subject that their children have difficulties in, instead of generalising weaknesses by subjects (KISB, 2012) (Appendix 5).

**eReport Card™** records all your children's output learning sessions, be it eAssessment or eTrial Exam. This feature gives parents unprecedented 1st hand knowledge of their children's strong and weak subjects. It records and displays their children's average scores for each subject for that month (KISB, 2012) (Appendix 6).

## Conclusion

According to the latest Malaysian Educational Blueprint 2013-2025, the Malaysian education system needs to be transformed to prepare future generations that fit the needs of the 21<sup>st</sup> century. A key component of this blueprint is to maximise the usage of Information, Communication and Technology (ICT) to scale up quality learning across Malaysia (MOE, 2012). However, it is important to conduct further studies to analyze the impact of ScoreA programme on academic achievement. Such investment is worthwhile if it results in positive effect on academic outcome. Another

issue that needs to be addressed is equity aspect. Students from lower income households might not have internet access at their home and might not be able to benefit from such program. Thus, it is essential for the Malaysian government to sponsor such program at school so that all the children regardless of their socio-economic background have equal opportunity for quality education.

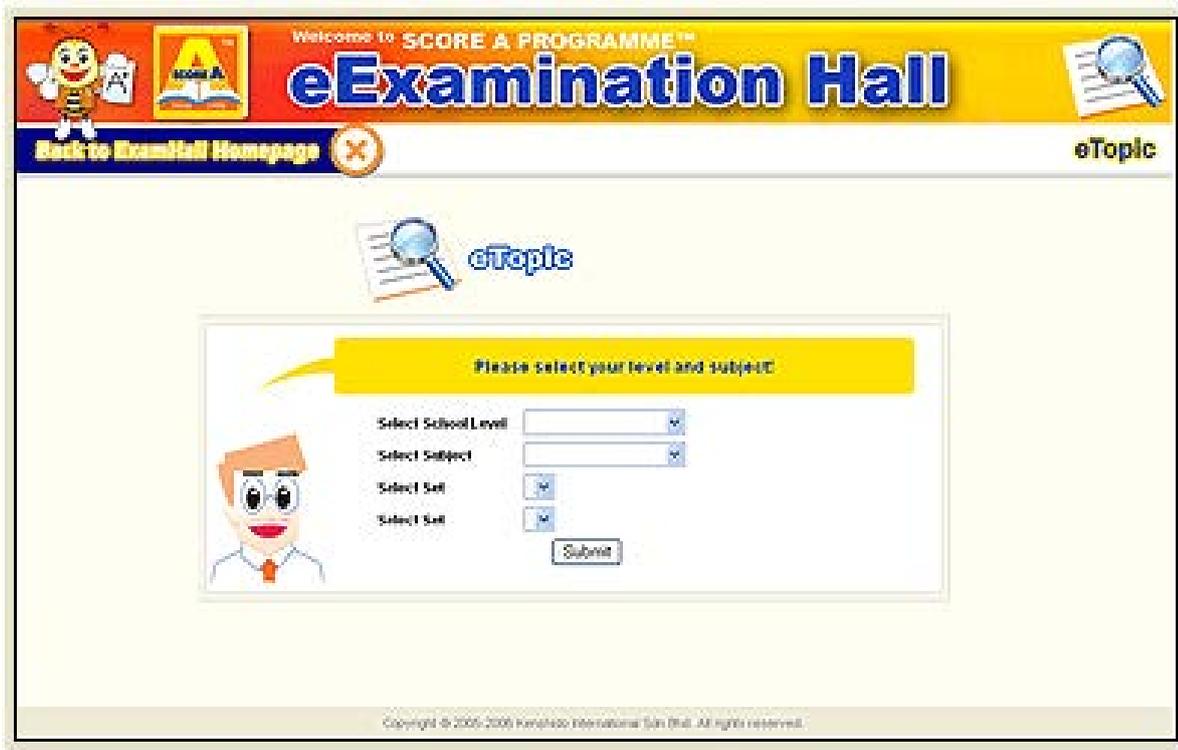
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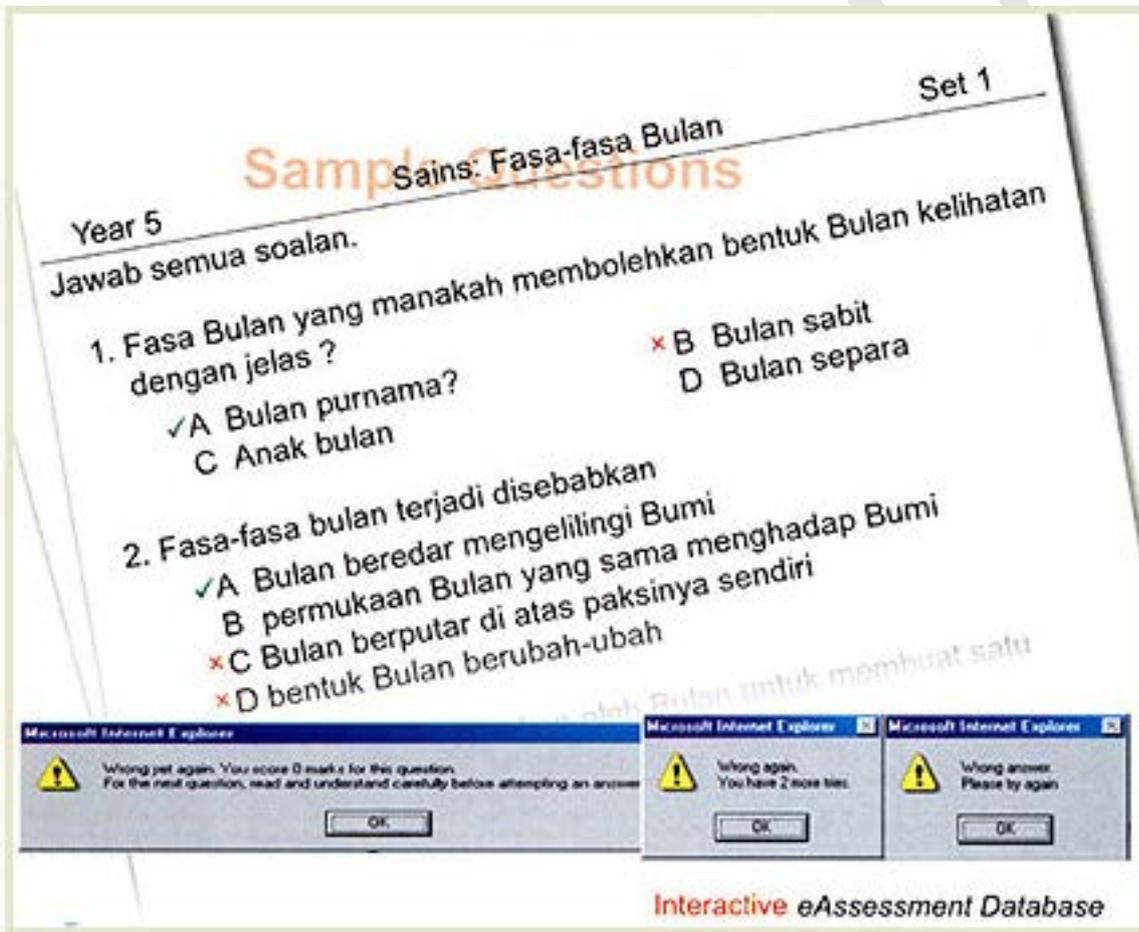
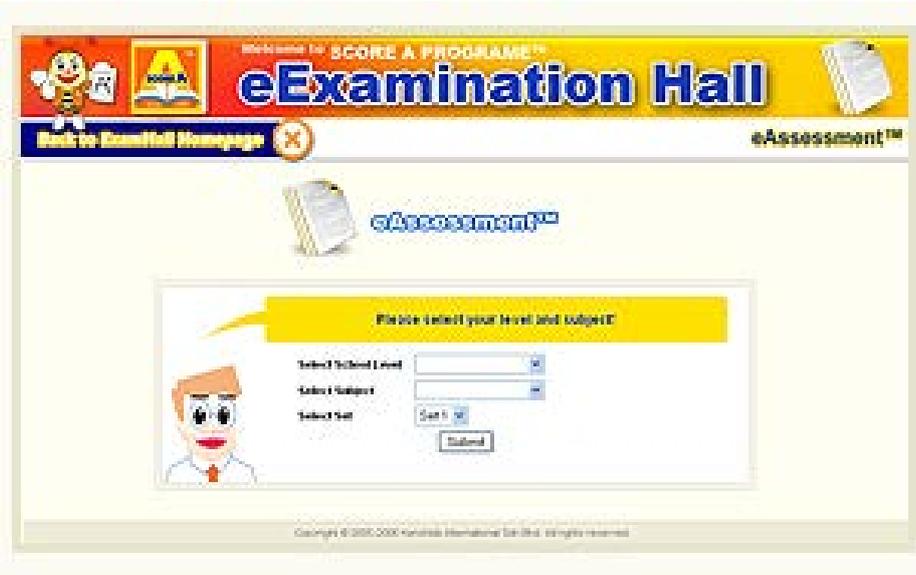
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Appendix 1: eTopic



Source: KISB(2012)

Appendix 2: eAssessment



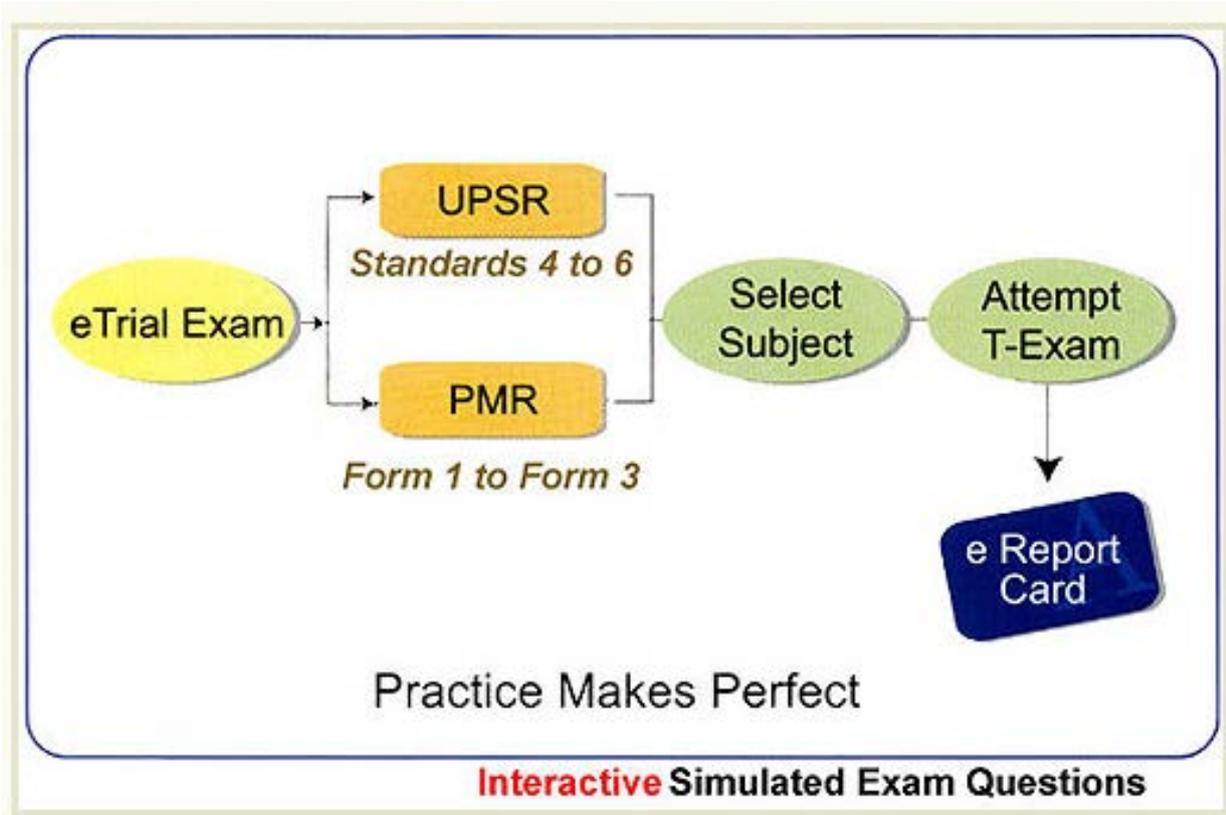
Source: KISB (2012)

### Appendix 3: ePastYearExam



Source: KISB (2012)

Appendix 4: eTrialExam



Source: KISB (2012)

## Appendix 5: eProgress



Welcome to SCORE A PROGRAMME™  
**eExamination Hall**

Back to ExamHall Homepage

eProgress

**eTopic Progress Report**  
 Please select School level and Month!

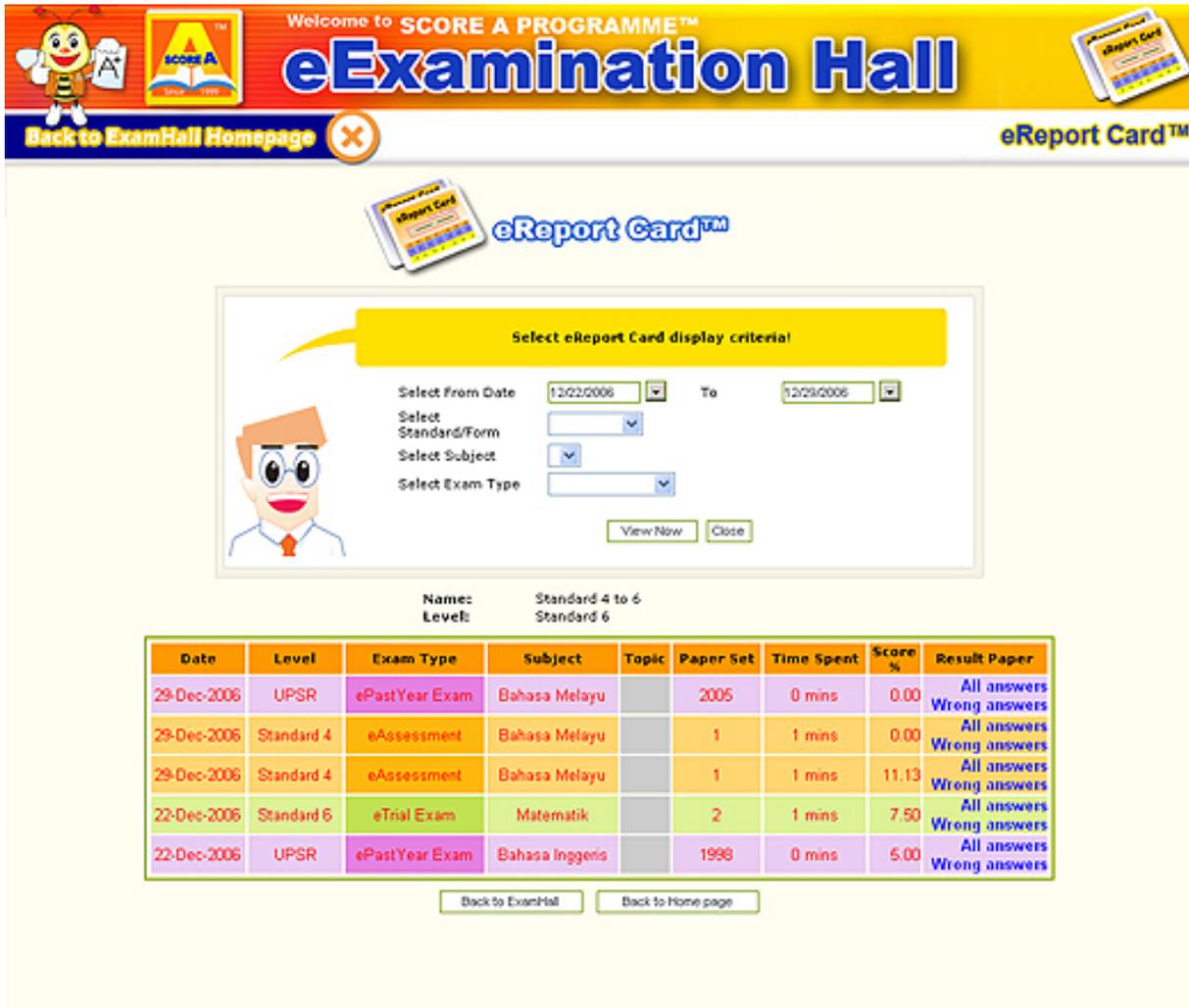
Select School Level: Standard 4  
 Select Month: January

| Subject/Week    | 1 | 2 | 3                                   | 4                                    | 5                                   |
|-----------------|---|---|-------------------------------------|--------------------------------------|-------------------------------------|
| Bahasa Melayu   |   |   | Attempts = 2<br>Percentage = 62.27% | Attempts = 6<br>Percentage = 76.29%  | Attempts = 1<br>Percentage = 62.20% |
| Bahasa Inggeris |   |   |                                     | Attempts = 1<br>Percentage = 100.00% | Attempts = 2<br>Percentage = 74.47% |
| Bahasa Cina     |   |   |                                     |                                      |                                     |
| Matematik Cina  |   |   |                                     |                                      |                                     |
| Sains Cina      |   |   |                                     |                                      |                                     |
| Matematik       |   |   | Attempts = 1<br>Percentage = 97.80% | Attempts = 3<br>Percentage = 87.44%  | Attempts = 1<br>Percentage = 55.60% |
| Sains           |   |   | Attempts = 1<br>Percentage = 75.53% | Attempts = 6<br>Percentage = 87.07%  | Attempts = 3<br>Percentage = 85.96% |
| Science         |   |   |                                     |                                      |                                     |
| Mathematics     |   |   |                                     |                                      |                                     |

Back to ExamHall    Back to HomePage

Source: KISB(2012)

## Appendix 6: eReportCard



**Select eReport Card display criteria**

Select From Date: 12/02/2006 To: 12/09/2006

Select Standard/Form: [Dropdown]

Select Subject: [Dropdown]

Select Exam Type: [Dropdown]

View Now Close

Name: Standard 4 to 6  
Level: Standard 6

| Date        | Level      | Exam Type      | Subject         | Topic | Paper Set | Time Spent | Score % | Result Paper              |
|-------------|------------|----------------|-----------------|-------|-----------|------------|---------|---------------------------|
| 29-Dec-2006 | UPSR       | ePastYear Exam | Bahasa Melayu   |       | 2005      | 0 mins     | 0.00    | All answers Wrong answers |
| 29-Dec-2006 | Standard 4 | eAssessment    | Bahasa Melayu   |       | 1         | 1 mins     | 0.00    | All answers Wrong answers |
| 29-Dec-2006 | Standard 4 | eAssessment    | Bahasa Melayu   |       | 1         | 1 mins     | 11.13   | All answers Wrong answers |
| 22-Dec-2006 | Standard 6 | eTrial Exam    | Matematik       |       | 2         | 1 mins     | 7.50    | All answers Wrong answers |
| 22-Dec-2006 | UPSR       | ePastYear Exam | Bahasa Inggeris |       | 1998      | 0 mins     | 5.00    | All answers Wrong answers |

Back to ExamHall Back to Home page

Source: KISB(2012)

**SELECTIVE CYCLOPROPANATION TESTS ON THE  
3-(BUT-3-ENYL)CYCLOHEX-2-EN-1-OL  
PRESENTATION TYPE: Poster**

Halaimia Farhi<sup>1</sup>, Dehmchi Farouk<sup>2</sup>, Lakehal Imane<sup>3</sup>

<sup>1,2,3</sup> Laboratory Organic Synthesis and Biocatalysis, Badji Mokhtar University, BP 12, Annaba 23000, Algeria

E-mail: farhinet2004@yahoo.fr

The optically active bicycloalcanols may be precursors of interesting enantiomerically enriched compounds, so in this work and in the first place, we intend to prepare bicyclo [n, 1,0] hex (hept) an -2- ols (n =3,4) differently substituted, thus showing the influence of ring size and substituents on the enantioselectivity. Second and to synthesize spiro chiral optically active compounds, we tried to develop a method for selective synthesis of 6 - (but-3-enyl) bicyclo [4.1.0] heptan-2-ol, indeed it must provide access to spiro compounds by cyclization of a chiral radical hexenyl, resulting from the opening of a cyclopropyl, radical is formed from the corresponding ketone compound and samarium iodide [1] or by treatment with Bu<sub>3</sub>SnH, compound resulting from the substitution of the hydroxyl [2]. During these radical cyclizations, the configuration asymmetric carbon is quaternary shall remain unchanged and the preparation of bicyclo [4.1.0] heptan-2-ols optically active would synthesize such compounds spiranniquis enantiomerically enriched.

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2. D.L. J. Clive, S. Daigneault, *J. Org. Chem.* **1991**, 56, 3801.

# SILICON CARBIDE GRAINS AND SCATTERING OF AGB STARS

Ahmad H. Abdelhadi  
New York Institute of Technology  
P.O. Box 840878  
Amman 11184  
Jordan  
aabdel06@nyit.edu

**Abstract:** Surprisingly, ancient stardust from stars existed before the Sun was born has made their way to Earth in meteorites. These silicon carbide grains are peculiar in their age and isotopic ratios; they formed before the Sun was born, and their isotopic signature indicates that they come from a different galactic region. This work aims to seek a possible paradigm for such richness and peculiarity through Monte Carlo simulation of scattering of Asymptotic Giant Branch (AGB) stars off molecular cloud. Such approach randomly generates AGB stars in regions close to the Galaxy bulge and examines possibility of migration to outer regions by scattering off molecular cloud. A successful explanation to this problem will influence how we think nuclides were formed and then distributed in the Galaxy and will shed new light unto the age and the chemical evolution of the Milk Way Galaxy. Thus, it is important that we know where do they come from and how do they end up in our backyard?

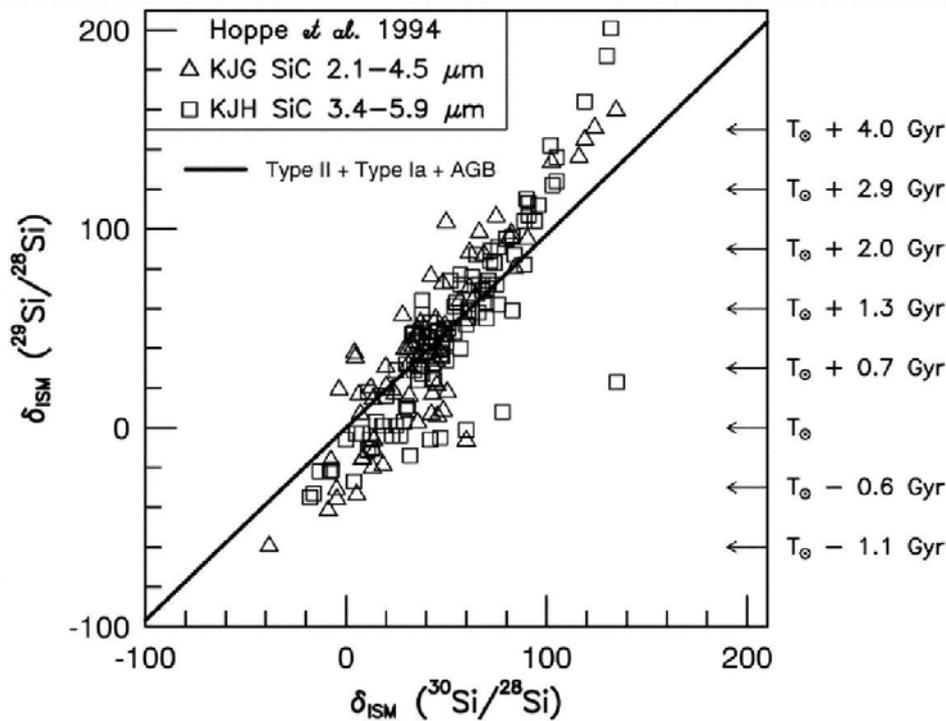
**Key words:** AGB stars, Monte Carlo, Silicon Carbide

## Introduction

Many studies (e.g. 5) have shown that the mainstream presolar silicon carbide (SiC) grains extracted from meteorites formed in asymptotic giant branch stars. Ion probe studies show them to have  $^{29}\text{Si}/^{28}\text{Si}$  and  $^{30}\text{Si}/^{28}\text{Si}$  isotopic ratios larger than those found in solar material (see Figure 1). The problem lies in the fact that the mainstream presolar SiC grains are richer in the heavier silicon isotopes than the solar composition even though the grains must have originated in stars that formed prior to the Sun. To deliver their grains to the solar birth cloud, the donor stars clearly must have been born and evolved prior to solar birth. Homogeneous chemical evolution of these Si isotope ratios increase monotonically with time and simply can not accommodate earlier stars having higher ratios. Therefore, one seeks reasons for the high isotopic ratios of the majority of donor stars. Clayton (1997) argued that this silicon isotopic richness is due in part to the diffusion of the parent AGB stars from more central birthplaces within the Galaxy. Due to a more evolved interior position, these central birthplaces are known to have a higher metallicity. The outward diffusion can be likened to the gravity assist used in solar system exploration. AGB stars scatter by near gravitational encounters with molecular clouds. This changes the orbits of some to spend much time at larger galactic radii than those of their birth. There they give out their stardust.

## Method

Since I propose to deal with star-molecular-cloud encounters, one might ask if stars collide with one another. Of course, by "collisions between stars" I don't mean collisions in quite the same sense as those between two billiard balls. A more appropriate name would be encounters. Nonetheless, this question has been addressed by other researchers (e.g. Binney & Tremaine, 1987; Tayler, 1996) and the interval between collisions was calculated to be  $10^{19}$  years. This is considerably longer than the believed age of the Galaxy ( $1 - 2 \times 10^{10}$  years). Evidently, the stars in the Galaxy do not suffer significant individual deflections due to the presence of other stars, and large-angle collisions between stars are very infrequent and do not contribute to migration of AGB stars.



**Figure 1:** Silicon isotope deviations in a three-isotope plot. Murchison SiC samples measured by Hoppe et al. are shown and have a best-fit slope of 4/3. The renormalized mean Interstellar Medium (ISM) evolution is shown as the solid line, and by construction it passes through solar abundances at  $t = t_{Solar}$ . With such a construction, deviations with respect to solar abundances and with respect to interstellar abundances are the same  $\delta_{Solar} = \delta_{ISM}$  (Clayton, 1997).

To calculate the orbits of stars, I require a galactic mass model that defines an expression for the galactic gravitational potential. In using such a model, I neglect the forces from Individual stars and consider only the large-scale forces from the overall mass distribution, which is made up of thousands of millions of stars. Here, I use a numerically convenient axisymmetric gravitational potential proposed by Miyamoto and Nagai (1975).

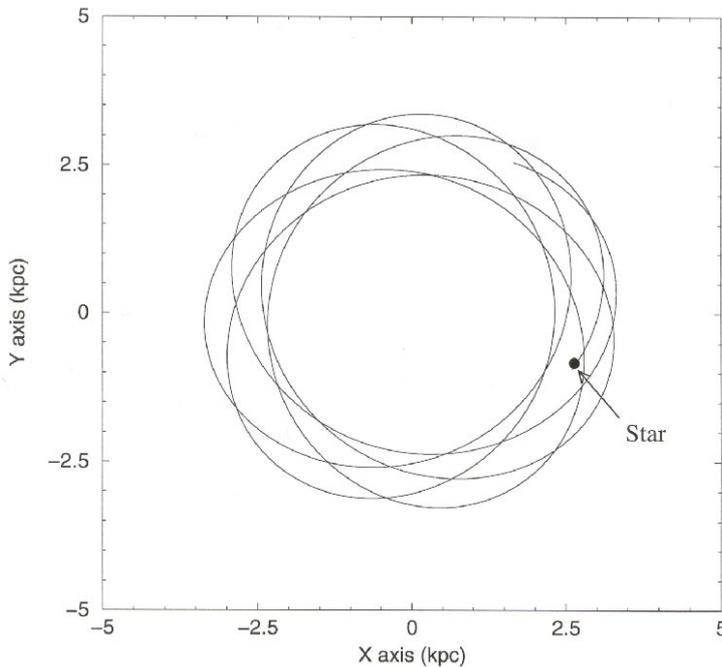
$$\Phi(R, z) = -\sum_{i=1}^3 \frac{GM_i}{\sqrt{R^2 + (a_i + \sqrt{z^2 + b_i^2})^2}}$$

where  $R$  is the galactocentric radius and  $z$  is the height above and below the galactic mid-plane. Respectively, the three parameters  $a$  (in kpc),  $b$  (in kpc), and  $M$  (in  $10^{10} M_{Solar}$ ) are: 0.0, 0.3, and 1.8 for the bulge; 6.2, 0.4, and 17.4 for the disk; 0.0, 31.2, and 83.5 for the corona<sup>4</sup>. Depending on the choice of the two parameters  $a$  and  $b$ ,  $\Phi$  can represent the potential of anything from an infinitesimally thin disk to a spherical one. This expression is free from singularities everywhere in space and is in good agreement with observational determinations of the Galactic rotation curve, the vertical force  $K_z$  at the Sun's position, and the total local mass density (Hoppe, Amari, Zinner, Ireland, & Lewis, 1994) ( $\rho_{Solar} \sim 0.15 M_{Solar} pc^{-3}$ ). I should also mention that I omit non-axisymmetric structures such as an inner bar, the spiral arms, and local features such as Gould's Belt. A typical star's orbit is given in Figure 2.

As for the molecular clouds, they individually produce fluctuations in the gravitational field seen by nearby stars, which in return produce changes in the magnitude and direction of each stellar velocity. Understand that this work doesn't seek to model the physical and geometrical properties of the molecular clouds. I seek instead only a presentation of the gravitational effect of molecular clouds on stellar orbits. Molecular clouds are detected and mapped by observing millimetre emission from a trace molecule: carbon monoxide CO (Pudritz, 2002). I used the results from the different galactic plane surveys (Pudritz, 2002; Solomon & Sanders, 1985) to distribute the molecular clouds radially. These results show that the molecular clouds are the dominant component of the interstellar medium in the inner half of the disk at  $R < 0.8R_{Solar}$  with a rise between  $R = 5$  and  $R = 7$  kpc and a sharp fall toward the larger radius where there is very little emission beyond  $R = 15$  kpc. Most of the surveys (Binney & Merrifield, 1998; Pudritz, 2002; Solomon & Sanders, 1985; Ward-Thompson, 2002) suggest a median cloud mass of about  $10^5 M_{Solar}$ . Since my problem concerns

the effect of the molecular clouds on the motion of stars through an otherwise azimuthally symmetric potential, I can utilize a simple approximation of their masses and the radial distribution for that purpose. To a first approximation, I can take the molecular clouds to be spherical with a uniform density.

Again, it is not my intention to model the molecular clouds or their radial distribution. For that purpose, I employ a Gaussian distribution that randomly generates positions for the molecular clouds along the galactic mid plane. The transformation I use for the Gaussian deviations is (Press, Teukolsky, Vetterling, and Flannery, 1992):



**Figure 2:** A face-on galactic plane orbit that forms a rosette. The star has an initial circular velocity 196.2 km/s and lived for 0.5 billion years.

$$R = \sqrt{-2 \ln a_1 \cos 2\pi a_2}$$

where  $R$  is the galactocentric radius,  $a_1$  and  $a_2$  are two uniform deviates on  $(0,1)$ .

## Discussion

A typical calculation is set up to trace  $10^4$  molecular clouds and  $10^3$  stars for two billion years. I place the molecular clouds randomly on circular orbits in the galactic mid plane. Since each molecular cloud is more massive than the star; a gravitational force from a nearby star on the molecular cloud is going to be small and thus neglected. To a first approximation, the molecular clouds retain their circular orbits and constant angular momentum. The stars are initially distributed randomly in radial zones. A zone is a ring with 500 pc width; for example, the region between  $R = 4.0$  kpc and  $R = 4.5$  kpc is one zone. Each zone has  $10^3$  stars positioned randomly in  $R$  and in its azimuthal angle in the galactic mid plane. Each star is given a randomly generated peculiar velocity between 10 and 20 km/s. The direction of the peculiar velocity is also randomly chosen in  $[\theta]$  and  $[\phi]$ , where  $[\theta]$  and  $[\phi]$  are the known spherical coordinates. Added to the peculiar velocity is the proper circular velocity deduced from Miyamoto and Nagai potential. With these initial conditions the system evolves for two billion years. I have used a numerical method called the Bulirsch-Stoer algorithm (Press, Teukolsky, Vetterling, and Flannery, 1992) with adaptive time step to trace the orbits of stars by integrating the equation of motion for the stars. Bulirsch-Stoer method is very efficient when high-accuracy solutions for ordinary differential equations are desired. The idea is to start with an initial value and calculate the value at the end of the an interval many times with successively finer steps, and then fit a polynomial or a rational function to extrapolate to the magical limit of an infinitely small step size.

The nearby molecular clouds' gravitational field mainly governs a star's trajectory. The lengthy nature of this type of calculations suggests making another approximation: only forces from nearby molecular clouds are included in the total force  $\vec{F}$  in Newton's second law. The galactic gravitational force is derived from Miyamoto and Nagai potential.

## Results

The galaxy is divided into six zones or rings, each having a radial width of 500 pc and containing 1000 stars. Stars are borne at random locations in their defined zones before their orbits evolve for two billion years during which each orbit is computed. The stars initial conditions are stored for later comparison. The results have shown that, for the most part, stars experience a small perturbation in their orbits and they are less likely to deviate largely from their initial circular orbits. Around 40% of stars did not leave their starting zones. Close to 40% of the stars suffered inward migration. Only a small fraction of AGB stars  $\sim 1\%$  migrated to larger radii. Wielen et al (1996) found that the Sun was born at galactocentric radius  $R = 6.6$  kpc and has in 4.5 Gyr diffused outwards to its present location at  $R = 8.5$  kpc. My calculations found in two billion years a percentage of 0.4% stars born between 4.0-4.5 kpc migrate outward to 6.0-6.5 kpc zone where they give their AGB stardust to a presolar cloud. This result, in particular, is very interesting because Sellwood and Binney (2001) studied the scattering of stars by spiral waves and concluded that the grains must have migrated from  $R \sim 4$  kpc to  $\sim 6$  kpc where they were incorporated into a presolar cloud.

## Conclusion

Close encounters between AGB stars and molecular clouds are apparently too infrequent to contribute primarily to the problem of silicon isotopic ratios in mainstream SiC grains. Migration of AGB stars from more central regions in the galaxy due to scattering by molecular clouds is deemed unlikely. The percentages the calculations have produced are small and cannot account for the observed richness in the heavier silicon isotopes when compared to solar values. I have shown only a few stars do that.

## Acknowledgments

I thank Professor Donald D. Clayton at Clemson University, in Clemson, South Carolina, in the USA. The NASA Origin of Solar Systems Program has supported this work.

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# SİMETRİK GEOMETRİYE SAHİP ÇERÇEVELERDE, DAİRESEL KESİTE SAHİP MERKEZİ ÇELİK ÇAPRAZLARIN PERFORMANS ANALİZİ

Elif AĞCAKOCA, Berker ALICIOĞLU, Muharrem AKTAŞ, Zeynep YAMAN  
Sakarya Üniversitesi  
İnşaat Mühendisliği Bölümü  
Türkiye

[elifd@sakarya.edu.tr](mailto:elifd@sakarya.edu.tr), [muharrema@sakarya.edu.tr](mailto:muharrema@sakarya.edu.tr), [zdyaman@sakarya.edu.tr](mailto:zdyaman@sakarya.edu.tr)

**Özet:** Bu çalışmada hedeflenen, simetrik geometriye sahip yapı sistemlerinin Türk Deprem Yönetmeliğinde bulunan Merkezi Çelik Çaprazlı Perde türlerinden bazılarının, seçilen kesite göre yapısal performansının belirlenmesidir. Seçilen Merkezi Çelik Çaprazlı Perde türlerinin geometrisi diyagonal ve ters V olarak belirlenmiştir. Bu perde türlerinin çaprazlarında kullanılacak kesit geometrisi ise dairesel borudur. Seçilen yapılarda diyagonal profillerin boyutları belirlenirken aynı kesit alanına sahip olmaları sağlanmış böylece yapı maliyetine de sınırlandırma getirilmiştir. Yapılan analizler sonucunda, yapı performansının diyagonal ve ters V çapraz türlerindeki limit değeri incelenmiştir. Çalışmanın yapısal analiz ve sonlu eleman modellemesinde, doğrusal olmayan statik analiz yöntemi kullanılmıştır.

**Anahtar Kelimeler:** Push-over, çelik merkezi çaprazlar, itme analizi

## Giriş

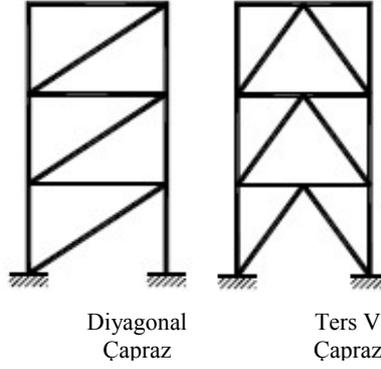
Çelik yapıların, depremde oluşan ilave yükler altında sünek davranması istenir. Yapının sünekliği, elemanlarının (kolon, kiriş) ve bu elemanların birleşim bölgelerinin yanal yükler altında yeterli dayanımı göstermesi ile mümkün olur. Binaların deprem yüklerine karşı yeterli performansı göstermesi için pek çok uygulama mevcuttur. Bu uygulamaların başında çelik perde sistemi kullanımı gelmektedir. Çelik yapıları tasarlarken, kullanılacak perde sistemi yapının deprem yükleri altındaki davranışını büyük ölçüde değiştirmektedir. Bu değişim, sağladığı dayanıklılık açısından olumlu etki göstermektedir. Ayrıca çelik perde kullanımı yapıya sağladığı hafiflik ve süneklik yapı davranışı için avantaj sağlamaktadır. Bu nedenle, depreme dayanıklı yapı tasarlanmasında perde seçimi oldukça önemlidir. Çelik perde seçiminde dikkat edilmesi gereken en önemli nokta, uygun çapraz sisteminin ve bu çapraz sisteminde kullanılacak profill kesitinin seçimidir.

Yapıda kullanılacak çaprazlar içmerkez ve dışmerkez olarak ikiye ayrılır. Elemanların birleştirilme yöntemi sistemin en önemli özelliğidir. Kolon, kiriş ve çapraz elemanların eksenlerinin eksantirisite oluşturmayacak şekilde merkezi olarak birleştirilmesi ile merkezi çelik çaprazlar oluşturulur. Merkezi çaprazlı çerçeveler, moment aktaran çerçevelerden daha düşük süneklikli olacak şekilde tasarlanır. Dışmerkezi çaprazlı çerçeveler ise moment aktaran çelik çerçevelerin yüksek duktilitesi ile merkezi çaprazlı çelik çerçevelerin dayanım ve rijitliğini birleştirebilmesidir. Bu çerçeveler, kolon-kiriş birleşim noktasına veya çapraz elemanların kesişim noktaları arasında belirli bir eksantirisite verilerek oluşturulur (Korkmaz, 2008).

Merkezi çelik çaprazlı perdeler, moment aktaran çelik çerçeve sistemlere göre oldukça büyük elastik yatay rijitliğe sahiptir. Dışmerkez güçlendirilmiş çerçeve sistemler ise, yüksek elastik rijitliğe, ve enerji yutma kapasitesine sahiptir (Uzgider, 2005). Çeşitli geometriye sahip yapılar, değişik çelik çapraz şekilleri ile yatay yük taşıma kapasiteleri incelenmiş taşıyıcı sistem davranış katsayıları FEMA ile karşılaştırılarak çelik çapraz tiplerinin önemi vurgulanmıştır(Bakır 2006). Çok katlı çelik yapıların performans dayalı tasarım yöntemleri üzerinde durmuştur kapasite spektrum metodu ve deplasman katsayıları metodu kullanılarak performans değerlendirilmesi yapılmıştır. Bununla birlikte taşıyıcı sistemin ve yapı elemanlarının sahip olması gereken nitelikler belirlenmiştir(Şen 2006).

## Çelik Çaprazlı Perde Sistemler ve Türk Deprem Yönetmeliğinin Koşulları

Merkezi çelik çaprazlı perdeler, mafsallı birleşimli veya moment aktaran çerçeveler ile bunlara merkezi olarak bağlanan çaprazlardan oluşan yatay yük taşıyıcı sistemlerdir. Bu tür sistemlerin yatay yük taşıma kapasiteleri, eğilme dayanımlarının yanında, daha çok veya tümüyle elemanların aksenal kuvvet dayanımları ile sağlanmaktadır. Merkezi çelik çaprazlı perdelerin türleri Şekil 1' de görüldüğü gibidir(DBYBHY2007).

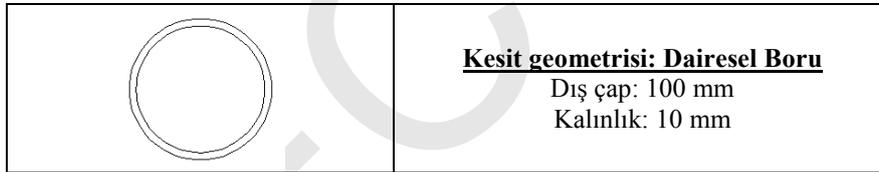


**Şekil 1:** Kullanılan merkezi çelik çaprazlı perdeler (DBYBHY2007)

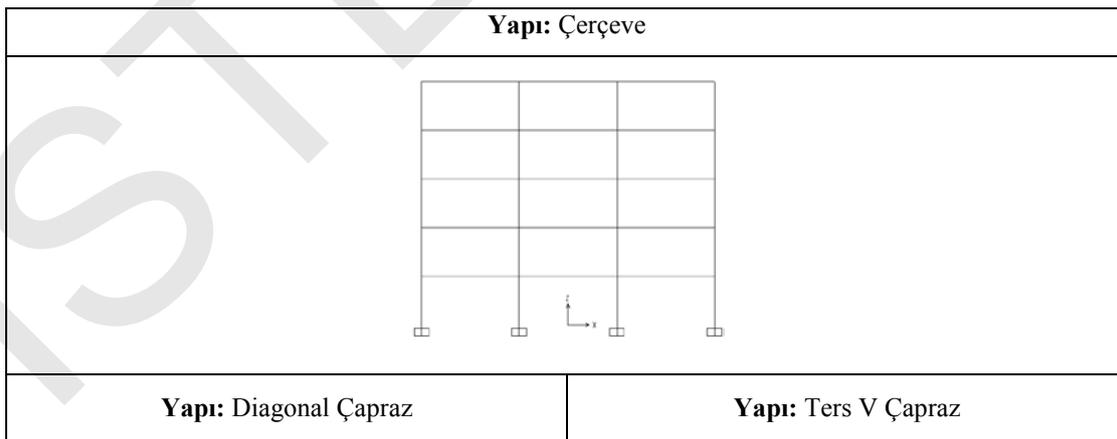
Çalışma kapsam açısından, merkezi çelik çaprazlı perdeleri, doğrusal olmayan yapı davranışını ve çözümlemesini içermektedir. Merkezi çelik çaprazlı perde olarak, Deprem Bölgelerinde Yapılacak Binalar Hakkında Yönetmelik(DBYBHY)'inde madde 4.5 Merkezi ve Dışmerkez Çelik Çaprazlı Perdeler başlığı altında verilen çelik çapraz türlerinden ikisini ele alınmıştır.

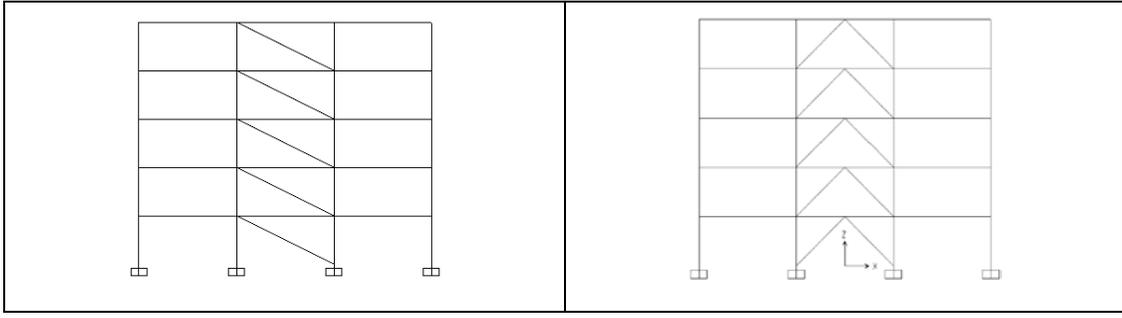
### Çalışmanın Amacı Ve Kapsamı

Analizler Sap 2000 sonlu eleman programı kullanılarak yapılmıştır. Sap 2000 programı ile yapıların doğrusal olmayan davranışı temsil eden yapı kapasite eğrisinin (pushover eğrisi) elde edilmesi bir takım kabuller ile mümkündür(SAP, 2009). Yatay yükler altında gerçek yapı davranışına yakın çözüm elde etmek için, malzemenin gerçek davranışını ve yapı geometri değişimini göz önüne alan doğrusal olmayan statik analiz yapılır. Çalışmada simetrik düzlem bir çerçevede, yapının doğrusal olmayan davranışını olumlu etkileyecek daire enkesitine sahip çapraz perde türünün belirlenmesi hedeflenmektedir. Çaprazlarda kullanılan dairesel profilde et kalınlığı 10 mm kesit alanı 28.27 cm<sup>2</sup> olarak belirlenmiştir Şekil 2. Şekil 3'de görülen çerçeve tipi enine ve boyuna doğrultularda simetrik olup çalışma kapsamında incelenen çerçeve tipidir.



**Şekil 2:** Çapraz enkesiti





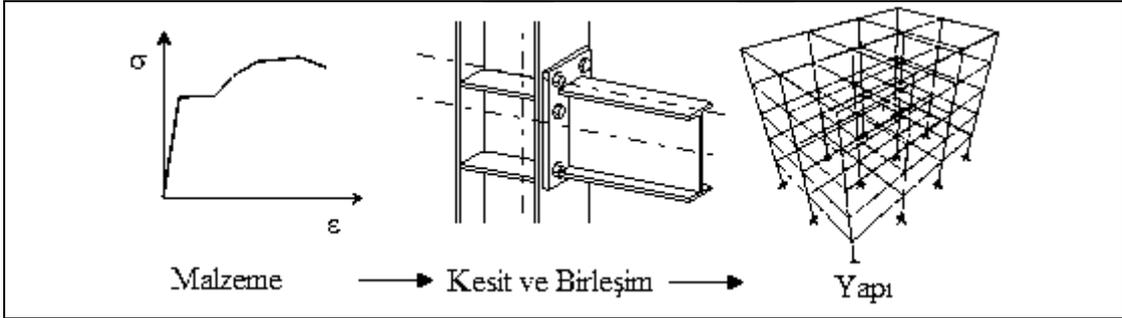
Şekil 3: Çaprazlı ve çaprazsız düzlem çerçeveler

### Çalışmada Esas Alınan Yapı ve Özellikleri

Düsey yükler etkisi altında yapıda mafsallaşma gerçekleşmemesi için kolonların kirişlerden daha rijit olması gerekmektedir. Bu sebeple seçilen çerçeve sistemleri için kolon kesitlerine ait atalet momenti ve kesit alanı, kiriş kesitlerine oranla daha büyük alınmıştır. x yönünde 3 açıklıklı, z yönünde 5 açıklıklıdır. Açıklık mesafeleri x yönü 6 metre, z yönü 3 metredir. Kirişlerin üzerine 1 t/m' lik çizgisel düşey yük tanımlanmıştır. Kolonlar için IPE300, kirişler için IPE240 profilleri seçilmiştir. Çelik malzeme akma dayanımı ise 2.40 t/cm<sup>2</sup>' dir. Çerçeveye eklenen çelik perde sistemleri, DBYBHY'de bahsi geçen Merkezi Çelik Çaprazlı Perdelerden seçilmiştir.

### Yapı Sistemlerinin Doğrusal Olmayan Statik Analizi

Çelik yapıların doğrusal olmayan davranışı, temel olarak çelik malzemenin doğrusal olmayan davranışından ve yapının geometrisinin doğrusal olmamasından kaynaklanmaktadır. Yapı sisteminin doğrusal olmayan davranışını şematik olarak Şekil 4'da olduğu gibidir.



Şekil 4: Doğrusal olmayan yapı davranışının şematik gösterimi.

Yapı davranışına en yakın çözüm hem gerçek malzeme davranışının hem de geometri değişimlerinin göz önüne alındığı çözümleridir. Çelik malzemeden oluşturulmuş bir yapının yanal yükler altında davranışı doğrusal elastik değildir. Ayrıca çelik kesit ve birleşimlerden oluşan yapının davranışı, yapıya etki eden iç ve dış yükler altında geometri bakımından da doğrusal olmayacaktır. Yapısal çözümleme olarak sadece malzemenin ya da sadece geometri değişimlerinin göz önüne alınması yapının çözümlemesini doğrusal olmaktan çıkarmaktadır.

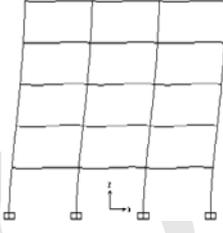
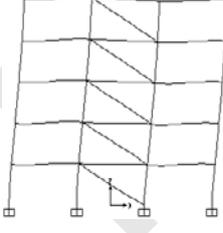
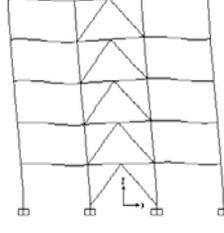
Depreme dayanıklı yapı tasarlarken, depremin yapıdan isteyeceği maksimum kuvvet bulunup, tasarım bu kuvvete karşı koyacak şekilde yapılır. Ancak dayanıma göre hesapta kullanılan maksimum kuvvet dikkate alındığında, yapı maliyeti çok yüksek ve taşıyıcı kesitler büyük olmaktadır. Bu sebepten dolayı kesitler depremin istediği maksimum kuvvete göre değil, depremin yapıdan talep ettiği sünekliğe göre tasarlamak daha avantajlı olmaktadır. Deprem yüklerinin deprem yönetmeliklerinde yer alan taşıyıcı sistem davranış katsayısıyla azaltılması bu nedenle yapılır. Yapı için performans kavramı da bu nokta da başlamaktadır.

## Sonlu Eleman Modelleme Aşamaları

Sonlu eleman yöntemi ile yapılan çözümlemede çerçeve geometrisi ve yükler oluşturulur. Yapı elemanları için plastik kesit tanımlamaları yapılırken, kirişlerin eğilme momenti (M3) etkisinde, kolonların aksel yük ve eğilme momenti (P-M3) etkisinde, perde çapraz elemanların ise aksel yük (P) etkisinde mafsallaşacağı ön görülür. Analiz tamamlandıktan sonra yapı sistemi için istenilen analiz türüne ait şekil değiştirmeler, kesit tesirleri ve mafsallaşma durumları elde edilmiş olur. İstenirse mafsallaşma durumu, mafsallaşma derecesi ve değerleri ile ayrıca plastik mafsalın davranışı bulunur. Bunun yanında mafsallaşmanın çekme ya da basınç karakterli olup olmadığını da gözlemlemek mümkündür.

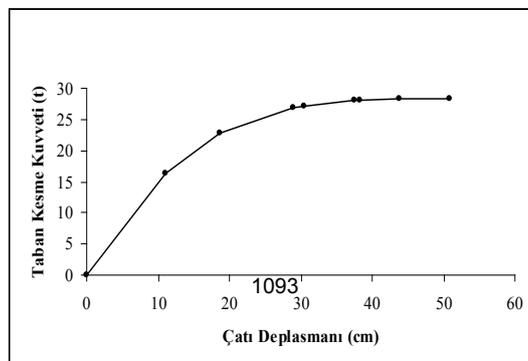
Bir yapının doğrusal olmayan performans analizini yapılırken önce yapının geometrisi ve yükleme durumları tanımlanır. Yükleme durumları yatay ve dikey olarak ayrılır ve yapıya etkilir. Yükleme işleminden sonra analiz durumunun tanımlanması gerekir. Analizin yapılabilmesi için bir takım kabuller ve plastik mafsal hipotezi kullanılır. Yapı kapasite eğrisinin (pushover eğrisi) elde edilmesi için doğrusal olmayan statik analiz çözümünün yapılması gerekir. Bu işlemler dikey yükler ve yatay yükler için ayrı ayrı yapılır.

Yapının doğrusal olmayan çözümlemesinde ilk önce dikey yük analizi yapılır ve bu analiz sonrasında yapı elemanları için gerilme durumu elde edilir. Çerçevenin doğrusal olmayan statik analizde yatay yükleme durumunu belirlemek için modal analizden yararlanılmıştır. X yönü hâkim periyoduna karşı gelen yapı mod şekilleri tercih edilmiştir ve bunlar Şekil 5’de gösterilmiştir.

|   |  |
|---|--|
| <b>Yapı: Çerçeve</b><br><b>Periyot: 0.285</b>                                       |  |
|   |  |
| <b>Yapı: Diagonal Çapraz</b><br><b>Periyot: 0.113</b>                               | <b>Yapı: Ters V Çapraz</b><br><b>Periyot: 0.083</b>                                  |
|  |  |

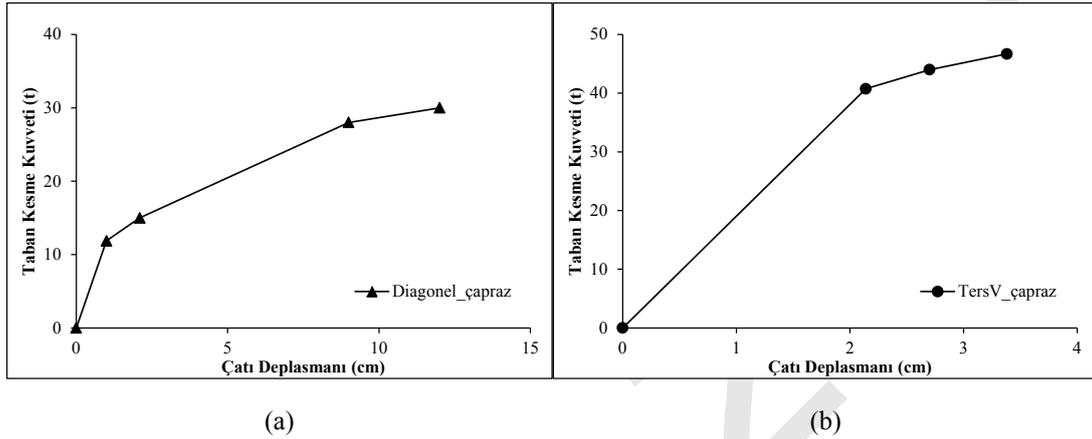
Şekil 5: Doğrusal olmayan yapı davranışının şematik gösterimi.

Yatay yük etkisindeki analiz, bu gerilme durumunun sonrasında gerçekleştirilir. Yatay yük her adımda bir miktar daha artırılarak yapıda deformasyon oluşması sağlanır. Bu çözümleme neticesinde, her adımda oluşan deformasyonlar için toplam taban kesme kuvveti – çatı yer değiştirmesi değer çiftleri hesaplanmış olur. Bu hesaplanan değer çiftlerinin bir grafikte gösterimiyle yapı kapasite eğrisi elde edilmiş olur. Çelik perde ilave edilmemiş yapının taban kesme kuvveti-çatı deplasman eğrisi Şekil 6’de gösterilmiştir.



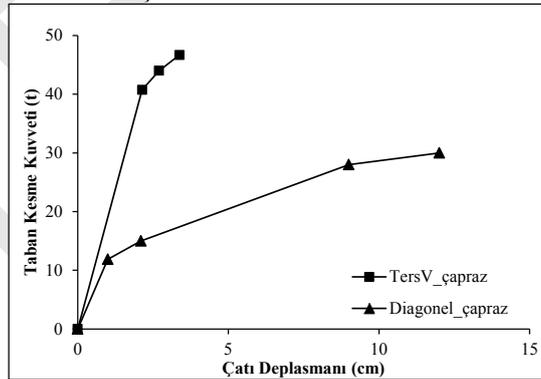
**Şekil 6:** Düzlem çerçevenin push-over eğrisi

Analiz sonucunda çerçeve için elastik ve plastik limit değerleri hesaplanır. Elastik limit değeri, çerçeve türleri için Şekil 6'da gösterilen yapı performans eğrisinde eğrinin doğrusal olduğu son noktadaki taban kesme kuvveti ve çatı deplasman değerini ifade etmektedir. Plastik limit değeri, çerçevenin performans eğrisinde eğrinin doğrusal olmadığı son noktadaki taban kesme kuvveti ve çatı deplasman değerini ifade etmektedir. Bu değer yapının oluşan plastik mafsallar sonucunda mekanizma durumuna gelerek göçmesinden önceki son değerdir.



**Şekil 7:** Taban kesme kuvveti- çatı deplasman grafiği (a,b)

Şekil 7-a'daki dairesel kesite sahip diagonal çaprazla güçlendirilmiş çerçevenin elastik limit değeri, 1.00 cm ve buna karşılık gelen taban kesme kuvveti 11.87 t olarak hesaplanmıştır. Plastik limit değeri, 12.00 cm ve buna karşılık gelen taban kesme kuvveti 30.01 t olarak hesaplanmıştır. Şekil 7-b'deki dairesel kesite sahip ters V çaprazla güçlendirilmiş çerçevenin elastik limit değeri, 2.14 cm ve buna karşılık gelen taban kesme kuvveti 40.75 t olarak hesaplanmıştır. Plastik limit değeri, 3.38 cm ve buna karşılık gelen taban kesme kuvveti 46.69 t olarak hesaplanmıştır. Diagonal ve Ters V çaprazların karşılaştırması Şekil 8'de verilmiştir.



**Şekil 8:** Diagonal ve Ters V çapraz türlerinin taban kesme kuvveti- çatı deplasman değerleri

## 1. Sonuçlar

Çelik yapılarda yapı davranışını olumlu yönde iyileştirmek ve yan yükler altında performansını arttırmak amacı ile çelik perde kullanımı oldukça önemlidir. Çelik perde tertibi ve perdede kullanılacak kesit geometrisi yapı davranışını önemli ölçüde değiştirmektedir. Bu nedenle yapıyı oluşturan çerçeveler göz önüne alınarak hem perde tertibi hem de perde profil kesiti seçimi önem taşımaktadır.

Analizler sonucu elde edilen veriler ışığında, kullanılan dairesel en kesit ile oluşturulan diagonal ve ters V perde türlerinin yapı performansına etkileri karşılaştırılmıştır. Bu eğriler altında kalan alan yapının sönmülediği enerji miktarını göstermektedir. Bu alan ne kadar büyük olursa yapı o kadar fazla enerji sönmülemektedir. Aynı enkesite sahip farklı perde türleri bu kriter de göz önüne alınarak kıyaslanmıştır.

Elastik sınır durumundaki maksimum deplasman kıstas alındığında;

- Perde teşkili daire kesitli diyagonal seçilmesi durumunda elastik sınır 0.99 cm olarak hesaplanmıştır.
- Perde teşkili daire kesitli ters V seçilmesi durumunda elastik sınır 2.14 cm olarak hesaplanmıştır.
- Perde teşkili dairesel kesitli diagonal seçilmesi durumunda çerçeve en esnek davranışa sahip olmaktadır.
- Perde teşkili dairesel kesitli ters V seçilmesi durumunda çerçeve en rijit davranışa sahip olmaktadır.

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## SIMULATION OF SAFE HEIGHT EMBANKMENT ON SOFT GROUND USING PLAXIS

Fauziah Kasim<sup>a 1</sup>, Prof. Dr. Aminaton Marto<sup>b</sup>, Bakhtiar Affandy Othman<sup>c</sup>, Prof. Dato' Dr. Ismail Bakar<sup>d</sup> and Muhamad Fadhil Othman<sup>e</sup>

<sup>a,b,c,e</sup> Department of Geotechnics and Transportations, Faculty of Civil Engineering, 81310 UTM Skudai, Johor, Malaysia

<sup>d</sup> Research Center for Soft Soil (RECESS), Faculty of Civil & Environmental Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia

**Abstract:** Industrial development in Malaysia has rapidly increased, there are many construction projects has been carried out. Referring to the above, it can cause reducing the construction area. In this situation, nowadays many construction need to be constructed on the soft ground. When construction is done on soft ground, the problem is it will give a weak foundation due to increasing of settlement and also directly, it can cause construction costs to be high. They construct the embankment to control the settlement of the soil but, the settlement still occurs during and after filling the embankment. In order to reduce and minimize this problem, they need to do some ground improvement. They are many methods to improve the ground, one of the way is by using geosynthetic product which is geotextile. The aim of this paper is to determine the safe height of embankment constructed on soft ground through application of geotextile as soil reinforcement. The geotextile with various geotextile reinforcement spacing were applied in an embankment. The height of embankment placed on soft ground was about 3 to 5 m height. To know those effects, software PLAXIS Version 8.2 was used to analyses the embankment. From the analysis, it can be concluded that the safe height of the case embankment was 4.9 m and the spacing of geotextile was less than 1 m. Result for the embankment case study is as expected (Pass), because the specifications on case study is better than the critical condition of the analysis.

**Key words:** Geotextile reinforcement, deformation, safe height embankment, simulation

### Introduction

Nowadays, the rapid developments of our country have high demand of land area for the development. Due to lack area for the development construction on soft to very soft soil such as clay is commonly done. For soft soil such as soft clay the alluvial deposit usually show pronounced stratification and sometimes organic matter, seashell and decayed wood (Chin, 2005). The soft deposits are usually highly compressible properties of subsoil such as excessive settlement caused by bearing capacity failure of subsoil is the main concern of the problem. To build a construction on soft ground, they treat the soil by construct an embankment. IRC (2012) noted that an embankment usually refers to an earthen structure that is used to raise the elevation of a roadway or railway above the elevation of the surrounding area. He also said that an embankment is typically built by compacting earthen materials in place, so the compaction properties of soil (optimum water content and maximum dry density) are very important to performance. However, after completion of embankment construction, the settlement is still occur. In order to minimize the deformation of embankment over soft ground we need to add some material to the embankment such as the geosynthesis product. One of the common products that have been used into the embankment is geotextile. Past researchers (Santvooth, 1994; Koerner, 1998; Giroud et al., 1985) have used geotextile application in civil engineering field such as in geotechnical engineering. To reduce the deformation of an embankment, geotextile reinforcement is applied into the embankment. Deformation is a change in the shape or size of an object due to an applied force. The total deformation of the embankment is depending on the bearing capacity of the soil.

Bearing capacity is a total load applied that can be supported by the soil. When the soil have reach maximum pressure which can be supported without failure it is called Ultimate bearing capacity. The ultimate load which can support a foundation can be calculated using Terzaghi's bearing capacity theory. Terzaghi (1943) was first to present about a theory for ultimate bearing capacity and also developed a method for bearing capacity for general case on shear failure. The general shear failure case in the one normally analyzed and the equations are given below :

<sup>1</sup> Corresponding Author.

E-mail address: fauziahkasim@utm.my, bakh\_7@yahoo.com

$$qu = cNc + qNq + 0.5\gamma BN\gamma \quad (1)$$

where ;

$c$  : Cohesion of soil

$Nc, Nq, N\gamma$ : Bearing capacity factors

$\gamma$  : Unit weight of soil

$q$  : Overburden pressure

$B$  : Width of footing

Equation (1) is referred to as Terzaghi's bearing capacity equation. The term  $Nc$ ,  $Nq$ , and  $N\gamma$  are called the bearing capacity factors. In order to fulfill the aim, the application on the finite element method by using software PLAXIS Version 8.2 (PLAXIS, 2000) was used. The parametric modelling involved analysis of effect of various heights of embankment and spacing of geotextile reinforcement on deformation of embankment.

## Site Condition

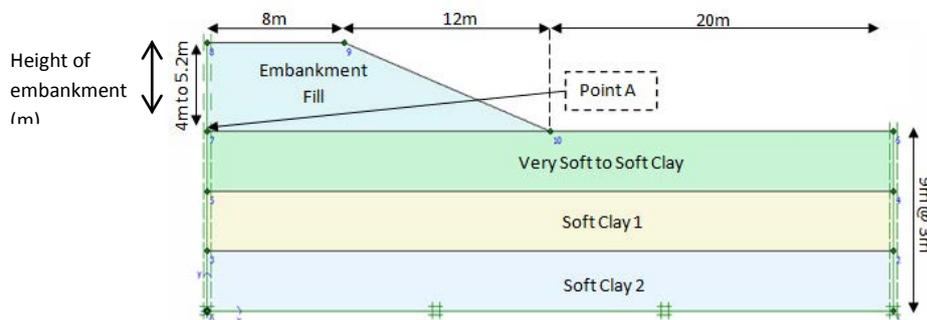
Soil investigation has been carried out on soft ground deposited at Research Center for Soft Soil (RECESS), Universiti Tun Hussein Onn Malaysia (UTHM), Johor, Malaysia. The ground water level on site varied from a depth of 0.2 m to 0.5 m below existing ground level. The laboratory test and in-situ test have been carried out on the parameters need for parametric study. The soft ground is underlain by three (3) major layer of soil where the upper layer is very soft to soft clay soil followed by soft clay (1) and soft clay (2) for bottom clay. Reported by Othman (2012), he have been summarized the parameters included geotextile, embankment and soft ground parameters need by simulation using Plaxis software. The parameters are presented in Table 1.

**Table 1:** Material parameters (Othman, 2012)

| Description             |                   | Embankment Fill | Very Soft to Soft Clay | Soft Clay (1) | Soft Clay (2) | Geotextile TS40 |
|-------------------------|-------------------|-----------------|------------------------|---------------|---------------|-----------------|
| $\gamma_{\text{unsat}}$ | kN/m <sup>3</sup> | 15.00           | 8.19                   | 12.55         | 10.76         | -               |
| $\gamma_{\text{sat}}$   | kN/m <sup>3</sup> | 18.90           | 12.82                  | 14.72         | 14.27         | -               |
| $k_x$                   | m/d               | 4.320E-03       | 3.825E-04              | 1.300E-03     | 2.125E-04     | -               |
| $k_y$                   | m/d               | 2.160E-03       | 1.912E-04              | 6.500E-04     | 1.062E-04     | -               |
| $\lambda^*$             |                   | -               | 0.075                  | 0.057         | 0.068         | -               |
| $\kappa^*$              |                   | -               | 0.025                  | 0.032         | 0.030         | -               |
| $c'$                    | kN/m <sup>2</sup> | 10              | 7                      | 10            | 5             | -               |
| $\phi'$                 | °                 | 30              | 27                     | 30            | 30            | -               |
| $\nu'$                  |                   | 0.3             | -                      | -             | -             | -               |
| $\psi$                  | °                 | 0               | -                      | -             | -             | -               |
| $R_{\text{inte}}$       |                   | 1.0             | 1.0                    | 1.0           | 1.0           | 1.0             |
| $r$                     |                   |                 |                        |               |               |                 |
| $EA$                    | kN/m              | -               | -                      | -             | -             | 13.5            |
| $E$                     | kN/m <sup>2</sup> | 8,500           | -                      | -             | -             | -               |

## Results and Discussions

There were 2 major analyses in the parametric study carried out to fulfill the aim of this paper, i.e, the determination safe of height of embankment placed on soft ground and the determination of effect of spacing and geotextile reinforcement on deformation on a case embankment. All analysis used undrained condition for the foundation soil while for the embankment was used in drained condition. The analyses were analyzed by using software PLAXIS Version 8.2. Figure1 shows the geometrical modelling and soil profile that used to in PLAXIS.

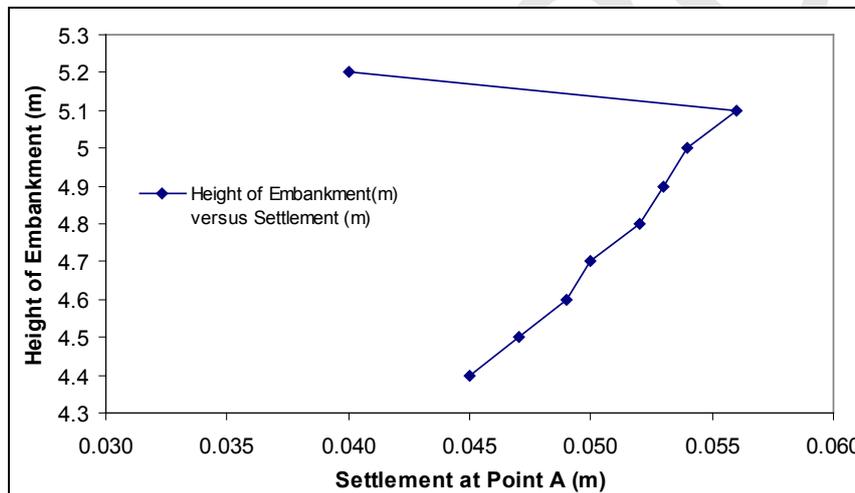


**Figure 1:** Geometrical modeling of embankment

Table 2 shows that the highest height for embankment could be constructed is up to 4.9 meters. It was based on that, immediately after filling reached height of 5 meters, the embankment started to show the failure. In addition, these results also coincide with soft soil behaviors in Malaysia where most of the soft soil in Malaysia could be as embankment height up to 5.5 meters (Muar Trial Embankment Report, 1989). These results also are proved by using Terzaghi's Ultimate Bearing Capacity equation where the maximum height is 4.4 meter. In this case, the geotextile have been installed at the interface between embankment and foundation soil which reported by Othman (2012). Figure 2 shows the settlement profiles from various height of embankment.

**Table 2 :** Result of settlement for various heights of embankments

| Height of Embankment (m) | Settlement at Point A (m) |
|--------------------------|---------------------------|
| 4.4                      | 0.045                     |
| 4.5                      | 0.047                     |
| 4.6                      | 0.049                     |
| 4.7                      | 0.050                     |
| 4.8                      | 0.052                     |
| 4.9                      | 0.053                     |
| 5.0                      | 0.054                     |
| 5.1                      | 0.056                     |
| 5.2                      | 0.040                     |


**Figure 2:** Settlement profile for various height of embankment

The typical geotextiles deployment scheme used in designing the geotextile reinforcement were 0.5 m, 1.0 m and 1.5 m. In order to see the effect on the spacing of the geotextile reinforcement the 3 m and 5 m embankment were chosen. The geotextile that had been used in this study is elastic model and 13.5 kN/m for the elastic normal (axial) stiffness, EA value. Table 3 and 4 show the detail of parametric value and result for spacing of geotextile reinforcement.

**Table 3 : Result of effects of spacing for 3 m embankment**

| Height Embankment (m) | UR Embankment (m) | Case   | Spacing (m) | Settlement (m) |
|-----------------------|-------------------|--------|-------------|----------------|
| 3                     | 0.027             | Case 1 | 1.0         | 0.022          |
|                       |                   | Case 2 | 1.5         | 0.024          |

**Table 4 : Result of effects of spacing for 5 m embankment**

| Height Embankment (m) | UR Embankment (m) | Case   | Spacing (m) | Settlement (m) |
|-----------------------|-------------------|--------|-------------|----------------|
| 5                     | 0.054             | Case 1 | 0.5         | 0.044          |
|                       |                   | Case 2 | 1.0         | 0.047          |
|                       |                   | Case 3 | 1.5         | 0.043          |

If the height of embankment is 5 meter, the embankment will definitely fail, but by entering the geotextile on the embankment with 0.5 meters spacing between the geotextile, the soil still can support the embankment with deformation 0.299 meters. However, when using 1 meter spacing between the geotextile, the embankment failed.

For the embankment case study it purposed height of embankment is 3 m and layer of geotextile at the bottom and in the middle of the embankment fill. With the result data in the earlier analysis, it can be expected to this embankment case study area will not fail. After the analysis using PLAXIS Version 8.2, the prediction that already made in the earlier was correct. The soil can support the embankment with vertical settlement 0.024 meters.

## Conclusions

In this paper, the simulation results of the embankment constructed on soft ground reinforced by geotextile using Plaxis software have been presented. Based on the results, it was found that commonly height of embankment can be constructed on soft ground in Malaysia is in the range 4 m to 5.5 m. The height of embankment and spacing between the geotextile reinforcement influence the deformation of an embankment. For typical maximum height of embankment on soft ground from this paper is 4.9 m, the spacing on the geotextile reinforcement in the embankment is about equal and less than 1 m, for ensuring its stability againts excessive settlement.

## Acknowledgements

The authors would like to thank to individual, groups of researchers and company involved in this research for their guidance and support. The appreciation is also addressed to Ministry of Higher Education (MOHE) of Malaysia and Universiti Teknologi Malaysia (UTM) through research project under the Research University Grant (RUG) Program, Vot No. Q.J130000.7122.05J79 for financial support.

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# SIMULATION OF SYNTHESIS GAS PRODUCTION BY TRIREFORMING OF METHANE

Shikha Singh, and Sheeba Jilani

Department of Chemical Engg., Aligarh Muslim University, Aligarh, India

[Sheeba\\_jilani@yahoo.co.in](mailto:Sheeba_jilani@yahoo.co.in)

**Abstract**-The proposed work outlines the modeling aspects of kinetic evaluation for four types of reforming process namely, trireforming of methane (TRM), partial oxidation of methane (POX), dry reforming of methane (DRM) and steam reforming of methane (SRM) for production of synthesis gas (syngas). The computational simulation of the four techniques by Matlab 7 indicated trireforming technique to be best among all as the obtained results for methane ( $\text{CH}_4$ ) conversion (>97%), carbon dioxide ( $\text{CO}_2$ ) conversion (68%) and  $\text{H}_2/\text{CO}$  ratio (1-2) were best for the latter case.

**Keywords:** Trireforming, partial oxidation, dry reforming, steam reforming, synthesis gas,  $\text{H}_2/\text{CO}$  ratio

## Introduction

The natural reserves all over the world are depleting at a faster rate as consumption of non renewable sources like coal and natural gas (NG) have endangered the existence of these resources. So, it draws attention towards searching an alternative like conversion of NG to high energy content fuels like synthesis gas and other distillates. The composition of natural gas comprises of methane, propane, butane, pentane and traces of hexane and heptanes. Natural gas could play a significant role for production synthesis gas (Syngas) via various reforming techniques. Syngas comprises of hydrogen ( $\text{H}_2$ ) and carbon monoxide (CO). The syngas produced serves as the feedstock in a variety of downstream processes, such as methanol synthesis, Fischer-Tropsch synthesis or ammonia synthesis. During gas-to-liquid processes, NG needs to be converted into syngas; about 60-70% of cost incurred for overall process is due to syngas production. Steam reforming of methane is a mature reforming technique but the need for high temperatures due to its endothermic nature makes it an expensive process. The concern with the economic viability issue led to the development of alternative processes of methane reforming, such as dry reforming, auto thermal reforming and partial oxidation. Dry reforming of methane gives high  $\text{H}_2/\text{CO}$  ratios but the formation of coke renders a major setback to this technique as coke formation threatens catalyst life and thereby enhancing the cost of process. Another reforming technique, partial oxidation of methane is an exothermic process and, thus, can be considered more economic than the processes of steam reforming or dry reforming, because it requires a lower amount of thermal energy. On the other hand, partial oxidation is considered an expensive process because it requires a flow of pure oxygen. Thus, there is a warning of danger that is inherent in the process of partial oxidation of methane, since the two reagents ( $\text{CH}_4$  and  $\text{O}_2$ ) can cause an explosion if the reaction is not conducted with the necessary care. The tri-reforming of methane (TRM) is a synergetic combination of the endothermic dry reforming of methane (DRM), exothermic partial oxidation of methane (POM), and steam reforming of methane (SRM). Cho et al., 2009 developed a new DME (dimethyl-ether) process where syngas is provided by natural gas tri-reforming. They proposed a model for the tri-reforming process based on a mechanism including homogeneous gas-phase reactions and heterogeneous catalytic reactions. The Langmuir-Hinshelwood approach was applied with quantifications of kinetic and Langmuir parameters. In this work a nickel/ $\gamma$ -alumina supported catalyst was formulated and employed to process the methane tri-reforming reactions in order to operate with activity and stability for the syngas production. A kinetic evaluation was performed to be applied in the process development. A model considering a proposition of a mechanism of four step reactions was formulated and fitted to the concentration measurements of a lab-scale reactor. The model was employed to predict operation conditions where low methane and carbon dioxide conversions occurred and higher hydrogen yield were obtained. Hong-Tao et al., 2007 investigated the thermal effects in a catalyst bed for the fixed-bed tri-reforming of methane over  $\text{Ni}/\text{Al}_2\text{O}_3$  (1.0 bar, 1,023–1,223 K). The results indicated that the temperature gradient of the catalyst bed in methane tri-reforming is smaller than in methane partial oxidation. During the tri-reforming operations, various side reactions of coke formation and elimination occurred simultaneously. Studies found indications through evaluations of steps of the tri-reforming process that confirmed the results obtained. M. Halmann et al., 2006, proposed process for syngas production based on the tri-reforming of such flue gases with natural gas could be an important route for  $\text{CO}_2$  emission avoidance. In

addition, by combining the carbothermic reduction of iron oxide with the partial oxidation of the carbon source, an overall thermo neutral process was designed for the co-production of iron and syngas rich in CO. In this work, models have been developed for the kinetic processes of reforming techniques namely, tri-reforming, steam reforming, dry reforming and partial oxidation of methane. The set of ordinary differential equations have been solved by ODE45 solver of Matlab tool box. The various results were compared and the best one was quoted among them. The results indicated tri-reforming of methane to be the best technique among all in terms of methane conversion, carbon dioxide conversion and H<sub>2</sub>/CO ratio.

## Model Development

The kinetic models for processes of steam-reforming, dry-reforming, partial oxidation of methane and tri-reforming were developed considering a micro fixed reactor ( $h_{\text{reactor}}=64.0$  cm,  $h_{\text{bed}}=2.0$  cm,  $d_{\text{reactor}}=212\mu\text{m}$ ) under atmospheric pressure and temperature of 1123K on nickel catalyst bed on gamma-aluminum tri-oxide support (Ni/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub>). The ratio of mixture of reactants of feed (natural gas, NG) was considered as CH<sub>4</sub>:CO<sub>2</sub>:H<sub>2</sub>O:O<sub>2</sub>/1.00:0.49:0.30:0.04 v/v and feed flow rate of 11.67 cm<sup>3</sup>/s was taken for the reforming processes. Methane steam reforming involves two reversible reactions, which were studied thoroughly by Xu, and Froment (1989).



The mass balances of the components are expressed as  $\frac{dP_i}{dt} + R_i = 0$ , where  $t$  (kg s/m<sup>3</sup>) is the spatial time.

$$\frac{dP_{\text{CH}_4}}{dt} = -\frac{\frac{k_1}{P_{\text{H}_2}^{2.5}} [P_{\text{CH}_4} P_{\text{H}_2\text{O}} - \frac{P_{\text{H}_2}^3 P_{\text{CO}}}{K_1}]}{\text{DEN}^2} - \frac{\frac{k_1}{P_{\text{H}_2}^{3.5}} [P_{\text{CH}_4} P_{\text{H}_2\text{O}}^2 - \frac{P_{\text{H}_2}^4 P_{\text{CO}_2}}{K_3}]}{\text{DEN}^2} \quad (4)$$

$$\frac{dP_{\text{CO}_2}}{dt} = \frac{\frac{k_2}{P_{\text{H}_2}} [P_{\text{CO}} P_{\text{H}_2\text{O}} - \frac{P_{\text{H}_2} P_{\text{CO}_2}}{K_2}]}{\text{DEN}^2} + \frac{\frac{k_1}{P_{\text{H}_2}^{3.5}} [P_{\text{CH}_4} P_{\text{H}_2\text{O}}^2 - \frac{P_{\text{H}_2}^4 P_{\text{CO}_2}}{K_3}]}{\text{DEN}^2} \quad (5)$$

$$\frac{dP_{\text{H}_2}}{dt} = 3 \frac{\frac{k_1}{P_{\text{H}_2}^{2.5}} [P_{\text{CH}_4} P_{\text{H}_2\text{O}} - \frac{P_{\text{H}_2}^3 P_{\text{CO}}}{K_1}]}{\text{DEN}^2} + \frac{\frac{k_2}{P_{\text{H}_2}} [P_{\text{CO}} P_{\text{H}_2\text{O}} - \frac{P_{\text{H}_2} P_{\text{CO}_2}}{K_2}]}{\text{DEN}^2} + 2 \frac{\frac{k_1}{P_{\text{H}_2}^{3.5}} [P_{\text{CH}_4} P_{\text{H}_2\text{O}}^2 - \frac{P_{\text{H}_2}^4 P_{\text{CO}_2}}{K_3}]}{\text{DEN}^2} \quad (6)$$

$$\frac{dP_{\text{CO}}}{dt} = \frac{\frac{k_1}{P_{\text{H}_2}^{2.5}} [P_{\text{CH}_4} P_{\text{H}_2\text{O}} - \frac{P_{\text{H}_2}^3 P_{\text{CO}}}{K_1}]}{\text{DEN}^2} - \frac{\frac{k_2}{P_{\text{H}_2}} [P_{\text{CO}} P_{\text{H}_2\text{O}} - \frac{P_{\text{H}_2} P_{\text{CO}_2}}{K_2}]}{\text{DEN}^2} \quad (7)$$

Dry reforming of methane mainly consists of following reaction (8), but generally it is accompanied by several secondary reactions of which the reverse water-gas shift reaction (9) appears to be the most important reaction.



The mass balances of the components are expressed as  $\frac{dP_i}{dt} + R_i = 0$ , where  $t$  (kg s/m<sup>3</sup>) is the spatial time.

$$\frac{dP_{\text{CH}_4}}{dt} = -\frac{k_1 K_{\text{CH}_4} (P_{\text{CH}_4} P_{\text{CO}_2} - \frac{P_{\text{CO}}^2 P_{\text{H}_2}^2}{K_1})}{(1 + K_{\text{CH}_4} P_{\text{CH}_4})} \quad (10)$$

$$\frac{dP_{\text{CO}_2}}{dt} = -\frac{k_1 K_{\text{CH}_4} (P_{\text{CH}_4} P_{\text{CO}_2} - \frac{P_{\text{CO}}^2 P_{\text{H}_2}^2}{K_1})}{(1 + K_{\text{CH}_4} P_{\text{CH}_4})} - k_2 (P_{\text{CO}_2} P_{\text{H}_2} - \frac{P_{\text{CO}} P_{\text{H}_2\text{O}}}{K_2}) \quad (11)$$

$$\frac{dP_{\text{H}_2}}{dt} = 2 \frac{k_1 K_{\text{CH}_4} (P_{\text{CH}_4} P_{\text{CO}_2} - \frac{P_{\text{CO}}^2 P_{\text{H}_2}^2}{K_1})}{(1 + K_{\text{CH}_4} P_{\text{CH}_4})} - k_2 (P_{\text{CO}_2} P_{\text{H}_2} - \frac{P_{\text{CO}} P_{\text{H}_2\text{O}}}{K_2}) \quad (12)$$

$$\frac{dP_{\text{CO}}}{dt} = 2 \frac{k_1 K_{\text{CH}_4} (P_{\text{CH}_4} P_{\text{CO}_2} - \frac{P_{\text{CO}}^2 P_{\text{H}_2}^2}{K_1})}{(1 + K_{\text{CH}_4} P_{\text{CH}_4})} + k_2 (P_{\text{CO}_2} P_{\text{H}_2} - \frac{P_{\text{CO}} P_{\text{H}_2\text{O}}}{K_2}) \quad (13)$$

Partial oxidation of methane involves one nonreversible reaction and two reversible reactions, which were thoroughly studied by Arai et al. (1986), and Ross et al. (1973).



The mass balances of the components are expressed as  $\frac{dP_i}{dt} + R_i = 0$ , where  $t$  (kg s/m<sup>3</sup>) is the spatial time.

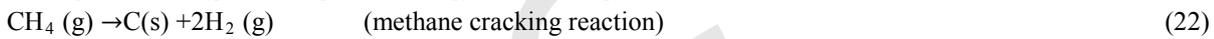
$$\frac{dP_{\text{CH}_4}}{dt} = -\frac{k_1 P_{\text{CH}_4} P_{\text{O}_2}^{0.5}}{(1 + K_{\text{CH}_4} P_{\text{CH}_4} + K_{\text{O}_2} P_{\text{O}_2})^2} - k_2 P_{\text{CH}_4} P_{\text{H}_2\text{O}} \left(1 - \frac{P_{\text{CO}} P_{\text{H}_2}^3}{k_2 P_{\text{CH}_4} P_{\text{H}_2\text{O}}}\right) - k_3 P_{\text{CH}_4} P_{\text{CO}_2} \left(1 - \frac{P_{\text{CO}_2} P_{\text{H}_2}^2}{k_3 P_{\text{CH}_4} P_{\text{CO}_2}}\right) \quad (17)$$

$$\frac{dP_{\text{CO}_2}}{dt} = \frac{k_1 P_{\text{CH}_4} P_{\text{O}_2}^{0.5}}{(1 + K_{\text{CH}_4} P_{\text{CH}_4} + K_{\text{O}_2} P_{\text{O}_2})^2} - k_3 P_{\text{CH}_4} P_{\text{CO}_2} \left(1 - \frac{P_{\text{CO}_2} P_{\text{H}_2}^2}{k_3 P_{\text{CH}_4} P_{\text{CO}_2}}\right) \quad (18)$$

$$\frac{dP_{\text{H}_2}}{dt} = 3k_2 P_{\text{CH}_4} P_{\text{H}_2\text{O}} \left(1 - \frac{P_{\text{CO}} P_{\text{H}_2}^3}{k_2 P_{\text{CH}_4} P_{\text{H}_2\text{O}}}\right) - 2k_3 P_{\text{CH}_4} P_{\text{CO}_2} \left(1 - \frac{P_{\text{CO}_2} P_{\text{H}_2}^2}{k_3 P_{\text{CH}_4} P_{\text{CO}_2}}\right) \quad (19)$$

$$\frac{dP_{\text{CO}}}{dt} = k_2 P_{\text{CH}_4} P_{\text{H}_2\text{O}} \left(1 - \frac{P_{\text{CO}} P_{\text{H}_2}^3}{k_2 P_{\text{CH}_4} P_{\text{H}_2\text{O}}}\right) + 2k_3 P_{\text{CH}_4} P_{\text{CO}_2} \left(1 - \frac{P_{\text{CO}_2} P_{\text{H}_2}^2}{k_3 P_{\text{CH}_4} P_{\text{CO}_2}}\right) \quad (20)$$

Tri-reforming is a synergetic combination of endothermic CO<sub>2</sub> reforming, and steam reforming and exothermic oxidation of methane. With this process concept, CO<sub>2</sub>, H<sub>2</sub>O, and O<sub>2</sub> in the flue gas from fossil-fuel-based power plants can be utilized as co-reactants for tri-reforming of natural gas for the production of synthesis gas. The set of reactions for the process are enlisted below:



The kinetic model for the reactions on Ni/γ-Al<sub>2</sub>O<sub>3</sub> by following reaction mechanism in which the rate expressions for reactions (21) – (24) are given by:

$$r_1 = \frac{k_1 K_{\text{CH}_4} C_{\text{CH}_4} K_{\text{O}_2} C_{\text{O}_2}}{(1 + K_{\text{CH}_4} C_{\text{CH}_4} + K_{\text{O}_2} C_{\text{O}_2})} \quad (25)$$

$$r_2 = \frac{k_2 K_{\text{CH}_4} C_{\text{CH}_4}}{(1 + K_{\text{CH}_4} C_{\text{CH}_4})} \quad (26)$$

$$r_3 = k_3 C_{\text{CO}}^2 \quad (27)$$

$$r_4 = \left( C_{\text{H}_2} C_{\text{CO}_2} - \frac{C_{\text{CO}} C_{\text{H}_2\text{O}}}{K_{\text{eq}}} \right) \quad (28)$$

The component relations  $R_i$  ( $i = \text{CH}_4, \text{CO}_2, \text{CO}, \text{H}_2$ ), based on rate laws of the four step reaction proposed above, are considered as:

$$R_{\text{CH}_4} = -r_1 - r_2$$

$$R_{\text{CO}_2} = r_3 - r_4$$

$$R_{\text{H}_2} = \frac{7}{4} r_1 - 2r_2 - r_4$$

$$R_{\text{CO}} = r_1 - 2r_3 + r_4$$

The mass balances of the components are expressed as  $\frac{dC_i}{dt} + R_i = 0$ , where  $t$  (kg s/m<sup>3</sup>) is the spatial time.

$$\frac{dC_{\text{CH}_4}}{dt} = -\frac{k_1 K_{\text{CH}_4} C_{\text{CH}_4} K_{\text{O}_2} C_{\text{O}_2}}{(1 + K_{\text{CH}_4} C_{\text{CH}_4} + K_{\text{O}_2} C_{\text{O}_2})} - \frac{k_2 K_{\text{CH}_4} C_{\text{CH}_4}}{(1 + K_{\text{CH}_4} C_{\text{CH}_4})} \quad (29)$$

$$\frac{dC_{\text{CO}_2}}{dt} = k_3 C_{\text{CO}}^2 - \left( C_{\text{H}_2} C_{\text{CO}_2} - \frac{C_{\text{CO}} C_{\text{H}_2\text{O}}}{K_{\text{eq}}} \right) \quad (30)$$

$$\frac{dC_{\text{H}_2}}{dt} = \frac{7}{4} \frac{k_1 K_{\text{CH}_4} C_{\text{CH}_4} K_{\text{O}_2} C_{\text{O}_2}}{(1 + K_{\text{CH}_4} C_{\text{CH}_4} + K_{\text{O}_2} C_{\text{O}_2})} - 2 \frac{k_2 K_{\text{CH}_4} C_{\text{CH}_4}}{(1 + K_{\text{CH}_4} C_{\text{CH}_4})} - \left( C_{\text{H}_2} C_{\text{CO}_2} - \frac{C_{\text{CO}} C_{\text{H}_2\text{O}}}{K_{\text{eq}}} \right) \quad (31)$$

$$\frac{dC_{CO}}{dt} = \frac{k_1 K_{CH_4} C_{CH_4} K_{O_2} C_{O_2}}{(1 + K_{CH_4} C_{CH_4} + K_{O_2} C_{O_2})} - 2k_3 C_{CO}^2 + (C_{H_2} C_{CO_2} - \frac{C_{CO} C_{H_2O}}{K_{eq}}) \quad (32)$$

The solutions of the these sets of mass balance system equations (4) - (7),(10) - (13) ,(17) - (20) and (29) - (32) were obtained with the 4th order Runge–Kutta method with the help of ODE45 solver from MATLAB toolbox. The operating parameters are enlisted in table 1, table 2, table 3 and table 4 [Xu and Froment (1986), Becerra et. Al (2003), Fernandes et. Al (2006), and Leonardo et. Al (2010)] .

**Table 1**

| PARAMETERS | PRE-EXPONENTIAL FACTOR                |
|------------|---------------------------------------|
| $k_1$      | 4.2248 (mol atm <sup>0.5</sup> / g h) |
| $k_2$      | 1.955 (mol/ g h)                      |
| $k_3$      | 1.0202 (mol atm <sup>0.5</sup> / g h) |
| $K_{CH_4}$ | 6.65 (atm <sup>-1</sup> )             |
| $K_{H_2O}$ | 1.77                                  |
| $K_{H_2}$  | 6.12 (atm <sup>-1</sup> )             |
| $K_{CO}$   | 8.23 (atm <sup>-1</sup> )             |
| $K_1$      | 7.846 (atm <sup>2</sup> )             |
| $K_2$      | 1.412                                 |
| $K_3$      | 1.11 (atm <sup>2</sup> )              |

**Table 2**

| PARAMETERS | PRE-EXPONENTIAL FACTOR  |
|------------|---|
| $k_1$      | $7.13 \times 10^5 \exp\{(-10.7 - 1.1) \times 10^4 / RT\}$<br>[mol g <sup>-1</sup> bar <sup>-1</sup> h <sup>-1</sup> ] |
| $k_2$      | $15.92 \exp\{(-64.8 - 38.0) \times 10^3 / RT\}$<br>[mol g <sup>-1</sup> bar <sup>-1</sup> h <sup>-1</sup> ]           |
| $K_{CH_4}$ | $4.01 \times 10^{-1} \exp\{(-74.6 - 26.0) \times 10^3 / RT\}$<br>[bar <sup>-1</sup> ]                                 |
| $K_1$      | 0.52 atm <sup>-1</sup>  |
| $K_2$      | 10 atm <sup>-1</sup>  |

**Table 3**

| PARAMETERS | PRE-EXPONENTIAL FACTOR                            |
|------------|---|
| $k_1$      | 1.10 [mol/s.g <sub>cat</sub> .Pa <sup>1.5</sup> ] |
| $k_2$      | 4.19 [mol/s.g <sub>cat</sub> .Pa <sup>1</sup> ]   |
| $k_3$      | 2.42 [mol/s.g <sub>cat</sub> .Pa <sup>1</sup> ]   |
| $K_{CH_4}$ | 6.65 [Pa <sup>-1</sup> ]                          |
| $K_{O_2}$  | 1.77 [Pa <sup>0.5</sup> ]                         |

**Table 4**

| PARAMETERS | PRE-EXPONENTIAL FACTOR                                   |
|------------|--|
| $k_1$      | $1.21 \pm 0.06$ mol/ g <sub>cat</sub> .s                 |
| $k_2$      | $3.91 \pm 0.16$ mol/ g <sub>cat</sub> .s                 |
| $k_3$      | $7.32 \pm 0.32$ m <sup>3</sup> / mol.g <sub>cat</sub> .s |
| $k_4$      | $1.04 \pm 0.05$ mol/ g <sub>cat</sub> .s                 |
| $K_{CH_4}$ | $2.93 \pm 0.11$ m <sup>3</sup> / mol                     |
| $K_{O_2}$  | $3.53 \pm 0.15$ m <sup>3</sup> / mol                     |
| $K_{eq}$   | $1.07 \pm 0.06$ m <sup>3</sup> / mol                     |

## Results:

From the plots (fig.1,fig.2,fig.3 ) it can be concluded that the **Methane Conversion** is highest in trireforming i.e. 97.8% while in case of steam and dry reforming it is 93.92% and 95.88% respectively. The results for partial oxidation of methane show 96.18% of methane conversion. Thus it can be seen that trireforming results in higher methane conversion as compare to other reforming techniques. The **CO<sub>2</sub> Conversion** with respect to time is found to be 67.8323% in case of trireforming while for SRM, DRM and POM it results in 47.755%, 58.103%, and 51.6253% of CO<sub>2</sub> conversion respectively. The **H<sub>2</sub>: CO Ratio** is found to be in range of 1.1-1.97 for trireforming of methane while dry reforming of methane the shows a trend of H<sub>2</sub>: CO ratios lower then 1.The range for partial oxidation varies from 1.1-1.7 comparable to TRM process. On the other hand, steam reforming of methane results in highest range of H<sub>2</sub>: CO ratio i.e. 2.1-3 among all the four discussed reforming strategies. It should be pointed out that the H<sub>2</sub>: CO ratio in synthesis gas is important since synthesis gas with different H<sub>2</sub>: CO ratios have different applications in industry. The current major applications of synthesis gas include methanol synthesis and fisher-Tropsch (F-T) synthesis that require synthesis gas with a H<sub>2</sub>: CO ratio in range of 1-2.The H<sub>2</sub>: CO ratio obtained in case of dry reforming is lower than or equal to 1 due to which the composition is not stoichiometric with F-T reactions. Moreover, this kind of synthesis gas (H<sub>2</sub>: CO ≤ 1) requires further treatment in order to be applied in methanol and F-T synthesis. Similarly syngas obtained from steam reforming cannot be directly applied in methanol or F-T synthesis due to high values of H<sub>2</sub>: CO ratios usually 3 or larger then 3.Although POM produces syngas in considerable H<sub>2</sub>: CO ratio of range 1-2, this reaction is difficult to control due to its exothermic feature and is dangerous and expensive due to handling of pure oxygen

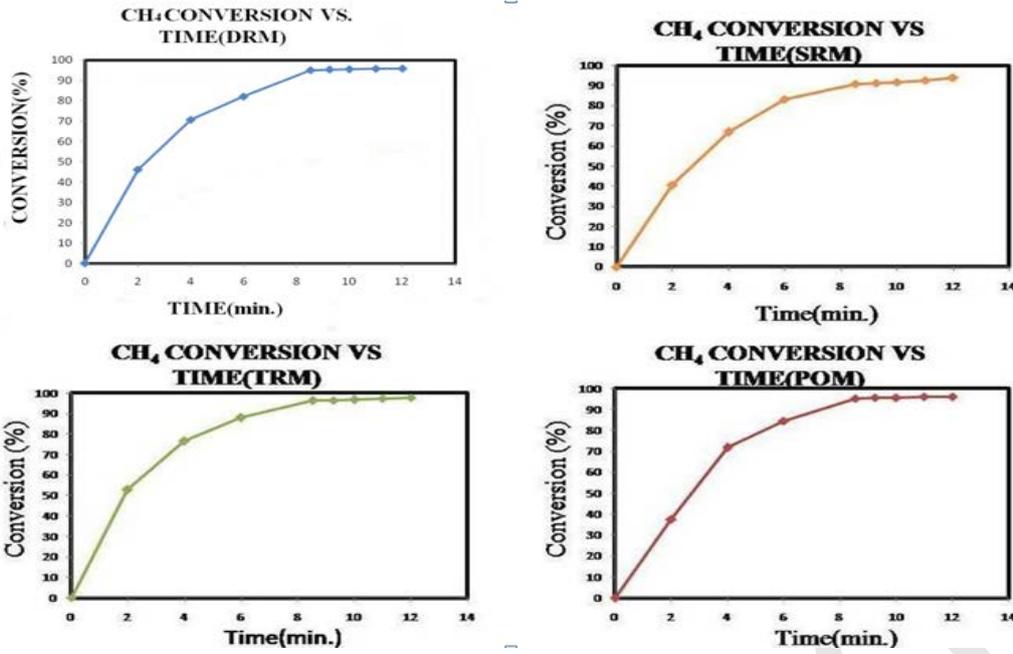


Fig.1 CH<sub>4</sub> Conversion (%) versus Time (min.)

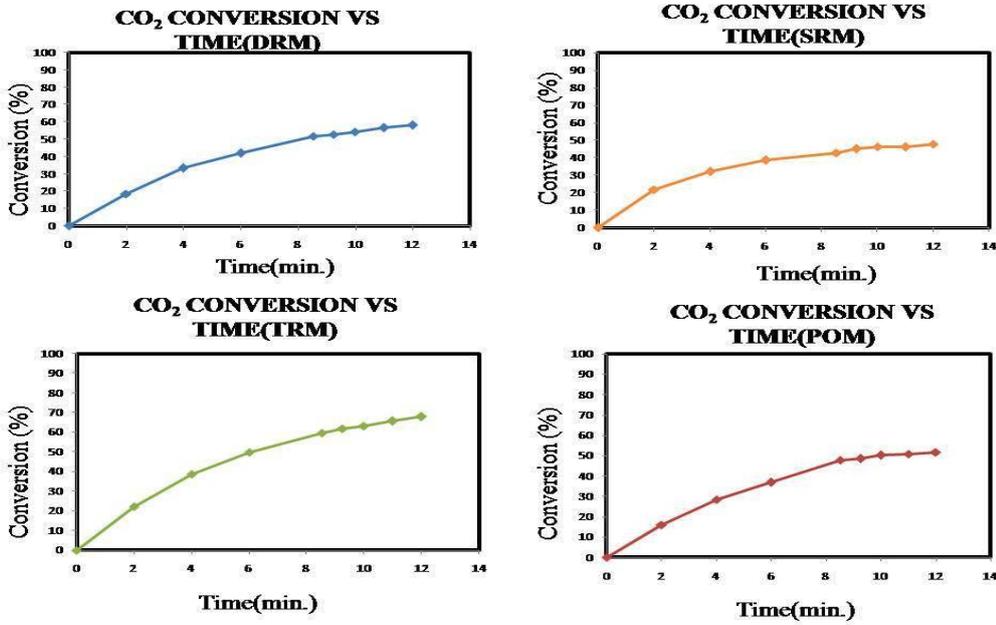
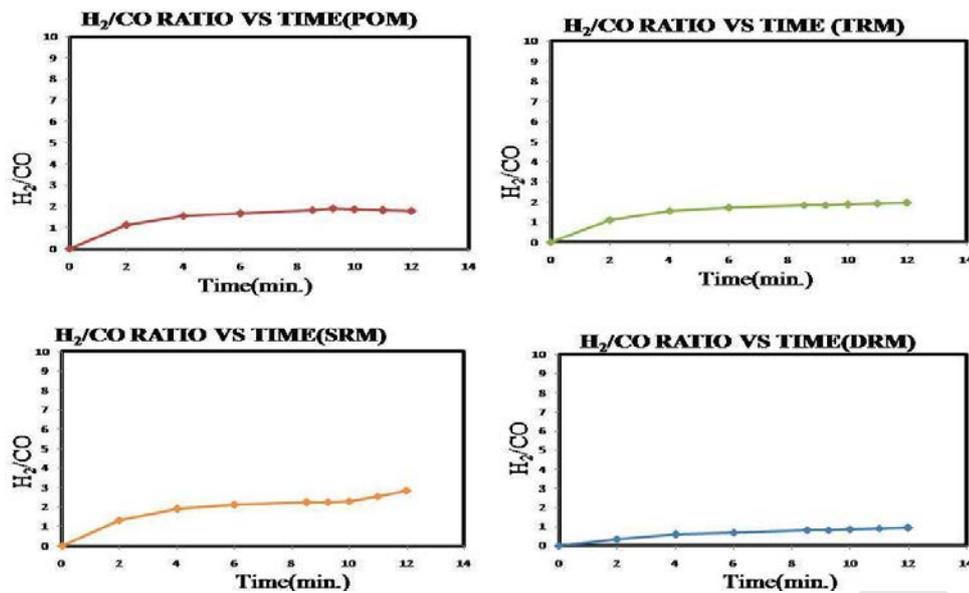


Fig.2 CO<sub>2</sub> Conversion (%) versus Time (min.)


 Fig.3 H<sub>2</sub>/CO Ratio versus Time (min.)

### Conclusions:

The reforming of methane was studied from modeling point of view in a micro fixed reactor. A comparative analysis indicated that Tri-reforming is more desired for producing syngas with desired H<sub>2</sub>/CO ratios of 1.5-2.0 compared to CO<sub>2</sub> reforming, steam reforming and partial oxidation of methane. Moreover, Tri-reforming of methane can be achieved successfully with high conversion (>97%) and high CO<sub>2</sub> conversion (>68%) for producing syngas with desired H<sub>2</sub>/CO ratios of 1-2 over supported nickel catalyst at 1123 K under atmospheric pressure. The tri-reforming of methane is a challenging technology and requires more research work like energy management, effective conversion of CO<sub>2</sub> and integration of the new process for industrial scale applications.

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### Nomenclature

- $k_i$  (i=1,2,3...n)-Kinetic parameters of the step reactions of reforming process  
 $K_i$  (i=1, 2, 3...n)- Equilibrium parameters of the step reactions of reforming process  
 $r_j$  (j=1,2,3..n)- Rate laws for reaction steps  
 $R_j$  (j=1,2,3..n)- Mass balance equations for the components  
 $X_i$  (i=1,2,3..n)-Conversion of components  
 $P_i$  (i=1,2,3..n)-Partial Pressure of components  
 $P$ -Total Pressure of the System  
 $C_i$  (i=1,2,3..n)-Concentration of components  
 $F_i$  (i=1,2,3..n)-Molar Flow Rate of components  
 $F$ -Total Flow Rate of Feed  
 $r_1$  -Radius of the reactor  
 $z$ -Length of the reactor  
 $t$ =time

# SIMULATION OF THE DYNAMIC BEHAVIOR OF ROTORS BY INTRODUCING HYSTERESIS PARAMETERS FOR THE CONTROL OF VIBRATION AMPLITUDES

K. Lebchek and T. Outtas

Laboratory of Structural Mechanics and Materials  
 faculty of technology - University of Batna

klebchek@hotmail.com, klebchek@yahoo.fr Tel/fax : 033 81 21 43

**Abstract** The aim of this work is the study of behavior of rotor dynamics of industrial turbines, using numerical simulation. Finite element model was developed by introducing a new hysteresis parameter to control more precisely the behavior of rolling bearings. The finite element model is used to extract the natural frequencies and modal deformed rotor vibration, as it identifies the constraints acting on the system and predict the dynamic behavior of the rotor transient. Results in Campbell diagram and those relating to the unbalance responses show significant amplitude differences in the parameters of hysteresis imposed.

**Key words:** rotor dynamics, hysteresis, finite element, rotor vibration, unbalance responses, Campbell diagram.

## Introduction

The rotors are defined like any element turning around a fixed axis. The field of the rotors is vast, for example the animated geostationary satellites of a free rotation being in accordance with the definition of the rotors, such rotors are called free rotors, in opposition to the fixed rotors which are supported by stages. The fixed rotors are present in many fields: aeronautics, the car, nuclear power or oil industry. In our study, one will focus oneself on the fixed rotors, more precisely on those with horizontal axis applied in particular to the rotors of turbines of electrical production. The axial vibrations and of torsion are uncoupled from the vibrations more of inflection in which one is interested more particularly in overall dynamics. Essential studies of the dynamics of the rotors concerning the layout of the diagram of Campbell who represents the evolution of the Eigen frequencies according to the number of revolutions and the calculation of the answers to unbalance mainly at the time of the passage the critical velocities. The existence of the gyroscopic moments responsible for the variation of the Eigen frequency according to the number of revolutions or that of circulatory forces, make the movement unstable starting from a certain speed in the linear field. The set of themes approached within the framework of this work relates to the study of the dynamic stability of horizontal rotors, and more precisely the rotors of turbines industrial.

## Modeling mathematical formulation

Rotor systems usually consist of many disks attached to a shaft that are constrained by bearings, dampers, seals etc. to a small lateral motion. For simplicity, a horizontal Jeffcott rotor with a disk of mass  $m$  mounted at mid-span of a massless elastic shaft is considered in this study. The coordinates  $x, y$  and  $\zeta, \eta$  represent the stationary and rotating axes. The eccentricity of the mass center of the disc from the geometric centre of the disc is  $e$ . The rotational speed and the damping coefficient are  $\Omega$  and  $c$ , respectively.

Since the local flexibility induced by the transverse crack generates equations of motion with periodic stiffness coefficients in the fixed reference frame, the equations of motion of Jeffcott rotor are expressed in a rotating frame as follows:

$$\begin{aligned} m\left(\ddot{\zeta} - 2\Omega\dot{\eta} - \Omega^2\zeta\right) + c\left(\dot{\zeta} - \Omega\eta\right) + k_{\zeta\zeta}\zeta + k_{\zeta\eta}\eta \\ = me\Omega^2 \cos\alpha - mg \cos\Omega t \\ m\left(\ddot{\eta} + 2\Omega\dot{\zeta} - \Omega^2\eta\right) + c\left(\dot{\eta} + \Omega\zeta\right) + k_{\eta\zeta}\zeta + k_{\eta\eta}\eta \\ = me\Omega^2 \sin\alpha + mg \sin\Omega t \end{aligned}$$

where  $k_{\zeta\zeta}, k_{\eta\eta}$  are direct stiffnesses along  $\zeta, \eta$  directions, and  $k_{\zeta\eta}, k_{\eta\zeta}$  are cross-coupled stiffness's.

The setting in equations of a system of solids, connected by flexible elements (of known stiffnesses) and of the shock absorbers (of constant data) provides one exact modeling of the system. The finite element method (MEF) breaks up a structure in small simple elements, discretized, of standard beam, plate, rotor... the vibratory behavior of the element is brought back to that of the nodes. Then one connects the various elements (grid) by observing the conditions of continuity. we can extract the matrices from mass and stiffness of the structure complete and deduce the own pulsations from the system not deadened and its normal modes. This tool for simulation of mechanical systems allows to better understand the

behavior of a rotor. The gyroscopic effect must be taken into account and of the methods of resolution specific can be advantageously employed.

**For the disk :**

$$T_d = \frac{1}{2} M_d (\dot{u}^2 + \dot{w}^2) + \frac{1}{2} I_{dx} (\dot{\theta}^2 + \dot{\psi}^2) + \frac{1}{2} I_{dy} (\Omega^2 + 2\Omega\dot{\psi}\theta)$$

$$\frac{d}{dt} \left( \frac{\partial T}{\partial \dot{\delta}} \right) - \frac{\partial T}{\partial \delta} = \begin{bmatrix} M_d & 0 & 0 & 0 \\ 0 & M_d & 0 & 0 \\ 0 & 0 & I_{dx} & 0 \\ 0 & 0 & 0 & I_{dx} \end{bmatrix} \begin{bmatrix} \ddot{u} \\ \ddot{w} \\ \ddot{\theta} \\ \ddot{\psi} \end{bmatrix} + \Omega \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -I_{dy} \\ 0 & 0 & I_{dy} & 0 \end{bmatrix} \begin{bmatrix} \dot{u} \\ \dot{w} \\ \dot{\theta} \\ \dot{\psi} \end{bmatrix}$$

**For the shaft:**

$$T_a = \frac{\rho S}{2} \int_0^L [\delta \dot{u}' N_1' N_1 \delta \dot{u} + \delta \dot{w}' N_2' N_2 \delta \dot{w}] dy + \frac{\rho I}{2} \int_0^L \left[ \delta \dot{u}' \frac{dN_1'}{dy} \frac{dN_1}{dy} \delta \dot{u} + \delta \dot{w}' \frac{dN_2'}{dy} \frac{dN_2}{dy} \delta \dot{w} \right] dy$$

$$- 2\rho I \Omega \int_0^L \delta \dot{u}' \frac{dN_1'}{dy} \frac{dN_2}{dy} \delta \dot{w} dy + \rho I L \Omega^2$$

The deformation energy is obtained from the expression :

$$U_a = \frac{EI}{2} \int_0^L \left[ \delta u' \frac{d^2 N_1'}{dy^2} \frac{d^2 N_1}{dy^2} \delta u + \delta w' \frac{d^2 N_2'}{dy^2} \frac{d^2 N_2}{dy^2} \delta w \right] dy$$

**For the bearings:**

The characteristics of stiffness and damping connect the forces to displacements and speeds. The influence of the slopes and the moments is usually neglected. :

$$\begin{bmatrix} F_u \\ F_\theta \\ F_w \\ F_\psi \end{bmatrix} = - \begin{bmatrix} k_{xx} & 0 & k_{xz} & 0 \\ 0 & 0 & 0 & 0 \\ k_{zx} & 0 & k_{zz} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} u \\ \theta \\ w \\ \psi \end{bmatrix} - \begin{bmatrix} c_{xx} & 0 & c_{xz} & 0 \\ 0 & 0 & 0 & 0 \\ c_{zx} & 0 & c_{zz} & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \dot{u} \\ \dot{\theta} \\ \dot{w} \\ \dot{\psi} \end{bmatrix}$$

The first matrix is a matrix of stiffness, the second a matrix of viscous damping. These matrices are generally not symmetrical (hydrodynamic bearings) and the terms can vary in a important manner according to the number of revolutions .

**For the mass unbalance :**

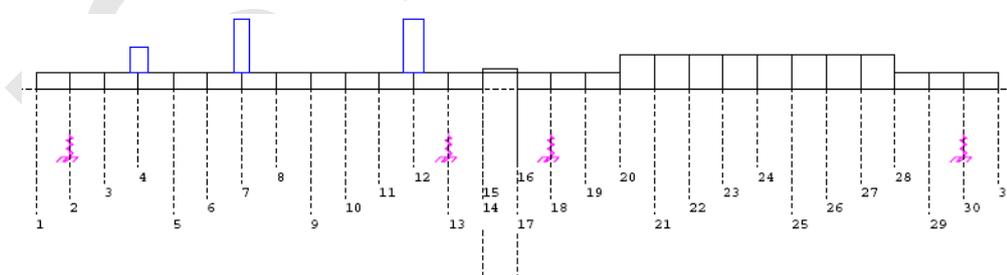
The general expression of the kinetic energy due to an unbalance is given below, the application of the equations of

$$\frac{d}{dt} \left( \frac{\partial T}{\partial \dot{\delta}} \right) - \frac{\partial T}{\partial \delta} = -m_b d \Omega^2 \begin{bmatrix} \sin \Omega t \\ \cos \Omega t \end{bmatrix}$$

Lagrange gives:

## Results and discussion

The model of compressor object of studied is modeled and discretized by the computation software of the dynamic rotors of the laboratory of Dynamics of the Machines and the Structures INSA de Lyon, by considering a rotor discretized in 31 nodes and three stages of comparable turbines to full discs, the complete rotor is supported by four elastic bearings with damping. The rotor is supposed to be coupled with a motor reducer with an elastic joining with variable, compensation stiffness of stability.



**Figure 1:** discretization of rotor by 31 nodes and 4 elastic bearings

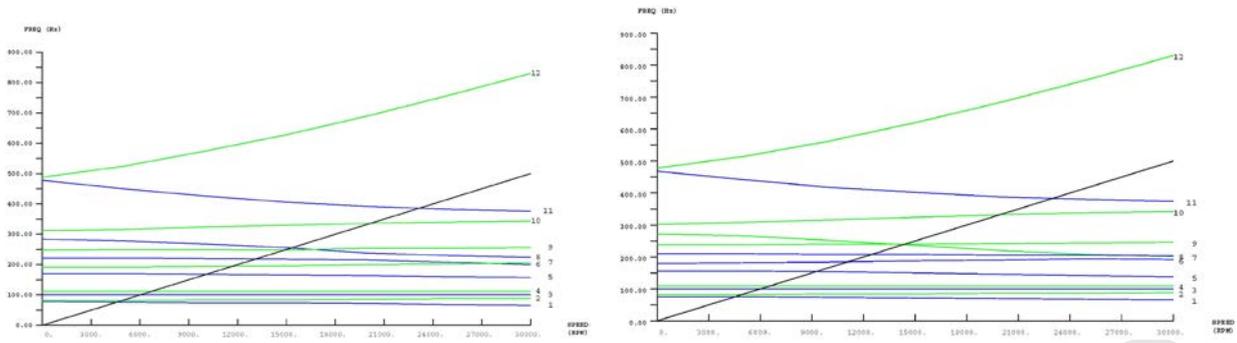


Figure 2: Campbell diagrams, (a) rotor without surigidity, (b) rotor with surigidity

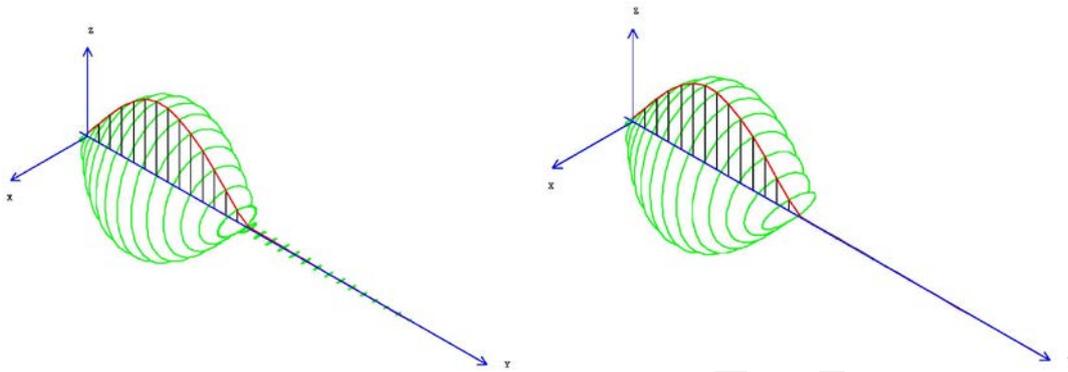


Figure 2: modes in rotation, (a) mode 2 without surigidity, (b) mode 2 with surigidity

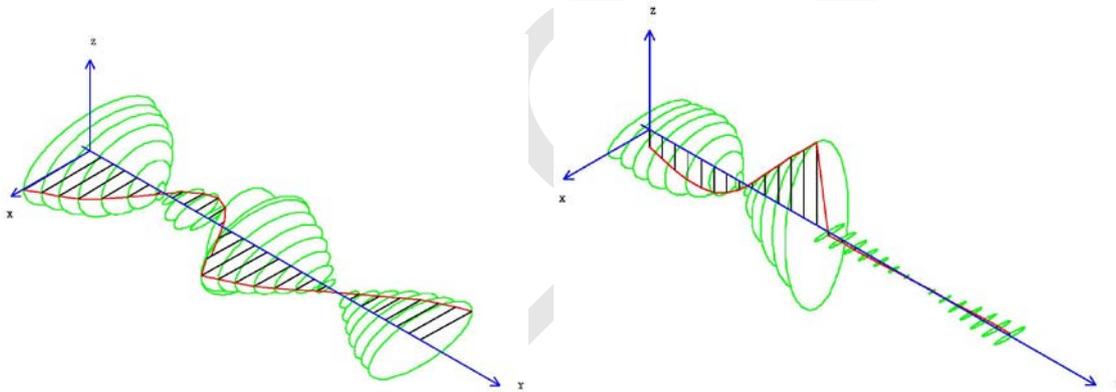


Figure 3: modes in rotation, (a) mode 6 without surigidity, (b) mode 6 with surigidity

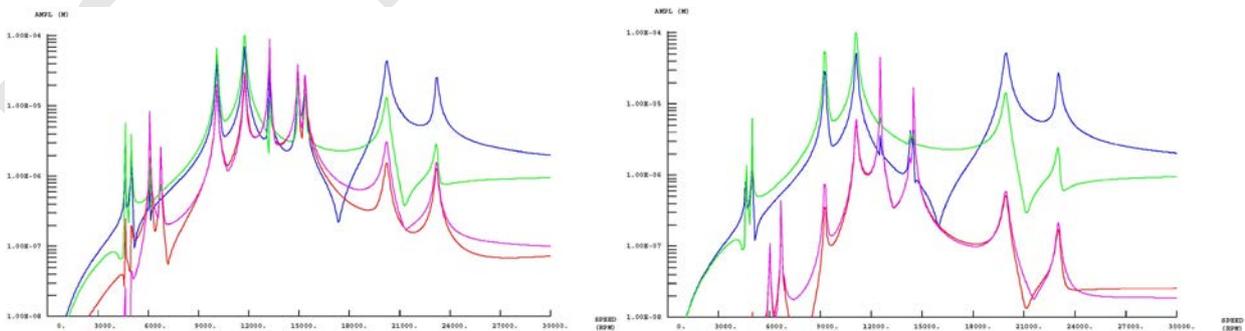


Figure 4: mass unbalance, (a) without surigidity, (b) with surigidity

### Discussion and conclusions

#### a) Sensitivity of the modes suitable for an excitation

The clean modes taken into account are those of which frequencies are inside or close to the beaches speed of operation there understood during the launching phase.

**b) Diagram of Campbell**

One visualizes the whole of these calculations using a diagram of Campbell associated with the deformation with the clean modes, such as represented on the figures V-2 and V-8. Frequencies of excitation taken into accounts are from 0 to 900 Hz. We notice the extent of stability for all the beaches number of revolutions from 0 to 30000 tr/min, and that in the case of direct or opposite precession. The same remarks and observations are to be emitted for case of the rotor with additional rigidity.

**c) Positioning critical velocities**

The critical velocities must be far away from the normal beach of operation of the line of trees. It is understood easily that them desirable margins of separation between critical velocities and beach of operation are function of the damping of the modes considered and that they increase when damping decreases. One will refer usefully to the API codes (American Petroleum Institute) [5] [6] [7], which defines, according to damping, them minimal margins of separation between a critical velocity and the beach of operation. In conclusion, a critical velocity, result of a first study, not answering this criterion, must then be either moved, or deadened more, while intervening on the geometry of the mobiles and on the characteristic of the stages.

**d) Modes of rotations**

Curves represented in figures (V-3 with V-6) and (V-9 with V-12) in the case of surigidity of the rotor, the deformations of the rotor represent in space in rotation, more precisely the trajectories of the centers gravities of various points of the rotor. In both cases, namely normal rotor or rotor with rigidity additional, the curves represent 2nd mode of inflection with 8th mode of inflection, present elliptic trajectories because gyroscopic coupling, we notice that the ellipses are all the more flattened since the anisotropy of the stages is high. We as noticed as the amplitudes of vibration evolve proportionally at rotational frequencies for each mode of rotation.

**e) answer to the mass unbalance**

Software used for the determination of the clean modes of inflection also make it possible to carry out calculations of answer to one unbalance. This analysis consists in determining, for each one of critical velocities, the response of the rotor to preset unbalances and judiciously placed in order to have an important answer of rotor. Thus, to evaluate the incidence of an unbalance on the first mode of inflection, one will place this unbalance to the maximum of the deformation, that is to say with vicinity of the center of the rotor. On the other hand, for a mode of end of tree (figure 19), the unbalance will be placed at the end of this end of tree One then obtains the amplitude of the vibrations in each point of rotor for a given unbalance. These calculations are to be realized on all

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## SOME ANALYSIS ON A FIRST COURSE IN LINEAR ALGEBRA

Sinan AYDIN  
Education faculty  
Kocaeliuniversity  
Turkey  
sinanaydin1704@yahoo.com

**Abstract:** The aim of this paper is to analyze some topics about linear algebra course, along with researches and opinions which are original and useful. The considered topics are the content, textbooks, students' learning profiles, teaching methods, using computer programs, and connections with other mathematics courses. According to the main results of the analyses, it is an oversimplification to think that there is a unique right way to teach this course. Although many mathematicians could expect that the first linear algebra as if were the same everywhere, the reality is different from this idea. The recent editions of linear algebra textbooks are usually good materials for what is being taught at the introductory level. It seems that only expressing and showing of teacher may not significantly improve students' learning of an abstract course. In recent years, linear algebra researchers have formulated some efficient teaching methods in order to facilitate meaningful learning. Software provides helpful visualization in two or three dimensional vector spaces. By the creating interactive environment of the computer programs, students can explore with matrices, linear transformations and numerical representations. And finally, there is an obvious connection between linear algebra, calculus, differential equations, and statistics.

**Keywords:** learning and teaching linear algebra, textbook, computer program

### Introduction

There is a general view expressed in the literature that students having problem with linear algebra course have very little understanding of the basic abstract concepts. Carlson (1993) stated that solving systems of linear equations and calculating products of matrices is easy for the students. However, when they get to subspaces, spanning, and linear independence students become confused and disoriented. Carlson (1993) further identified the reasons why certain topics in linear algebra are so difficult for students; presently linear algebra is taught far earlier and to less sophisticated students than before. The topics that create difficulties for students are concepts, not computational algorithms. Also, different algorithms are required to work with these ideas in different settings.

The effective ways to teach linear algebra is one of the main study subjects who focused on linear algebra teaching. When a teacher has taught a course a few years, it is very easy to slip into a routine teaching manner in this course. The textbook, the material, the lectures, the questions, all become familiar. The instructor has no hesitation what must be done each session of the course. In such a case, everybody knows the effective ways to teach linear algebra. But, it is suggested that there are deeper issues on the teaching the course that need a new modification (Carlson at al., 1993). Elementary linear algebra courses are taught large and very diverse students in the last years. How much emphasis should be done on theorems, proofs and applications? How abstract should the concepts be? How effect computer can be benefited? How connection is there with the other mathematics courses? And which teaching strategies are effective? These questions have revealed a wide interest in linear algebra teaching. There have been widespread discussions, workshops of experts, special sessions at the meetings and panels. Also, it has been presented many research articles and textbooks on linear algebra education. After all, what can be said about teaching linear algebra?

In this study, it is analyzed goals and content, students and teaching approaches, texts and computer software. By an educational perspective, nobody is professional the art of teaching linear algebra. It is not easy to say that there is a unique right teaching way for this course. Although many linear algebra teachers speak of the first linear algebra course as if it were the same everywhere, the reality is far, richer and more diverse (Harel, 1998). Even our student group described linear algebra courses for this study that reflect different goals, and approaches. The purpose of this article is to share some of these questions, along with resources and opinions.

### The Content

The Linear Algebra Curriculum Study Group (LACSG) recommended a core curriculum for a first linear algebra course (Carlson at al., 1993). The group members first interviewed from a variety of linear algebra instructors, and they developed their report after much discussion about that needs linear algebra and what is reasonable to teach in a first course, and how computer software should affect the teaching. As a result of the recommendations proposed by LACSG, the emphasis in linear algebra was shifted to a matrix-oriented course concentrating on applications and reducing the emphasizing on abstraction of concepts. While this shift in focus is valuable to mathematics and non-mathematics majors, the relegation of abstraction to an "also ran" in comparison to applications is doing mathematics

majors a great disservice. According to Alan Tucker (1993, p. 4), "linear algebra was positioned to be the first real mathematics course in the undergraduate mathematics curriculum because its theory is so well structured and comprehensive, yet requires limited mathematical prerequisites". It is the first class where undergraduates are expected to prove theorems and is thus a pivotal course with respect to their ability to conjecture and write coherent proofs. Tucker (1993, p.5) emphasizes that "A mastery of finite vector spaces, linear transformations, and their extensions to function spaces is essential for a practitioner or researcher in most areas of pure and applied mathematics". The content of many textbooks reflects the LACSG recommendations, and computer software (such as matlab and mathematica) has become more powerful (Howard, 1997; Richard, 1997; Kolman, 1999).

In 1998, a study group from the Park City Mathematics Institute (PCMI) considered the idea of trying to update this recommended curriculum, in light of how it is actually being used today (Day & Kalman, 1999). In the PCMI there were as many ways to construct a first linear algebra course as there were different departments' students for linear algebra, and they expect the first linear algebra course to play different roles in their own curriculum. Some have a large population of engineering students, with an emphasis on physical science applications. It was soon clear for the study group that no single model curriculum would serve the needs of all these different approaches, and they abandoned any hope of either updating the LACSG recommendations.

What should be the content of the first linear algebra course? After the above discussions, we can say that a first step toward answering this question is to decide what curriculum model makes sense at your department. That means your department must pay attention to what topics you hope the students will learn.

## Textbooks

Linear algebra did not really come to be recognized as a subject until the 1930's. Particularly influential in this process were the book of B. L. van der Waerden (1936) and the book of Garrett Birkhoff and Saunders MacLane (1941). Both were on "Modern Algebra" but included chapters on linear algebra. The separate linear algebra course became a standard part of the college mathematics curriculum in the United States in the 1950's and 1960's (Schneider & Barker, 1968). It appears that the Introductory linear algebra course was one of the first times it was offered there as a regular course in 1965 at Indiana University (Cowen, 1997).

From the 1970s until today, every concrete Linear Algebra textbook based approach starts with practical computations, such as Gaussian row reduction, or with applications such as systems of linear equations and progresses to the underlying concepts. It is driven by concrete forces and attempts to understand abstract concepts from examples (Anton, 1973). This approach has persisted into the 1990's (Lay, 1994).

I have reviewed eight recent editions of linear algebra books received from different publishers, to discern any general trends in the teaching of introductory linear algebra (Strang, 2005; Poole, 2007; Lawrence, Insel, & Friedberg, 2008). These texts are a good representative sample for what is being taught at the introductory level. Given that most authors of textbooks try to pack in enough material so as to make the text useable for more advanced linear algebra courses, it is not surprising that the general theory of vector spaces is introduced at some point towards the middle or the end of the text. Several authors introduce the language of the general theory early, first only in the context of  $\mathbb{R}^n$ , as a transition from the concrete to the abstract.

We see in these books that traditional applications of linear algebra which have tended to come from Physics and Engineering are now augmented by simple applications from disciplines such as Economics, Biology, and Computer Science. It would be rare indeed to see a linear algebra text nowadays without links to calculator and computer technology and without some discussion of computational issues. Some texts envision the technology as a fully integrated component, and others as an add-on. The technology aspect appears either in the form of an accompanying Lab manual, a reference to web-based activities, or as "technology exercises" at the end of each chapter. However, all of the texts are written in a way that allows one to use them without any technological components.

## Students' learning profiles

Who are linear algebra students? What are their goals? Why are they learning linear algebra? All of the subjects in linear algebra education, the issue of understanding how students learn is the one that made the greatest impact on the researchers (Dubinsky, 1997; Dorier, Robert, Robinet, & Rogalski, 2000). There is not a great deal of published literature on how students learn linear algebra. Guershon Harel has been studying some aspects of this for several years, and his papers provide some suggestions for linear algebra teachers (Katz, 1995; Harel, 1998). David Carlson (1993) presents an interesting hypothesis about the special difficulties that linear algebra presents for students, and Ed Dubinsky (1997) offers another point of view.

Many teachers accept that students have to construct their own knowledge in order to achieve meaningful learning. To be more accurate, we are, as teachers, not sure how to assist students in this construction, but it seems that simply showing what is true and telling students what we wish them to know is not generally sufficient. Several studies in calculus course have showed that students do not generally have a rich conceptual understanding of graphs and functions (Davis, & Vinner, 1996). It was analyzed that linearity and independence are also concepts with which most students struggle (Bogomonly, 1999). And it seems clear that simply doing a better job of telling and showing may not significantly improve their learning of such difficult topics.

The researchers (Day, & Kalman, 1999) from the Park City Mathematics Institute proposed that we should become better listeners. Specifically, they suggested that we select a few students and interview them in depth, instead of correcting their misconceptions. This means taking time to observe and listen carefully to what they are really doing when they think about linear algebra. Explore what the student is thinking, paying careful attention to the ideas behind what the student says. How does a student reach conclusions that we find wrong? Over time, such interviews may reveal some ways in the thinking and misconceptions of our students that lead us to a better understanding of how they learn.

As mathematicians, we are aware of the rich interconnections of different ideas and concepts in mathematics. We would like our students to learn how different ideas work together, supporting and validating each other. We know from experience that understanding of this kind is not acquired as a result of being told of each definition or principle. It develops through actively exploring a mathematical topic, discovering and rediscovering the interconnections until they become familiar and commonplace. But we who have developed understanding on this level risk forgetting the effort that came before: the missteps, false generalizations, incomplete and inconsistent conceptions. Meaningful learning is difficult to achieve and it rarely occurs unless students actively grapple with the ideas.

## Teaching strategies

The usability of computers has forced mathematicians to rethink the way they are teaching mathematics. When a calculation can be operated quickly and satisfactorily by a computer program, one has to ask 'what is it that a student really needs to learn?' As a response, at the least, students need to develop critical thinking skills, to understand well the main concepts of mathematics and to be able to apply them in different situations.

In his study, Herrero defined five strategies to effective using of computer in the teaching linear algebra (Herrero, 2000). The following strategies are described: (1) exploration of new concepts through computer exercises; (2) teaching linear transformations as early as possible; (3) emphasis on geometry; (4) teaching to write mathematics through development of a portfolio; (5) using computer projects for motivation and applications. The purpose of each of these projects is to introduce students to a new subject in linear algebra through a hands-on approach. They are intended to provide motivation for new definitions, show the need for the new theorems, make conjectures, and realize the usefulness of the new theorems by applying them to solve various problems. Computer-based instructions may lower the quality of learning if too much emphasis is placed on individual work with the computer. Incorporating technology into mathematics teaching works best, when it is done with teaching strategies that benefit from critical thinking and increase communication between students and teachers.

What can linear algebra teachers do to enrich lecturing, in order to better facilitate meaningful learning? Guershon Harel and Larry Sowder (2003) used an intense lecture-discussion method in his linear algebra classes at Purdue, which could be described as a rich extension of lecture. He insists that the students participate in working through all concepts. He uses MATLAB in a brief but important way, to facilitate examples: together the class figures out what must be calculated, how to do it and what results are expected; then he does the calculation and they discuss whether the results were what they expected and how to verify them.

Day (1997) applied "Mazur's polling method" in linear algebra classes. The author, in particular, tried a few variations on the method. She used polling spontaneously and very quickly, to liven up lectures (Show hands. Who thinks that idea will work? Who doesn't?). She also used it more formally after many students missed the following question on an early test: "True or False?" *If  $A$  and  $B$  are invertible then  $A + B$  is invertible.* Before returning the graded tests, she asked the class to vote on this question, and about half said "true", half "false". Then she asked students to find someone who disagreed with them and discuss which answer was really correct. She moved around, listening and occasionally asking pointed questions, for about 5 minutes. Then they voted again and about 80% got the correct answer. Some of the students who understood correctly explained how they went about answering it. This exercise took about 15 minutes, but it was a productive way to get students to think about how to analyze such a question, and to see how effective it can be to look for really simple examples.

## Using computer programs

Why and how to use technology is another question for linear algebra teaching. There are several different roles that technology can play in instruction, from eliminating computational drudgery in realistic applications, to providing environments for actively exploring the properties of mathematical structures and objects (Herrero, 2000). Linear algebra teachers have different views and experience using computer programs (MATLAB, Maple, Mathematica, Mathwright) in the lectures. Some of them assign computer projects to be done outside of class. Some use computer demos and examples to enrich lectures, and others rarely lecture at all, instead using software as a primary means for delivering mathematical material to the students, with a significant proportion of class time spent interacting with the computer.

The main purposes can be summarized from the different views about why and how to use software in teaching linear algebra are: for computation in meaningful applications; as a matrix calculator; as a direct focus of instruction;

for visualization; to provide an environment for active exploration of mathematical structures; and to explore some of the limitations of floating point calculations.

It is possible to find many applications that will be of interest to students from just about any background. However, in most real world problems, the dimensions of the matrices make hand calculation completely inadequate. Even with relatively low dimensional problems, the overhead of hand calculation quickly becomes distracting or simply overwhelming. Some teachers use technology just to provide students first-hand experience with real applications in realistic settings.

Calculators and software like Matlab, Maple, and Mathematica provide students a means of instantly and effortlessly performing matrix computations, and thus free them to concentrate on what the computations mean, and when and why to perform them (Tucker, 1993). Many instructors use software in this context. Rather, students are intended to answer questions about what happens when certain computations are performed, without having to think too much about the mechanics of carrying out the operations. For example, students might experiment with the effect of scalar or diagonal matrices as multipliers, without actually performing all the matrix multiplications by hand. Most instructors feel that doing some of the matrix multiplications by hand provides insight about why results appear as they do. But, we can say that the ability to rapidly investigate a large number of examples makes a contribution to understanding.

Software can provide helpful visualization with two and three dimensional graphics. The ATLAST project provides a number of excellent tools. For example, the program span plots in 3 space the images of a large number of vectors, under multiplication by a particular fixed matrix. Software can be used to create interactive environments in which students can explore and experiment with vectors, matrices, transformations, etc., with graphical, symbolic, and numerical representations. Usually students must learn some syntax to use the software, but it is possible to free them from that by creating activities with a windows-style point and click interface. Matlab supports this kind of development, and to a more limited extent, Maple and Mathematica can be used in a similar way. There is a version of Mathwright that is available for free on the Internet, along with sample activities for students (Mathwright, 2008). The library includes a few linear algebra activities.

## Connections with other mathematics courses

Guershon Harel (1997) has pointed out that calculus rests on a foundation of several years of background study at the secondary level, while linear algebra demands mastery of a number of critical ideas with little or no prior foundation. He goes on to propose that students be exposed to linear algebra at the secondary level, so that in college they have a suitable basis for abstraction and continued study.

What about students' prior knowledge is important for linear algebra teachers to consider? At the most concrete level, it is important to find out what linear algebra topics your students may already have seen. Have they worked with vectors, lines and planes in  $\mathbb{R}^3$ ? How many have already used matrix inversion on graphing calculators to solve linear systems? How many have worked with row operations? How do the answers impact your decisions about what to include in the course, and how long to spend on each topic (Cowen, 1997)?

The apparent connections between linear algebra, calculus, and differential equations are understandable by students. Also, it can be seen some contact points of linear algebra with other areas such as statistics and abstract algebra. The question of how to organize these connections is determined by linear algebra teachers. However, the prerequisites for linear algebra definitely affect what topics students can learn and how they can use them. If multivariable calculus is a prerequisite, then ideas about two and three dimensions that were presented in the calculus course can be more easily generalized in linear algebra. If students are required to see linear algebra first, then it can be used freely in calculus in the discussion of topics such as derivative and continuity (Katz, 1995). At many departments, neither of these courses is a prerequisite for the other. In that case, concepts like linearity of functions must be developed independently as needed in each course.

## Conclusions

How to teach linear algebra is an important research question. We all know how to teach this course, and none of us do. We all know in the sense that we all have a good idea what we will do the next session we are scheduled to teach that course. But we need to understand better how students learn, and to aware that the appropriate content, strategies and context will be different in different settings. There is no one right way to teach that course, and there are some issues that may not be definitively resolved. We hope that this article has had a useful effect on the reader, and that the references may provide resources for further study.

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# STANDARDIZATION BASED ON MULTIWEBSITE SYSTEM INTEGRATION

Dimitar DIMITROV

**Abstract:** This paper explores the standardization processes implemented in the software production industry using a multiwebsite system. Standardization in the industry is applied for better quality control, optimized management and increased customer approval and trust. Research and experiments on multiwebsite system architecture were conducted by the author. They led to a specification of architecture parts which can be subject to standardization. The multiwebsite architecture is based on SOA (Service Oriented Architecture) and Multitenant architectures. The multiwebsite architecture as a backbone of a web development company can help the establishment of quality and management standards. The established standards can be open for the public and closed for internal processes. Using the multiwebsite architecture a company can easily adjust the production and management processes according to international standards. The architecture involves mainly QA(Quality Assurance) and Management standards. This paper also covers possible certifications which a software development company can get by applying standards of a multiwebsite system. Applicable international standards as the ISO 9000 family including ISO 9001 and the subset standard ISO/IEC 90003 are also covered. The standardizations in a multiwebsite system will result in maximizing the efficiency of a software company making it competitive and organized.

**Key words:** Standardization, software development standardization, quality assurance.

## Introduction

The definition “multiwebsite system” refers to a system architecture which consists and controls a set of many websites. While analyzing software development technologies, new development frameworks impose standardization in the development processes. Software design patterns like Model View Controller - MVC (McArthur, 2008) are imposed as a leading standard in web development frameworks. The multiwebsite system architecture details are not a subject of this paper. For the purpose of this paper a short description of the architecture will be given to highlight its main features.

This paper describes the way the software development industry can increase the quality of its production by standardizing the development and management processes by multiwebsite system integration. The system architecture pushes the software development companies to create a company backbone. In the conventional website development even if the company integrates some quality and development standards it would be very hard to control the compliance with the standards. When the control is not good enough the standards will not be strictly followed and the quality of the end product will be lowered. When a company decides to integrate a multiwebsite system as a backbone of the development process not only they integrate a framework base for optimizing development time and cost, but also they integrate a development standard. The multiwebsite system defines all the protocols and defines a guideline to development and management processes. All new websites and modules can be developed using these standards only.

Standardization approaches proposed in this paper include coding standards, standards in the website creation process, standardization in the user interface, administration and customer support and standards in data exchange. Furthermore applying international standards in QA and management is also encouraged when using this type of system architecture. Certification in these standards is also a good practice but involves additional investments. The paper proposes some well recognized international standards which can be applied in this field.

## Multiwebsite system architecture

The software architecture is a set of unique websites with similar functionality. Each website of the set can have a different owner and can be controlled separately. The system can have many website owners and each owner can have many websites. Each owner can control all of his websites from a single administration point using a single sign on (SSO). When the core functionality is created all that the developers need to do is to develop the differences in each website. For example if all websites in the set has an average of 80% similarity in functionality, after building the core functionality based on the architecture to create a new unique website they build only the 20% difference. The other option is to have non-unique websites with unique content. In this case the core functionality will be prebuilt at 100%, and after the system is created all they need to do to create a new website is to add a new account for the new owner. That way a multiwebsite software system can optimize development processes to a level that small software companies can manage and support huge amount of clients in a certain field of development. For a brief example the core of the system can be e-commerce website. A software development company wants to build unique e-commerce websites and

sell them. The difference is in the design and in certain specific modules. When the core is ready it is reused for each customer automatically and the development is led down to the design and the custom modules. Mostly there can be prebuilt designs which are not unique. In this case if custom design is not needed the e-commerce website can be built with a click of a button.

To optimize the processes in a software company which uses multiwebsite system architecture standardization is highly recommended.

## Experiments and results

The experiments for the research were conducted in a real work environment in a software development company. A multiwebsite system was developed according to the described architecture. The system is used in a department which provides social marketing services. The system was used with no standardization for 6 months. The benefits were the increased productivity, better service, maximizing the profit, lowering the cost as expected. The focus of the department is production of Facebook applications and conducting marketing campaigns. For the production of a common marketing application the average time for development has been 80 hours. After adopting and regularly updating the multiwebsite system the development time has decreased to 1 day averagely for custom design applications and less than 1 hour for the most other applications.

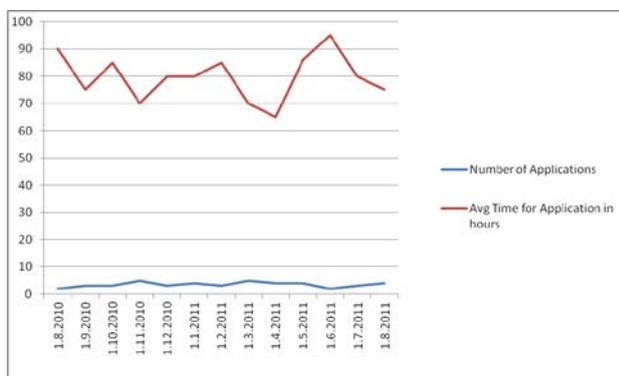


Figure 1: Production statistics before adopting MS

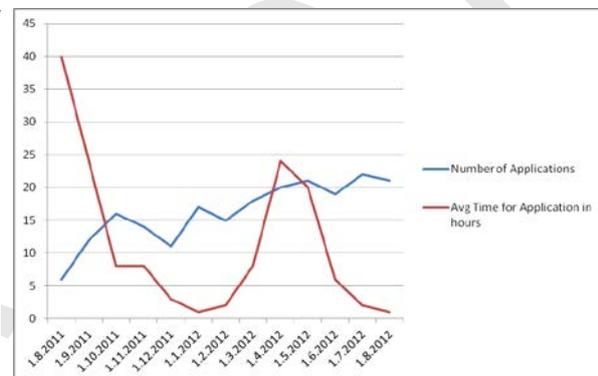
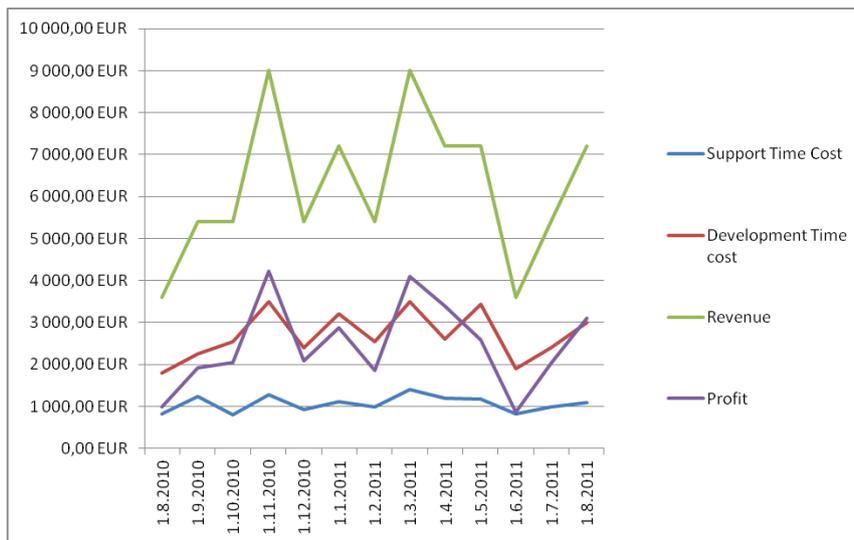


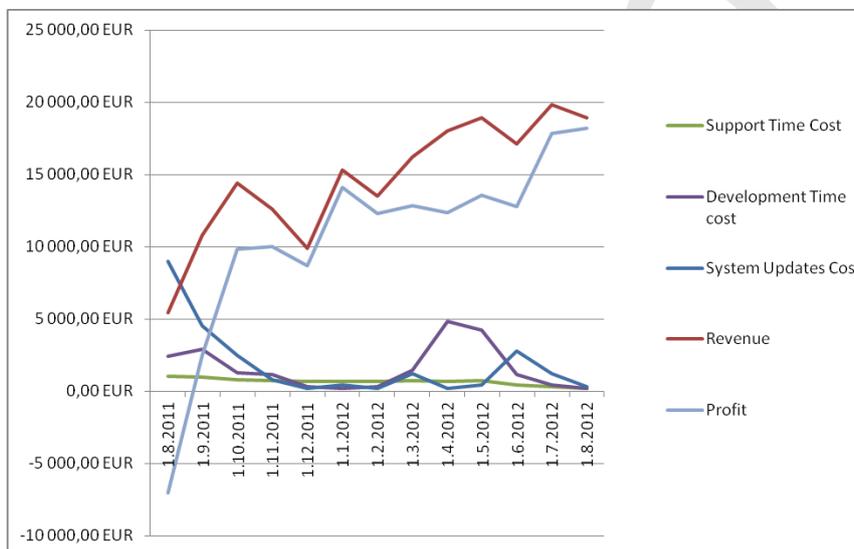
Figure 2: Production statistics after adopting MS

The charts represent the production evaluation for 12 months before the multiwebsite system was developed and adopted, and also the 12 months of using the system in production. Reports for the previous 3 years are for the period before adopting the system and they are similar to Figure 1. They show an average of 4 applications produced by the department per month with an average of 80 man hours per application. Figure 2 shows how the production evolved after adopting a multiwebsite system. Within 3 months the average time for application development dropped to values of 10 hours and gradually down to 2 hours average development time per application. This along with financial results discussed below resulted in increased production of applications. By the end of the first year application production increased to above 20 per month. This is almost 5 times increase in production. After nearly 6 months of operation clearly there are problems which resulted in the increased development time. This was due to the lack of control and standards. Measures for developing standards were taken to change the negative trend.

An overview of the effect of applying the system can be analyzed in details from the financial reports for the same period. The next charts provide summarized financial reports of the department. For Figure 3 one more main cost line is added, this is the expenditure of upgrading and updating the multiwebsite system. The analysis of Figure 3 targets the big difference between Revenue and Profit. This is due to the high amount of the expenditure (costs). The report shows that the support cost is averagely 10% of the Revenue and in some cases goes up to 25%. The Development cost is averagely 45% of the Revenue. Net Profit is less than 55% of the income and in critical points it goes down to 30%.



**Figure 3:** Financial summary report before adopting MS



**Figure 4:** Financial summary report after adopting MS

Figure 4 is a financial summary report for the 12 month period after adopting the multiwebsite system. The analysis clearly focus on the decrease of the cost which helps the Profit line to become near the Revenue line. The charts starts with a negative result for the first month, which is due to the investment made for the development and adoption of a multiwebsite system. The second month still have expenditures on the adoption process, which decreases the profit. These costs are the “System Updates Cost”. They are regular costs to provide additional functionality in order to ensure up to date applications. Development cost has dropped as most developmet has been transferred in the “System Updates Cost” field. All costs are minimized and there is a trend for Revenue and Profit growth after investing more funds in the “System Updates Cost” field. If more money are invested in the system updates a better service will be provided and more customers will be attracted. The minimization of the cost gave the possibility to lower the prices with 50%. The result is an increased competitiveness which in turn increased the sales and the profit. The profit has increased twice for one year and this trend continues.

The most interesting part of these reports are cost trends. Analyzing the costs provides usefull information on the ability for company growth. During the first 6 months the development time decreased lowering the cost, but during that period the system grew along with the customer orders. Support cost was decreasing progresively, but with the increased customer base the trend changed its course. The decision for process standardization was made. A workgroup was created to describe all processes running in the department. Some of the most important processes were targeted for optimization. The adoption of the standards and updating the system led to some additional investment, but the next 3 months have shown a decrease in the costs. And most importantly it loosened the connection between customer orders growth and costs. The researched and developed standards were purposed for the mltiwebsite system architecture and are targeting all developed multiwebsite systems.

## Multiwebsite system standards

This type of internal company standards must be formalized in documentations and manuals for each different employee position. Control of the applied standards can be audited internally. If certain international standard is adopted an external certifying organization will do the audit control to be sure that all the processes are well applied. Regular hierarchical reporting should be applied for self management especially for the purposes of controlling software lifecycle and QA. Following internal standards are meant for establishing good practices within a company and are proven to provide optimization in organizations which use a multiwebsite system as a backbone. Optimization results in lowering expenditure, increasing profit, the ability for stable company growth, increased competitiveness and most of all providing better service.

### Standardization in the software coding

The development of a multiwebsite system as an architecture is advised to be created using MVC frameworks like Symfony (Zaninotto, 2007), Zend, etc. Those frameworks establish the development standards. When a company decides to use a framework like Symfony for their development framework they will start a standardization process on the coding and structure of the core programming. Symfony forces coding standards which is well known Symfony developers.

Frameworks like Symfony are also based on different technologies that implement certain development standards. Projects like Doctrine and Propel for standardization in the work with the database. Those frameworks also implement technologies for coding automation like Scaffolding. Scaffolds are being used in building construction, but they are also used in programming called Scaffold Programming (Tenne, 2010). This is a method for meta-programming to build software using the database schema. This approach allows a programmer to describe the way the database can be manipulated by the end user. A compiler then uses this description to generate code which can be used by an application for creating, reading, updating and deleting records from the database. Ultimately software templates are treated as a scaffold in the process of creation of a more powerful application.

When the multiwebsite system is built using a framework like Symfony it will inherit the coding standards and will implement the lower level standards. The purpose of a multiwebsite system is to focus on the Software as a Service business field and it will establish standards in the development and support in all directions of SaaS (Menken, 2010).

The quality control management or so called quality assurance (QA) is also included in frameworks like Symfony. The developer can build QA automated tests which will monitor the quality of the end product when adding new functionality. This is an essential process in the way of applying and certifying international QA standards.

### Standardization in website creation

With an integrated multiwebsite system the creation of a website is a one way process. It can be automated in most cases and when custom development is needed a standard for adding custom modules is established. If the standard is not followed the new module will not work. This is why when you have thousands of modules for websites in the multiwebsite system you always know how a module is created, where it is placed, how it can be modified. Within the system this is the leading business focused process. Important processes within a company should be standardized in order to provide a quality service. To standardize a process can simply mean to make a documented agreement with the people involved in the process. This agreement states that the process must be executed in a certain steps following exact guidelines and rules. If the rules are not applied the agreement is broken and the standard is not followed, this is where the management control is applied to maintain the standard.

### Standardization in administration

The multiwebsite system offers single administration point for multiple websites. When a customer buys a set of websites he will control them all using the same functionality. When he wants to add more websites to his business, he already knows the standards of the functionality and can easily adjust to administrating the new websites. Functionality standards for administration includes for example the places of the buttons "Save", "Edit", "Delete", etc. or the way the tables are listed and where the head menus are placed. When a customer already used the established standards with another website of the multiwebsite system, any new website will be easy to work with.

### Standardization in user interface

Similar to the functionality a common user interface will help in easier usage of the software. All the websites in the multiwebsite system are administered with a common user interface. All the control of those websites has the same look and feel. This type of standardization will improve the production rate of administration and moderation of the websites in the multiwebsite system. This standardization in design will also optimize designing of new features, which will assure good quality of the end product.

### Standardization in customer support

One of the key features of the multiwebsite system is the standardization in the support. It allows the establishment of support standards for supporting tens of thousands websites, each owned by different client. All standards the system implements help for the establishment of a support standard. By utilizing a support standard each

support person knows the solution to the customer problems in advance. They follow the established protocol and can help any customer using the standards for user interface and administration.

To support the same amount of websites built separately with non-standardized administration and user interface would be a nightmare. Each website has its own way of control. If the customer needs step by step explanations the support person must get to know the documentation for his website, so they can navigate the customer to the solution to his problem. This can make the standard support time consuming and would result in unneeded expenditure on support staff.

### **Standardization in data exchange**

Data exchange between the websites in a multiwebsite system is a property with no alternative in the conventional website development. When a company integrates a multiwebsite system it can provide the customers with the possibility of simple data exchange between their websites. For example this could be products or categories moving from one e-commerce website to another, or blog posts from one site to another.

When the system is developed, standardization in the data structures must be created. All data objects must be defined as a standard for future development over those objects. Standards can be versioned for future upgrades, with the only rule that all versions of a standard must be back compatible.

### **Application Programming Interface (API) standardization**

Interoperability is a key feature for a system to be used by external systems. Standards defined in communication protocols or other API documentation. Using API standards a system offers external services and it is important for this process to be standardized with versioned back compatible protocols which external system implement. A popular example are companies like Google who provide APIs for their systems like Analytics, Adwords, Maps, Cloud and even whole external service systems that can be accessed only through API standard. This is just an example how most services from a system can be provided externally for the customers. They can use the data and functionality within their own systems which they already use.

### **Applicable international standards**

Establishing internal company standards may be enough to optimize the business processes. A further step is adopting international standards. This process involves a considerable investment. The costs for adopting ISO standards depends on management and employee time and effort, upgrading and creating documentation, training employees, registration fees, maintenance. The next step can be certification which can be done by accredited certification bodies. Certification is important for customer recognition. Well recognized international standards are developed by organizations like the International Organization for Standardization (ISO). There are standards focused on software development lifecycle and quality management. For certifying an integrated multiwebsite system a company can consider any of the following standards.

ISO/IEC 90003:2004 - Software engineering - Guidelines for the application of ISO 9001:2000 to computer software. The standard is applicable to organizations that purchase, develop, operate, maintain, or supply computer software or deliver related support services. It can be applied when the software is in the form of a marketed product, used to support the processes of an organization, part of a commercial contract with another organization, related to software services, embedded in a hardware product. ISO/IEC 90003:2004 is not a certification standard. Instead, it is used to develop an ISO 9001 Quality Management System which addresses the challenges faced by the software sector.

ISO/IEC 27001:2005 - Information technology, Security techniques, Information security management systems, Requirements. It is an information security management standard. It takes a very broad approach. In the context of this standard, the term information includes all forms of data, documents, messages, communications, conversations, recordings, and photographs. It includes everything from digital data and email to faxes and telephone conversations. It includes all forms of information. Similar applicable security standard is ISO/IEC 27002:2005.

(ISO/IEC 24748, 2009) - Systems and software engineering - Guide for life cycle management. The standard includes the steps: concept, development, production, utilization, support and retirement. Each of these stages is developed into three subsections: overview, purpose and outcomes.

International standards like ISO/IEC 12207, ISO/IEC 15504 and software process quality models like CMMI (Capability Maturity Model Integration) can be developed aiming to define the requirements of an ideal organization. An extended to ISO/IEC 12207 standard is the ISO/IEC 15288 - Standard for Systems Engineering Lifecycle Processes.

The social and economic long-term benefits of an international standard should justify the total cost of preparing, adopting and maintaining the standard.

### **Conclusions**

Standardization in the processes of software development, customer support and business processes helps to improve the quality of the end products and services. Defining standards in each field will be a base for future development of an organization in those fields. Standards can be regularly improved and all processes optimized.

Integration of standards in quality control can be certified and is well appreciated by customers. The multiwebsite system is a backbone of developing and controlling different company standards.

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# STAR-SHAPED MONOMERIC LIQUID CRYSTALLINE MATERIAL CONTAINING AZOBENZENE AT THE PERIPHERAL ARMS FOR PHOTONIC APPLICATION

A. A. Salisu<sup>1\*</sup>, M. Z. Ab Rahman<sup>2</sup>, S. Sidik<sup>2</sup>, A. H. Birniwa<sup>1</sup>, S. S. Abdullahi<sup>1</sup>

<sup>1</sup>Department of Pure and Industrial Chemistry, Bayero University, Kano P. M. B. 3011, Kano, Nigeria

<sup>2</sup>Department of Chemistry Universiti Putra Malaysia, 43400 Serdang Selangor, Malaysia

Corresponding Author address: [aasalisu@yahoo.com](mailto:aasalisu@yahoo.com), Tel. +2348065610456

**Abstract:** A new liquid crystal material whose molecular structure consists of disc-like 1,3,5-triazine unit as a central core and three rod-like azobenzenes as the peripheral arms unit is reported. The molecule 2,4,6-tris-(4-(4-acetylphenylazo)phenoxyhexyloxyethylamine)-1,3,5-triazine was prepared by nucleophilic addition of 4-(4-acetylphenylazo)phenoxyhexyloxyethylamine, the primary amino nucleophile to 2,4,6-trichloro-1,3,5-triazine electrophilic ring in presence of hydrochloride acceptor. Differential Scanning Calorimetry (DSC), Optical Polarizing Microscopy and X-Ray diffraction results revealed a Smectic A texture of the material.

**Keywords:** Discotic liquid crystal, Monomeric liquid crystals, 1, 3, 5-triazine, Smectic A phase

## Introduction:

Monomeric liquid crystal were found to be useful materials in electrooptical applications as they can be photo polymerized on the glass substrate surfaces during their application in liquid crystal devices (kumar *et al.* 2004). Low molecular mass thermotropic liquid crystals are usually composed of molecules incorporating just one rigid core, whereas liquid crystalline polymers arise from either attaching mesogenic groups to a polymer backbone or from incorporation of anisomeric units into a polymer main chain (Furumi *et al.* 2005, Yildirim *et al.* 2005). An approach towards oligomeric mesogens with a well defined molecular structure just bridging the gap between monomeric and polymeric mesogens consist the linkage of a defined number of form-anisotropic sub-units.

It has been demonstrated that the 1,3,5-triazine ring is a suitable structural element to be incorporated into thermotropic liquid crystals. More recently a 1, 3, 5- triazine has been used as a core (Goldman *et al.* 1998, Lee and Yamamoto 2005). From the synthetic view point, the mesogenic 1, 3, 5-triazine compounds have an advantage. Various nucleophilic side groups have been easily incorporated with the triazine ring by their reaction with cyanuric chloride, showing discotic as well as calamitic morphological behaviors depending on their structures (Lee *et al.* 2002). Selo *et al.* (2005) reported the synthesis and photochromism of the bifunctional monomers containing polymerizable acrylic/ methacrylic groups attached to both ends of and azobenzene core via flexible spacers. The monomers were used for UV-vis absorption studied in solution as well as in thin films. Generally, azobenzene are characterized by the reversible transformation from the more stable visible trans- to the less stable cis-form upon irradiation with UV light (Yu and Ikeda 2005, Lutfor *et al.* 2005).

In this paper a new liquid crystalline three arm star-shaped monomer containing azobenzene mesogenic units at the peripheral arms is prepared with aims to study the liquid crystalline properties and probably obtained a new promising material that can be utilized for application such, as optical information storage technology.

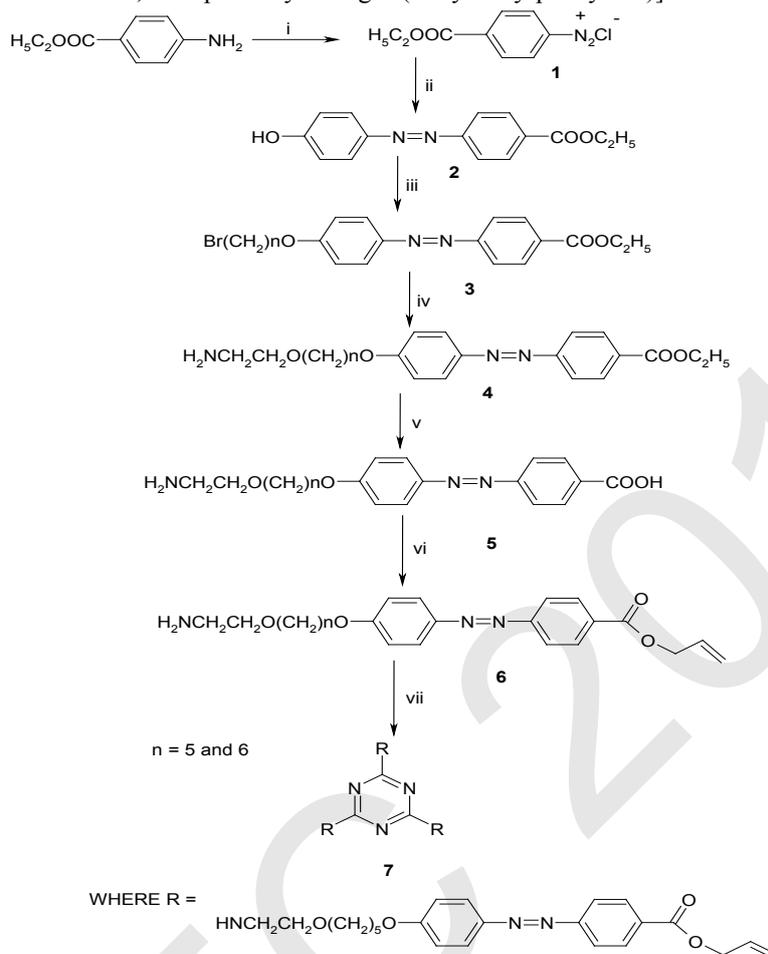
## Materials and Methods

### Materials

All materials are of analytical grade unless otherwise stated. 4-Aminoacetophenone (Fluka), Sodium nitrite (BDH), Urea (BDH), Phenol (Merck),  $\alpha$ ,  $\omega$ -dibromoalkanes (Fluka), potassium carbonate (Fluka), potassium hydroxide (Hamburg), ethanol amine (Acros), potassium carbonate (Fluka) and Cyanuric chloride (Acros) were used as received. Dry acetone, dry butanone and dry Tetrahydrofuran (THF) were obtained from distilling over phosphorous pentoxide (Merck). Other solvent and chemicals were used without further purification. Column chromatography used silica gel 60 (230-460nm), FT-IR spectra were measured on a BX spectrum II FT-IR spectrometer (Perkin Elmer). <sup>1</sup>H NMR spectra (400 MHz) were recorded on a Jeol ECA 400 NMR spectrometer (Jeol, Japan). Phase transition temperatures and thermodynamic parameters were determined by using a DSC 7 (Perkin Elmer) and DSC 8 (diamond DSC. Perkin Elmer) equipped with a liquid nitrogen cooling system under nitrogen atmosphere. The heating and cooling rates were 10°C min<sup>-1</sup>. Phase transition temperatures were collected during the second heating and the second cooling scans. An Olympus (Leica, Germany) polarizing optical microscope equipped with a Linkam THMSE-600 (Linkam, England) hot stage was used to observe phase transition temperatures and optical textures to analyze liquid crystal properties of the new material. The X-Ray diffraction measurement was performed using a nickel-filtered Cu-K <sub>$\alpha$</sub> -1 radiation with a Philips X-Ray diffractometer X'PART PRO PW 3040 (PanAnalytical Holland).

## Methodology

Scheme 1 illustrates the structures and the synthetic route to the 1,3,5-triazine monomer compounds. The peripheral arm units of the mesogenic part for all the compounds studied were prepared by diazotization of ethyl -4-Aminobenzoate and then coupling of diazonium salt, with phenol yielding 4-(4-Hydroxy-phenylazo)]benzoic acid ethyl ester 2.



Scheme 1: Reaction and Conditions: (i)  $\text{NaNO}_2/\text{HCl}$ , (ii)  $\text{C}_6\text{H}_6\text{O}$ ,  $0^\circ\text{C}$  (iii)  $\text{K}_2\text{CO}_3/\text{KI}$ ,  $\text{Br}(\text{CH}_2)_5\text{Br}$ , Acetone (iv) Acetone,  $\text{K}_2\text{CO}_3/\text{KI}$  (v)  $\text{MeOH}/\text{KOH}$  (vi)  $\text{DCC}/\text{DMAP}$ ,  $\text{C}_3\text{H}_5\text{OH}$  (vii)  $\text{K}_2\text{CO}_3$ ,  $\text{THF}/\text{Butanone}$

#### 4-(4-Hydroxy-phenylazo)]benzoic acid ethyl ester 2:

Ethyl -4-Aminobenzoate (10g, 60.6mmol) was dissolved in acetone (250 ml). Dilute hydrochloric acid [water (50 ml), conc. Hydrochloric acid (15 ml)] was added and the mixture was cool to  $2^\circ\text{C}$ . Sodium nitrite (5.4g, 60.6mmol), dissolved in water (20 ml) was added drop wise to the cooled mixture and stirred for 1h. Exactly, 5 ml of urea (1.21g 0.020 mol) solution was added for decomposing the excess of sodium nitrite for 10 min. Then, phenol (5.69g, 0.074 mol), dissolved in an acetone/water mixture (200 ml/100 ml) was added to the diazotized mixture and the reaction mixture was maintained at pH 7-10 by adding sodium hydroxide solution, stirring was continued for 2 h. The resulting mixture was made slightly acidic (pH <5) with dilute hydrochloric acid (ca. 80 ml, 10%) and 300ml of water for precipitation of the product and the precipitate was collected by filtration. The product was crystallized twice from methanol and ethanol. Yield 11.85 g (66%) as bright red crystal, m.p.  $196^\circ\text{C}$ , FT-IR (KBr,  $\text{cm}^{-1}$ ): 2938, 2862 (C-H,  $\nu$ ), 1674 (C=O,  $\nu$ ), 1598, 1498, 1470 (aromatic,  $\nu$ ), 1396 (C-H,  $\delta$ ), 1188 (C-O-C), 1254, 1126 (C-H,  $\delta$ ), 842 (aromatic,  $\delta$ ).  $^1\text{H}$  NMR, (600MHz,  $\text{CDCl}_3$ ),  $\delta$ : 8.08 (2H, d,  $J = 8.2$  Hz, ArH), 7.93 (4H, d,  $J = 8.7$ Hz, d,  $J = 5.8$  Hz, ArH), 7.02 (2H, d,  $J = 8.9$  Hz, ArH), 2.66 (3H, s,  $\text{CH}_3$ ), 1.93-1.84 (4H, m,  $\text{CH}_2$ ). Elemental analysis: calculated for  $\text{C}_{15}\text{H}_{14}\text{N}_2\text{O}_4$  (271.53) C, 64.34%; H, 5.74%; N, 13.75%. Found C, 63.62%; H, 6.62%; N, 14.33%.

#### 4-[4-(6-Bromo-hexyl-oxy)-phenylazo]benzoic acid ethyl ester 3:

A mixture of Compound 2 (3.00g, 11.11mmol) in dry acetone (200ml), potassium carbonate (12.6g, 91.3mmol), a catalytic amount of potassium iodide (50mg) and ten-fold excess of 1,6-dibromohexane (26.97g, 111.0mmol) was refluxed for 24 h under  $\text{N}_2$  atmosphere. The reaction mixture was filtered hot and acetone was removed under reduced pressure. Hexane was added (sufficient amount) to the product to remove un reacted 1,6-dibromohexane. The resulting precipitate insoluble in hexane was collected by filtration and the product was dissolved in dichloromethane and water. The organic phase was washed with dilute hydrochloric acid, sodium carbonate solution and water successively. It was

then dried over sodium sulfate and solvent was removed under reduced pressure. The product was crystallized from ethanol with hot filtration. Yield 3.7g (56%) and m.p. 126<sup>o</sup>C. FT-IR (KBr, cm<sup>-1</sup>): 2938, 2862 (C-H,  $\nu$ ), 1674 (C=O,  $\nu$ ), 1598, 1498, 1470 (aromatic,  $\nu$ ), 1396 (C-H,  $\delta$ ), 3076 (N-H,  $\nu$ ) 1188 (C-O-C,  $\nu$ ), 1254, 1126 (C-H,  $\delta$ ), 842 (aromatic,  $\delta$ ). <sup>1</sup>H NMR, (600MHz, CDCl<sub>3</sub>),  $\delta$ : 8.08 (2H, d, J = 8.2 Hz, ArH), 7.93 (4H, d, J = 8.7Hz, d, J = 5.8 Hz, ArH), 7.02 (2H, d, J = 8.9 Hz, ArH), 4.06 (2H, t, J = 6.4 Hz, OCH<sub>2</sub>), 3.44 (2H, t, J = 5.2 Hz, OCH<sub>2</sub>), 2.66 (3H, s, CH<sub>3</sub>), 1.93-1.84 (4H, m, CH<sub>2</sub>). Elemental analysis: calculated for C<sub>20</sub>H<sub>24</sub>N<sub>2</sub>O<sub>3</sub>Br (416.21) C, 64.78%; H, 6.85%; N, 12.75%. Found C, 66.42%; H, 7.22%; N, 14.83%.

#### 4-[4-(6-Aminomethoxy-hexyl oxy)-phenylazo]benzoic acid ethyl ester 4:

A mixture containing compound **3** (2.00g, 4.9mmol), ethanamine (0.302g, 4.9mmol), and potassium hydroxide (0.274g, 4.9mmol) were refluxed for 10h under nitrogen atmosphere with stirring in methanol (180ml). The reaction mixture was allowed to cooled down to room temperature, then poured into ice-cold water and acidified with dilute hydrochloric acid. The resulting precipitate, yellowish crystal was collected by filtration and crystallized from methanol. Yield 1.86g (63%), m.p. = 153 <sup>o</sup>C. FT-IR (KBr, cm<sup>-1</sup>): 2938, 2862 (C-H,  $\nu$ ), 1674 (C=O,  $\nu$ ), 1598, 1498, 1470 (aromatic,  $\nu$ ), 1396 (C-H,  $\delta$ ), 3076 (N-H,  $\nu$ ) 1188 (C-O-C,  $\nu$ ), 1254, 1126 (C-H,  $\delta$ ), 842 (aromatic,  $\delta$ ). <sup>1</sup>H NMR, (600MHz, CDCl<sub>3</sub>),  $\delta$ : 8.08 (2H, d, J = 8.2 Hz, ArH), 7.93 (4H, d, J = 8.7Hz, d, J = 5.8 Hz, ArH), 7.02 (2H, d, J = 8.9 Hz, ArH), 4.06 (2H, t, J = 6.4 Hz, OCH<sub>2</sub>), 3.44 (2H, t, J = 5.2 Hz, OCH<sub>2</sub>), 2.66 (3H, s, CH<sub>3</sub>), 1.93-1.84 (4H, m, CH<sub>2</sub>). Elemental analysis: calculated for C<sub>22</sub>H<sub>30</sub>N<sub>3</sub>O<sub>4</sub> (400.52) C, 69.63%; H, 6.91%; N, 13.75%. Found C, 67.42%; H, 6.72%; N, 13.83%.

#### 4-[4-(6-Aminomethoxy-hexyl oxy)-phenylazo]benzoic acid 5:

A mixture containing a solution of compound **4** (1.2g, 3.11mmol), and potassium hydroxide (0.872g, 15.6mmol) were refluxed in methanol for 6 h. The mixture was filtered hot and the filtrate was poured into ice-cold water and acidified with dilute hydrochloric acid. The resulting precipitate was collected by filtration and crystallized from methanol. Yield, 0.780g (42%), m.p. = 124<sup>o</sup>C. FT-IR (KBr, cm<sup>-1</sup>): 2938, 2862 (C-H,  $\nu$ ), 1674 (C=O,  $\nu$ ), 1598, 1498, 1470 (aromatic,  $\nu$ ), 1396 (C-H,  $\delta$ ), 3076 (N-H,  $\nu$ ) 1188 (C-O-C,  $\nu$ ), 1254, 1126 (C-H,  $\delta$ ), 842 (aromatic,  $\delta$ ). <sup>1</sup>H NMR, (600MHz, CDCl<sub>3</sub>),  $\delta$ : 8.08 (2H, d, J = 8.2 Hz, ArH), 7.93 (4H, d, J = 8.7Hz, d, J = 5.8 Hz, ArH), 7.02 (2H, d, J = 8.9 Hz, ArH), 4.06 (2H, t, J = 6.4 Hz, OCH<sub>2</sub>), 3.44 (2H, t, J = 5.2 Hz, OCH<sub>2</sub>), 2.66 (3H, s, CH<sub>3</sub>), 1.93-1.84 (4H, m, CH<sub>2</sub>). Elemental analysis: calculated for C<sub>20</sub>H<sub>26</sub>N<sub>3</sub>O<sub>4</sub> (372.51) C, 69.63%; H, 6.91%; N, 13.75%. Found C, 67.42%; H, 6.72%; N, 13.83%.

#### 4-[4-(5-Aminomethoxy-hexyl oxy)-phenylazo]benzoic acid allyl ester 6:

Compound **5** (500mg, 1.12mmol), allyl alcohol (65mg, 1.112mmol), and DMAP (24.7mg, 0.112mmol) was dissolved in a dried dichloromethane (100ml). After stirring the mixture for 30min at room temperature, DCC (24.7mg, 1.12mmol) was added and continued stirring for 24 h. The reaction mixture was filtered off and the solvent was reduced under reduced pressure. The product was dissolved in chloroform, extracted 2 times with a solution of 5% acetic acid and water successively. The chloroform was removed under reduced pressure and the product was crystallized twice from methanol and ethanol. Yield 43mg (48%), m.p = 210<sup>o</sup>C. FT-IR (KBr, cm<sup>-1</sup>): 2938, 2862 (C-H,  $\nu$ ), 1674 (C=O,  $\nu$ ), 1598, 1498, 1470 (aromatic,  $\nu$ ), 1396 (C-H,  $\delta$ ), 3076 (N-H,  $\nu$ ) 1188 (C-O-C,  $\nu$ ), 1254, 1126 (C-H,  $\delta$ ), 842 (aromatic,  $\delta$ ). <sup>1</sup>H NMR, (600MHz, CDCl<sub>3</sub>),  $\delta$ : 8.08 (2H, d, J = 8.2 Hz, ArH), 7.93 (4H, d, J = 8.7Hz, d, J = 5.8 Hz, ArH), 7.02 (2H, d, J = 8.9 Hz, ArH), 4.06 (2H, t, J = 6.4 Hz, OCH<sub>2</sub>), 3.44 (2H, t, J = 5.2 Hz, OCH<sub>2</sub>), 2.66 (3H, s, CH<sub>3</sub>), 1.93-1.84 (4H, m, CH<sub>2</sub>). Elemental analysis: calculated for C<sub>23</sub>H<sub>29</sub>N<sub>3</sub>O<sub>4</sub> (412.61) C, 69.63%; H, 6.91%; N, 13.75%. Found C, 67.42%; H, 6.72%; N, 13.83%.

#### 2,4,6-tris[4-(4-acetylphenylazo)phenoxyhexyloxyethylamine-1,3,5-triazine 7:

A mixture consisting of a solution of compound **6** (0.5g, 3.91mmol) in dry Butanone and THF 4:1 (80ml), Cyanuric chloride (0.239g, 1.30mmol) and sodium hydrogen carbonate ((0.539g, 3.91mmol) were refluxed for 24 h under nitrogen atmosphere. The reaction mixture was brought to the room temperature, poured into ice-cold water and acidified with dilute hydrochloric acid. The resulting precipitate was collected by filtration and crystallized twice from methanol and ethanol. Yield: 0.762g (67%) m. p. = 95 <sup>o</sup>C. FT-IR (KBr, cm<sup>-1</sup>): 2938, 2862 (C-H,  $\nu$ ), 1674 (C=O,  $\nu$ ), 1598, 1498, 1470 (aromatic,  $\nu$ ), 1396 (C-H,  $\delta$ ), 3076 (N-H,  $\nu$ ) 1188 (C-O-C,  $\nu$ ), 1254, 1126 (C-H,  $\delta$ ), 842 (aromatic,  $\delta$ ). <sup>1</sup>H NMR, (600MHz, CDCl<sub>3</sub>),  $\delta$ : 8.08 (2H, d, J = 8.2 Hz, ArH), 7.93 (4H, d, J = 8.7Hz, d, J = 5.8 Hz, ArH), 7.02 (2H, d, J = 8.9 Hz, ArH), 4.06 (2H, t, J = 6.4 Hz, OCH<sub>2</sub>), 3.44 (2H, t, J = 5.2 Hz, OCH<sub>2</sub>), 2.66 (3H, s, CH<sub>3</sub>), 1.93-1.84 (4H, m, CH<sub>2</sub>), 7.02 (3H, m, N-H). Elemental analysis: calculated for C<sub>213</sub>H<sub>231</sub>N<sub>36</sub>O<sub>9</sub> (1314.76) C, 69.63%; H, 6.91%; N, 13.75%. Found C, 67.42%; H, 6.72%; N, 13.83%.

## Results and Discussions

### Phase transition by DSC

The phase transition temperatures as well as the phase transition enthalpy changes were determined using differential scanning calorimetry (DSC) (Diamond DSC, Perking Elmer). The DSC thermograms of **5** in the first heating run exhibited a sharp melting peak centered at 93.97 <sup>o</sup>C ( $\Delta H = 84.36\text{J}^{-1}\text{g}$ ). On further heating, another peak appeared at 111.12 <sup>o</sup>C ( $\Delta H = 12.115\text{J}^{-1}\text{g}$ ) indicating a well defined liquid crystalline phase prior to the isotropic phase. On cooling

the isotropic phase to mesophase transition peak appeared at 109.14 °C ( $\Delta H = -12.081 \text{ J}^{-1}\text{g}$ ) and then crystallization peak appeared at 69.89 °C ( $\Delta H = -61.964 \text{ J}^{-1}\text{g}$ ).



Figure 1: DSC heating and cooling traces of compound 5 ( $10^{\circ}\text{C min}^{-1}$ ) Diamond DSC

On second heating a sharp melting peak appeared centered at 93.33 °C ( $\Delta H = 58.815 \text{ J}^{-1}\text{g}$ ) with a shoulder and another peak appeared again prior to the isotropic phase at 110.97 °C ( $\Delta H = 12.492 \text{ J}^{-1}\text{g}$ ) indicating also the presence of liquid crystalline phase. On second cooling the isotropic phase to mesophase transition peak appeared at 108.93 °C ( $\Delta H = -12.483 \text{ J}^{-1}\text{g}$ ) with almost the same heat of transition as the first cooling cycle (figure 2) and a sharp mesophase to crystallization transition peak appeared at 69.7 °C ( $\Delta H = -50.944 \text{ J}^{-1}\text{g}$ ). The material is very stable crystal at room temperature there were no any change of thermal behaviour observed on exposure to atmospheric moisture.

### Phase structures by OPM:

The phase structures were determined by optical polarizing microscope (OPM). The polarized optical micrograph of **7**, observed in the liquid crystalline phase in the second heating and cooling cycle, is shown in Figure 3. On heating to the isotropic phase, a smectic A texture was observed under the polarizing optical microscope at 114.2 °C (Figure 3a)

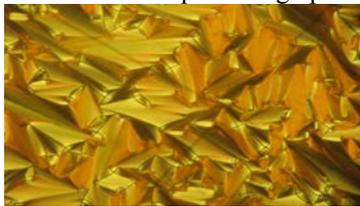


Figure 2: Optical photomicrograph of **5** obtained with a polarizing microscope (Olympus BX50 equipped with a hot stage Limcam THMSE 600) a) on heating isotropic liquid (Cross polarizer magnification  $\times 200$ ).

This texture was very stable up to about 128.3 °C and started clearing at 129.5 °C until it completely changed to an isotropic phase at 134.3 °C. The texture is a typical of a broken Fan-shaped focal-conic texture of smectic A phase.

### X-ray diffraction

The X-ray diffraction pattern of the smectic A mesophase exhibited by compound **7** contains a single peak in the low angle region implying a layered structure with a sinusoidal density wave along the layer normal, and a broad peak in the wide angle region centered at a spacing of 4.38 Å indicating a liquid-like arrangement of the molecules within the layers. The layer spacing  $d$  is  $2\theta = 19.02^{\circ}$  which is close to one-third that of the estimated all-trans molecular length,  $L$ , of the most extended conformation of 52.4 Å. The layer spacing has only small temperature dependence, and has the same value on heating and on cooling.

### Conclusion

Two series of monomeric liquid crystal material base on 1, 3, 5-triazine central core with three rod-shaped azobenzene containing a terminal vinyl group has successfully been prepared. The compounds **7a** and **7b** in the series exhibited smectic C and smectic A phases respectively. The azobenzene units usually shows *trans-cis-trans* isomerization, therefore, this mesogenic monomers could be useful for photoinduced reorientation of azobenzenes under for example UV irradiation which can be used in optical data storage devices.

### Acknowledgement

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## STRATEGIES FOR SUSTAINABLE DEVELOPMENT OF URBAN CITIES

Jinu Jose

[jinuJoseer@yahoo.com](mailto:jinuJoseer@yahoo.com)

+91 9825113066

Urban Planning Department  
SVNIT College, Surat  
Gujrat, INDIA

**CODE- C37590**

Growth has defined a new dimensions which magnifies the role of Sustainable development. Sustainable development synchronise the requirement of future generation and satisfies the present needs. Things does in a different way to promote more productive, more efficient and manageable system. The system should be transparent, accountable which forecast the requirements to harvest the fruit to shape the quality of life. It conceptualizes the ideas about the employment, economical magnetic characteristics, feasibility of the eco-developments. we need to address the innovative mechanism which is parallel to the Nature. We should provide a solution to rationalize the demand gap. We should create investment friendly approach and pool of opportunities in a eco-friendly way to foster the Growth in balanced stage. Our outlook on development sector is stable and primarily driven by huge demands of infrastructure efficiencies. There is an important need to channelize the developments of major sectors in sustainable efficient methods. The Strategies should showcases the Livable and sustainable form of development. It is the New mask of city geered by the Good governance and Public administered decisions to form the best sustainable solutions to formulate opportunities in a conserved manner. The Report envisages the sustainable developmental strategies to cope up with innovative technologies to Focus on the various aspects to ease the Quality of Life. There are certain Drivers to Pump the Economy in different sectors. Steering Development along with powerful strategies fuels the engine of economic growth and social vibrancy. Our goal is to emphasise a dynamic change to transform into vernacular system which compartmentalize futuristic requirements with respect to the resources.

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JINU JOSE  
M.Tech-Urban Planning  
2<sup>nd</sup> year  
SVNIT  
SURAT

## 1. INTRODUCTION

Cities are the engines for social and economic growth of a country. Cities have been pivotal in the creation of employment and the economic growth in the country. Rapid growth in urbanisation has placed immense strain on land and other natural resources. Environmentally degraded cities provide unhealthy, unclean and resource depleted environments to people. Urbanization is closely linked to modernization, industrialization, and the sociological process of rationalization. Urbanization can describe a specific condition at a set time, i.e. the proportion of total population or area in cities or towns, or the term can describe the increase of this proportion over time. It describes about the transformation due to Urbanisation in turn affects the sustainable Process. It orchestrates about the strategies for the balanced development which is parallel to nature. It showcases the impacts and affects of urbanization. The report envisages the better sustainable management of cities which boost up the quality of Life.

## 2. OBJECTIVES

- ✓ To study about the sustainable development approach
- ✓ To study about the strategies to develop the socio-economical aspects
- ✓ To Improve the conceptualisation of urbanisation effect
- ✓ To orient the economical growth to develop the efficiency in a conserved manner
- ✓ To envisage the action plan to implement the balanced development

## 3. SUSTAINABLE DEVELOPMENT

Sustainable development is a complex multidimensional concept which deals with a dynamic, balanced and adaptive evolutionary process, in which the balanced use and management of the natural environment base of economic development, is protected. It is a State of equilibrium condition in which environmental and Human impact concerns on economical development formation between the necessities of Present and future. It can be defined as the needs of present without compromising the ability of future generation to meet their own necessities. It is the capacity to support, maintain or endure integration of environmental, economic, and social dimensions towards responsible management of resources.

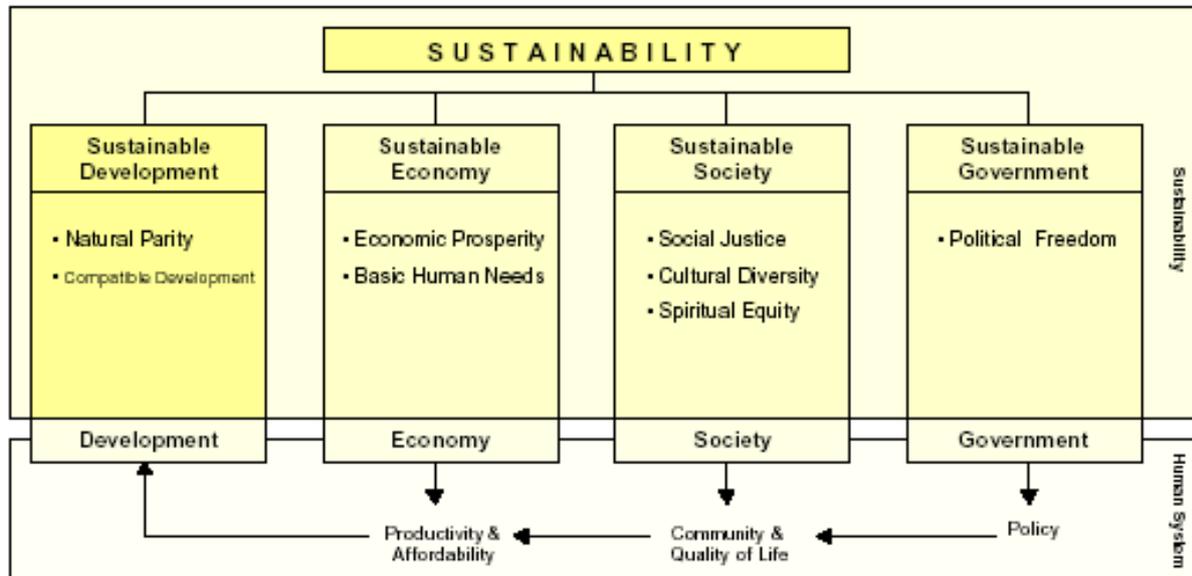


FIG-1 SUSTAINABLE FACTORS

#### 4. PRINCIPLES OF SUSTAINABLE DEVELOPMENT

- Natural systems have a right to coexist with human development.
- Natural resources are finite and human development shall not deplete or degrade the resources.
- Communities shall foster opportunities for civic engagement and personal interaction in vibrant public spaces.
- Technology, science, engineering, planning, and design shall be used to create efficient and long-lasting development.
- Nature cannot be controlled or evaded; therefore, it is the ultimate regulator of human development.
- Endeavor to incorporate human development into the natural context at all scales.
- Use of continuous and iterative character of the planning process to interject values of sustainable development.

#### 5. ASPECTS OF URBAN GROWTH CENTRES

The Sustainability focus on certain core areas which is a quick way to evaluate the environmental and community benefits and to identify any negative economic social and environmental impacts.

- Land Use and Location
- Transport
- Energy
- Waste
- Community Development
- Biodiversity/Open Environment
- Built Environment
- Pollution
- Human Activity
- Significance

## 6. STRATEGIC MANAGEMENT

The strategy means performing different activities or performing similar activities in different ways. It is the subject that has exercised the minds of political, military and business leaders for centuries. It is a systematic approach to major and increasing important responsibility of general management and relates the firm to its environment in a way which will ensure its continued success and make it secure from risks. It can be thought of three main elements

- ✚ Strategic Analysis
- ✚ Strategic Choice
- ✚ Strategic Implementation

## 7. FOCUS ON SUSTAINABLE DEVELOPMENT OF URBAN CITIES

Infrastructure is the back bone of every economy. Infrastructure contributes a great deal for sustained economic development. It is a new mask of city geered by Good governance and Public administered Decisions which showcases the Most livable and sustainable form. Transformation of Infrastructure driven primarily by the effective Economical stability. It requires an integration of economic, social and environmental approaches towards development. Urban cities focus on certain areas of infrastructure to enhance the efficiency of economical stability

1. Physical infrastructure
  - ✚ Water supply network
  - ✚ Drainage network
  - ✚ Solid waste management
  - ✚ Storm water management
  - ✚ Power
  - ✚ Communication
  - ✚ Domestic energy
  - ✚ Fire network
  - ✚ Milk distribution
2. Social infrastructure
  - ✚ Education
  - ✚ Health care

Urban environmental management is one of the most nodal issues as the urbanization trend continues globally. Among the challenges faced by urban planners and managers is the need to ensure ongoing basic human services such as the provision of public amenities for good quality of life.

The basic services are

- a. Water supply
- b. Sewerage/Sanitation
- c. Solid waste management
- d. Storm water drains
- e. Urban roads
- f. Primary education
- g. Primary health facilities

## 8. STRATEGIC APPROACH FOR SUSTAINABLE SOLUTIONS

As we know as population increases , the consumption of resources increases. Thus the depletion happens. For every system , there is a limitation to handle it. As a urban planner who focus on sustainable development , we provides a cluster of cities which adjoins together to yield good quality of life. Cluster of cities enhance the balanced development and nullify the urban sprawl. Each system of infrastructure could utilise properly in their maximum efficiency. Creation of magnetic centres on clusters fascinates the people to develop the areas in sustainable form. Thus we could attain balanced urban development. But we should pave a challengable strategic growth for the future generation requirements with respect to present scenario. For every problem ,there is solution .so we should visualize the solution which is compatible to every sector. Approach can be faceted on the basis of Economic ,social and environment.



FIG-2 SUSTAINABLE SOLUTIONS

### 9.ROLE OF GOVERNANCE IN DIFFERENT SECTOR

Our government stands committed to providing an environment which is conducive to enterprise and growth of economy, an environment which will facilitate rapid economic growth and higher living standards. We are committed to having a regulatory and policy environment which will unleash the creative energies of our people and will fulfill the expectations. We must adjust our systems, rules, procedures and processes of administration to meet the needs that would arise in the years to come. We must, therefore, constantly look over the horizon and plan for solutions in advance to emerging challenges. New thinking is required in important areas such as investor education and protection, corporate governance, corporate social responsibility .There are different elements where uniform development should be achieved.

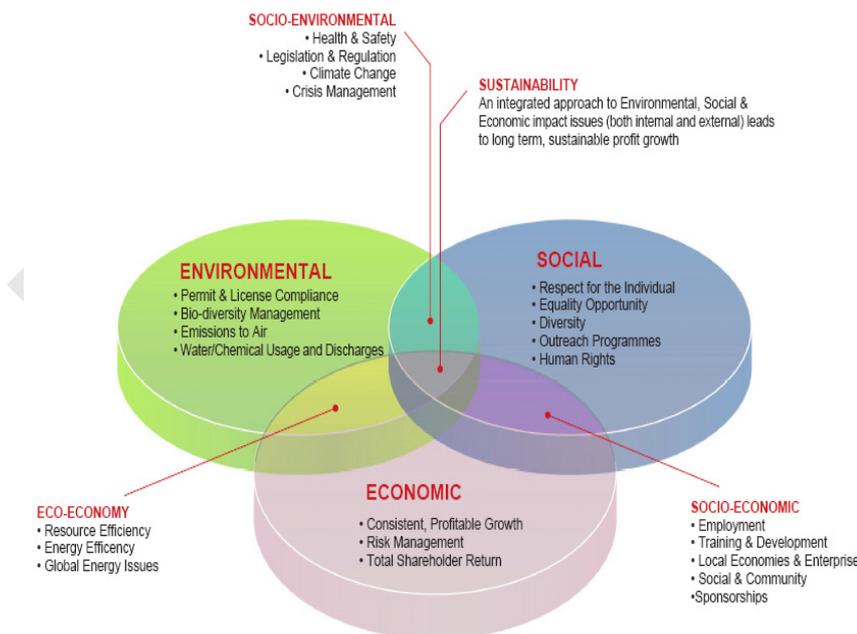


FIG-3 SUSTAINABLELEMENTS

### 10. EFFECTS OF URBANISATION

People from villages move into cities to seek economic opportunities. This migration from rural areas to mega cities is called urbanization. Cities are flourished with industries , educational institution recreational areas ,better food supplies healthcare with basic infrastructural facilities such as transportation , water supply, electrical, sanitary, etc. whereas there are limited opportunities & basic amenities avail within rural areas which contributes migration to cities. After rural migrants coming to urban area they spend their lives in insecure, poorly paid jobs in spite, they participate in economic growth, and adjust to economic change, through urban labor markets. They grow as urban poor slums & their life is worse than a village in most cases. They are not able to earn basic amenities of life, due to rich economy of cities.

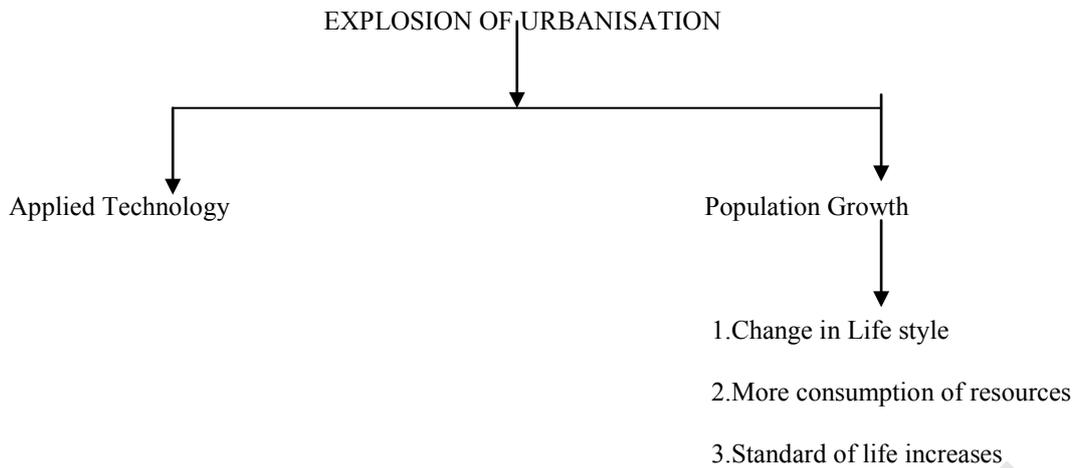


FIG-4 URBANISATION EFFECTS

### 11. IMPACTS OF URBANISATION

| POSITIVE IMPACTS           | NEGATIVE IMPACTS             |
|----------------------------|------------------------------|
| Industrialization          | Housing sector               |
| Employment Opportunities   | Land market                  |
| Application of Technology  | Cost of living               |
| Standard of life           | Cost of transportation       |
| Infrastructure development | Cost of urban infrastructure |
| Educational Development    | Environment                  |
| National growth            | Health Problems              |

TABLE-1 IMPACTS OF URBANISATION



## 12. INTEGRATION OF LAND USE MANAGEMENT

| Main                             | SUB   |
|----------------------------------|---|
| RESIDENTIAL                      | Primary Residential Zone                            |
|                                  | Mixed Residential Zone                              |
|                                  | Unplanned/Informal Residential Zone                 |
| COMMERCIAL                       |   |
|                                  | Retail Shopping Zone                                |
|                                  | General Business and Commercial District/ Centres   |
|                                  | Wholesale, Godowns, ware- houses/ Regulated markets |
| INDUSTRIAL                       |   |
|                                  | Service Industry                                    |
|                                  | Light Industry                                      |
|                                  | Extensive Industry                                  |
|                                  | Heavy Industry                                      |
|                                  | Obnoxious/ hazardous Industry                       |
| TRANSPORTATION AND COMMUNICATION |   |
|                                  | Roads   |
|                                  | Railways  |
|                                  | Airport   |
|                                  | Seaport & Dockyards                                 |

|                        |  |
|------------------------|--|
|                        | Bus Depots/Truck Terminals/Freight complexes   |
|                        | Transmission & Communications( Telephone Exchange, TV Station, Broadcasting Station, etc.) |
| PUBLIC AND SEMI PUBLIC |  |
|                        | Govt/Semi Govt/ Public Offices   |
|                        | Govt Land(Use undetermined)  |
|                        | Education & Research   |
|                        | Medical & Health   |
|                        | Social Cultural and Religious  |
|                        | Utilities and Services   |
|                        | Cremation and Burial grounds   |
| RECREATION             |  |
|                        | Playground/Stadium/Sports Complex  |
|                        | Parks & Gardens-Public Open Space  |
|                        | Special recreational zone- restricted open spaces  |
|                        | Multi-open space (Maidan)  |
| AGRICULTURE LAND       |  |
|                        | Agriculture  |
|                        | Forests  |
|                        | Poultry and Dairy Farm   |
|                        | Rural Settlements  |
|                        | Brick kiln & Extractive Areas  |
|                        | Water Bodies   |
| SPECIAL AREAS          |  |
|                        | Old Built up (Core) Areas  |
|                        | Heritage & Conservation Areas  |
|                        | Scenic Value Areas   |

|             |                              |
|-------------|------------------------------|
|             | Other Uses                   |
| VACANT LAND |                              |
|             | Built but un-occupied        |
|             | Vacant under construction    |
|             | Vacant developed but unbuilt |

TABLE-2 LAND USE STRUCTURE

### 13. POWERING THE ACTION PLAN TO SHAPE URBAN CITIES

Action plan which envisage the strategic development are

#### 1. Planning of Action Plan:

The planning should start with the identification of the activities/projects to be undertaken. Specified strategies should be developed to mandate the design of Action Plan (Long-term, medium term and short-term), with a shift from the casual approach to the project based accountability approach. Each of these plans should clearly specify requirements relates to baseline survey; activities to be undertaken, budgets allocated, time-lines prescribed, responsibilities and authorities defined and major results expected.

2. Implementation of Action Plan: The initiatives from planning level should consider the following parameters for identification/selection of schemes/projects:

- ✓ The time-frame and periodic milestones should be finalized at the outset
- ✓ The activities should help in building a positive image
- ✓ It closely linked with the principles of sustainable development
- ✓ Public-Private Partnership between the Government and the Central Public Sector Enterprise could also be encouraged to leverage the strengths of the latter in Disaster management
- ✓ It is to be implemented by Specialized Agencies
- ✓ Activities related to Sustainable Development will form a significant element of the total initiatives of all action plan .

#### 3. Monitoring

- ✓ Monitoring of projects is very crucial and needs to be a periodic activity of the Enterprise.
- ✓ Evaluation and assessment of feasible studies

### 14. ROLE OF PLANNER TO ACHIEVE THE SUSTAINABLE DEVELOPMENT

- First & most Important step is to achieve proper land use planning satisfying the future growth & demands of next 20 to 30 Years with provision of next 50 Years.
- The Urban area shall be planned with future expansion possibilities with connecting linkages in all directions.
- The growth of the city & the peripheral area (rural) should go hand in hand to avoid concentration & exploitation at one center.
- Transportation planning & road network shall be given prime importance as it is key factor of production economy. Public transport facilities shall be given importance.
- Infra-structure shall be provided with future consideration of growth & demands.
- Housing Sector shall be designed with sufficient open lands allowing future expansions.
- Transit house facilities for slums & migrators shall be provided.

- Lastly all resources are limited, hence it shall be properly analyzed & used efficiently for benefits of humans & environment.

## 15. CONCLUSION

The new sustainable policies which orient towards socio-economical growth objectives entails the significant contribution of urban sector for the urban productivity and employment. Sector development requires governments to provide appropriate regulatory frameworks, an attractive infrastructure investment, and a workforce with at least a basic education. Policies should be made for good quality public transport which can provide many economic benefits and can be cost effective, with supportive land use policies. Government should develop policies for affordable housing projects for different income groups & to make cities rid of unhealthy slums. Policies should be developed for growth of High-tech industries & specialisation techniques which can earn valuable foreign exchange and lot of money for a country in the stock markets. Investment policies for poor urban slums with affordable insurance & transit house facilities for slums should be thought of to make them sustainable in urban fabric. Thus it enhance the quality of life to built effectively for the sustainable development

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## STRATIFIED CHARGING GASOLINE ENGINE RUNNING WITH LPG

Cengiz ÖNER<sup>1</sup>, İbrahim CAN<sup>2</sup>

Fırat Üniversitesi, Elazığ/ Türkiye, [mconer@firat.edu.tr](mailto:mconer@firat.edu.tr)<sup>1</sup>  
Cumhuriyet Üniversitesi, Sivas/Türkiye, [23.ibrahim@gmail.com](mailto:23.ibrahim@gmail.com)<sup>2</sup>

**Abstract** : The energy conversion and values of limited emission level are very important issue for manufacturers and engine designers. Therefore the investigations about homogenous charge (HC) engine and stratified charge (SC) engine have commonly considered by literatures. Recently the number of vehicles use liquefied petroleum gas (LPG) on the road and the fitting of the LPG conversion system to vehicles is steadily increasing. The main purpose of this study, in order to run with poor mixture of gasoline engine as like diesel engine, the shape of charge was converted to stratified charge and was used LPG fuel. In this point of view, LPG-air mixture is prepared in two different environments and the rates, and mixture was taken into engine as stratified by two steps. The effects of engine performance, fuel consumption and emission characteristics are investigated for stratified charge application. The experiments were made under full load and full throttle position. According to the experiments of results, both the engine of power and torque not changed and the fuel consumption was achieved in reduction 15%. In addition, improvements have been obtained in value of emission.

**Keywords:** *Stratified-charge, Engine performance, Fuel consumption, Emission characteristics, Liquefied petroleum gas (LPG)*

### Introduction

Engine producers have to observe such standards as SULEV (super ultra-low emission vehicles), CAFE (corporate average fuel economy) and Kyoto protocol which introduce limitations on emission and fuel consumption (1). In order to meet these standards emphasis has been put on systems which both regulate fuel consumption and emission. In this line of thought, a new concept has been developed for gasoline engines with LPG-transformed stratification charging application. In this paper changes have been made to the suction system of a homogeneous charged engine and, in addition to them, a newly designed joint fuel manifold has been adapted and the charging system of the engine has been made stratified. The most basic difference between HC engines and SC engines is that the content of the mixture added into the cylinder is not identical at every point in SC engines and that stoichiometric or rich mixture around the spark plug is taken but an excessively lean mixture is taken in the rest of the cylinder. Combustion in SC engines is completed in two stages. First, it starts around the spark plug and the flame formed in the second stage makes sure that the excessively lean mixture in the rest of the cylinder is combusted. Total excess air coefficient (EAC) in the combustion chamber is in the lean area. Thus, as in diesel engines, the load is adjusted by changing the quality of the mixture partly without throttle valve in stratified charge Gasoline (SCG) engines (as load decreases, the mixture becomes leaner) (2). This, in turn, eliminates the losses caused by retrenching of throttle valve and increases efficiency in partial loads. One of the most important problems faced in SC engines is that stoichiometric mixture, which can easily be ignited in all load and speed regimes around the spark plug, cannot be provided and therefore lean mixture cannot be combusted safely. In order to solve these problems, according to their formation and combustion methods of air/fuel mixture, SCG engines are grouped in two categories:

a- Gasoline engines where, as the case in diesel engines, fuel is directly injected to the combustion chamber and fuel-air mixture is formed within the cylinder (Direct Injection SI Engine-GDI) [3,4,5].

b- SCG engines where, as the case in classic fuel engines, fuel-air mixture is formed outside the cylinder (in suction manifold) as ignited through the pre-chamber (Pre-chamber Torch Ignition Stratified Charge Engines) (6).

Although there are several studies in the literature on different fuel injection and charge strategies for gasoline engines,

There are almost no studies on LPG-using gasoline engines. In addition, the problems faced in LPG transformation for direct injection gasoline engines used today urged us to work in this area.

Accordingly, some changes have been made in the cylinder heads and suction manifold of a gasoline engine so that LPG-transformed gasoline engine could be SC. In this way the charge flow characteristic of the current engine has been changed and it has been ensured that LPG/air mixture is SC into the combustion chamber of the engine. The impact of regulations made on the engine on engine performance, fuel consumption and exhaust gases emission values have been examined. The applicability of the developed system to different gasoline engine types has been investigated.

### Stratified Charged Gasoline Engines

In HC engines, although optimum calibrations are made, fuel consumption of gasoline engines cannot be lowered under a certain level. The main reason of this is that compression rate in spark-ignited engines is limited due to the fact that fuel and air are compressed together and that gasoline engines, unlike diesel engines, cannot be operated with excessively lean mixtures. One of the most effective solutions to this problem is the SC principle which ensures that gasoline engines can operate with lean mixtures (7). SC principle was first applied by Ricardo in 1918. Engines that

operate with this principle are called SC engines (8). The reason for the increase in efficiency is that, unlike current engines, rich air-fuel mixture is obtained around spark plug and lean air-fuel mixture is obtained in other areas of the combustion chamber in SC application and the engine is thus operated with excessively lean mixtures. Yet, when the depletion in homogeneous charged gasoline engines is raised above certain limits, explicit decrease is observed in the effective power of the engine.

One of the pioneers of SCG engine described in the first group is Ricardo engine which was produced in early 1920s (9). The second application which was serial to this was GAZ-52 engine was developed in Russia in the early 1960s. In late 1960s and early 1970s, charged engines were in the agenda again. In the same period Wankel engine, which was a new invention, created a new application field for SC principle. Combustion chamber geometry of Wankel engine is not very suitable for homogeneous mixture; however, structural air movements within combustion chamber provide a suitable ground for SC. First studies on SC in Wankel engine were conducted by Curtis Wright and Mercedes and these studies can be grouped under second-type stratified engines [10,11].

Today studies for improving SCG engines are continuing perpetually. Almost all of the above listed studies on direct injection Otto engines conducted in the last decade were derived from direct injection diesel engines. However, the most important development in this subject is the serial production of FSI engines designed by Volkswagen and GDI engines designed by Mitsubishi (5, 12). Operation of these engines is based on an entirely different philosophy. As can be seen in figure 2.1, two-stage injection strategy was applied with a piston geometry that forms a two-zone combustion chamber [13,14].

When the working fluid has a higher specific-heat ratio like that of lean air-fuel mixtures, less fuel energy is wasted in raising the internal energy of the charge, so more is available for useful work. By stratifying the fuel-air mixture within the combustion chamber, the engine can be operated at very lean (up to 50:1) air fuel ratios. By stratifying the fuel-air mixture in the center of combustion chamber and keeping the hot burnt products away from the walls, heat losses can be decreased.

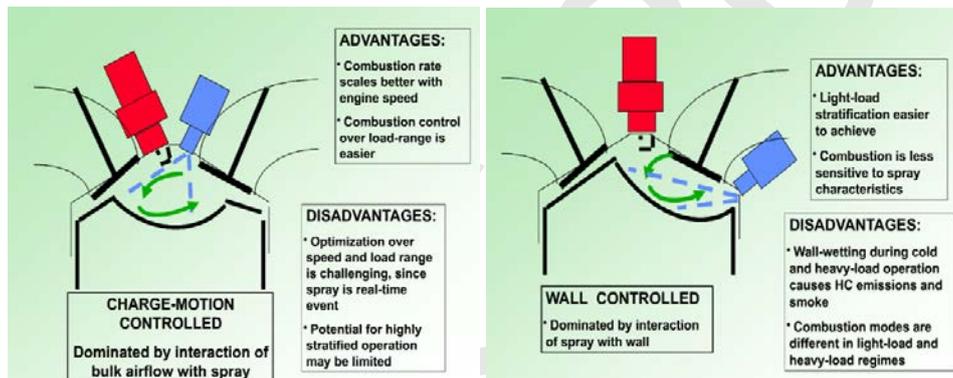
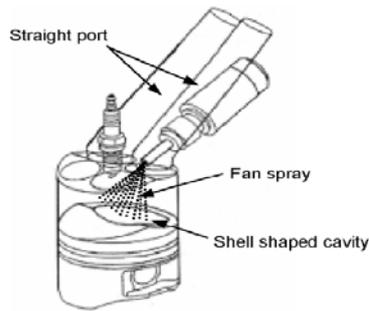


Figure 2.1: Different type direct-injection, lean-mixture Otto engine

This engine which has four valves, a compression rate of 12 and a pressure of 50 bars consumes 35% less fuel compared to an equivalent stoichiometric Otto engine with 40 km/h fixed speed. On the other hand, this engine also has the same performance with a stoichiometric Otto engine with the same volume. It is reported that it works regularly until EAC=4 value. This engine is an example of direct injection Otto engine which has been mass produced since 1997 (13).

Second type SC engines are designed with a novel method depending on the increase in the number of valves in the engines that have been produced recently. Accordingly when the engine will be operated with partial load and lean mixture, fuel-air mixture enters into only one of the suction channels or suction channels are sized so as to be able to create a charge movement that ensures stratification charge movement. In order to ensure this, first channels that lead to suction valves in multi-valve engines are designed independently (10, 11). In the literature it is seen that this type of lean-mixture engines are preferred by such engine producers as Mercedes, Honda, Toyota, Mitsubishi, Nissan, Kia, Volvo, Ricardo and that some of them have adopted mass production (Toyota, Mitsubishi). The lean-mixture engine introduced by Toyota in 1990 has four valves; the fuel is injected to suction channel through injector and there is a throttle that creates turbulence in front of the injector. This engine works with  $\lambda=1.5$  at partial load and with  $\lambda=1$  at acceleration and full load. As can be seen in figure 2.2, at speeds below  $4000 \text{ dak}^{-1}$ , the channel that creates rotation movement from the channels to which two suction valves are connected is open, which is closed by channel throttle. Thus, the air movement needed for lean mixture is obtained and gas throttle is brought to "open" position, which in turn decreases pumping losses [15].

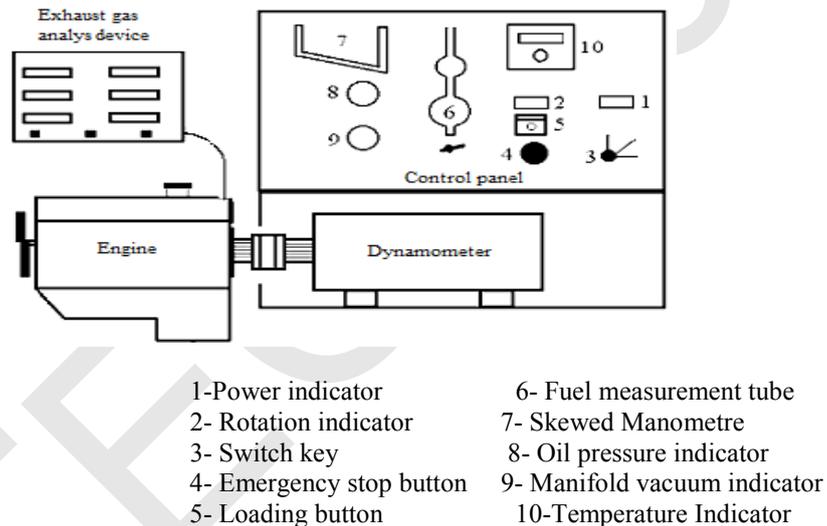


**Figure 2.2:** Toyota four-valve SC lean-mixture Otto engines [15].

## Test Materials and Methods

### Test mechanism

Schematic view of the engine used in tests is given in figure 3.1. The technical features are provided in table 3.1. In order that stratified charge that provides the foundations of our study can be generated, valve diameters of the engine were changed and valves were regulated so as to allow entrance to two distinct mixture entrances to one cylinder. The shapes of suction channels at the cylinder heads of the engine were changed so that airflow and mixture formation would be fit for purpose. LPG was used as fuel for operating the engine with SC. Some adjustments were also made in the serial-type LPG transformation system so that the LPG sent into the air during air passage from suction channels could be taken into the combustion chamber in a stratified manner.

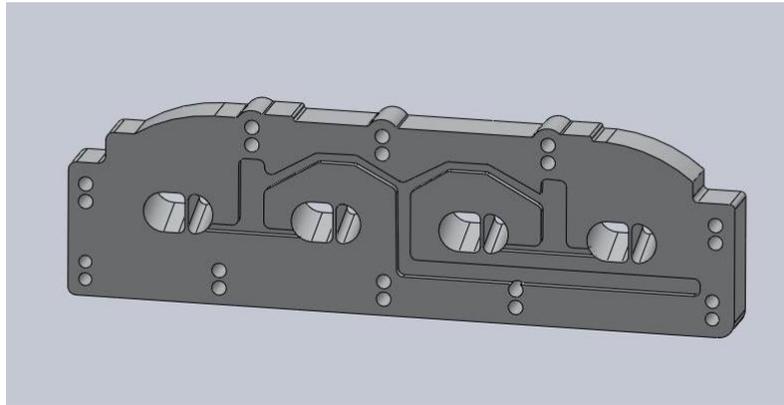


**Figure 3.1:** Schematic view of test mechanism

**Table 3.1:** Technical features of test engine

|                                    |   |
|------------------------------------|---|
| Type of engine                     | Four-cycle, stratified charge gasoline engine |
| Number of cylinders                | 4   |
| Cylinder diameter x stroke (mm)    | 89 x 95                                       |
| Cylinder volume (cm <sup>3</sup> ) | 1600  |
| Compression rate                   | 11:1  |
| Maximum power                      | 6000 min <sup>-1</sup> , kW                   |
| Maximum moment                     | 3300 min <sup>-1</sup> , Nm                   |
| Fuel system                        | Multipoint injection                          |
| LPG System                         | Serial multipoint injection                   |
| Fuel used                          | Gasoline/LPG                                  |
| Injector injecting pressure (bar)  | 5   |
| Ignition system                    | Electronic ignition                           |

The purpose of this study is that mixture will have two stages and different rates. For this purpose two-channel mixture slope with different diameters has been prepared, which can be seen in figure 3.3, and production was made at CNC machine.



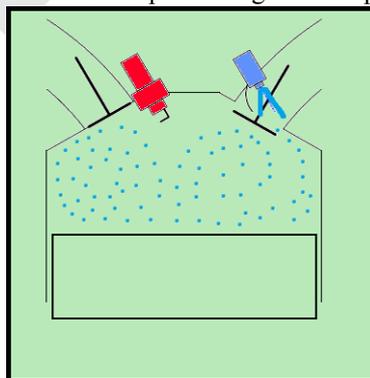
**Figure 3.3:** Mixture preparation slope

The aim of using a mixture preparation slope is sending stoichiometric or rich mixture to around spark plug and lean mixture to other parts of combustion chamber. Charge directors were placed behind the suction valves as seen in figure 3.4 so that the sucked fresh charge can be taken into cylinders in an expedient manner and the charge gains turbulence when being taken into cylinders and kinetic energy is increased.



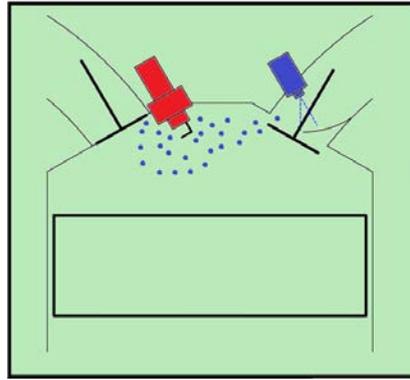
**Figure 3.4:** The images of mixture directors placed on cylinder head

The valve which ensures mixture entrance to the zones distant from spark plug and air entrance channels on the cylinder head are enlarged as can be seen in figure 3.5 with the purpose of increasing the amount of lean mixture that will be taken to these zones. With this procedure the diameter of housing was increased from 22 mm to 26 mm, which represents some 20% growth. In addition, with the director located behind the valve, the lean mixture prepared on mixture slope the lean mixture prepared at the mixture slope is charged to the points far from spark plug.



**Figure 3.5:** The view of entry of the mixture into the cylinder from large-diameter valve

In order to ensure stoichiometric mixture around spark plug, no change has been made to the valve and valve housing close to the spark plug. As can be seen in figure 3.6, with the director located behind the valve, stoichiometric mixture is filled to the zones close to the spark plug within the cylinder.



**Figure 3.6:** The view of entry of the mixture into the cylinder from small-diameter valve

As shown in figures 3.5 and 3.6, the mixture was taken into the engine in two stages so that the operation interval of the engine remained in the lean zone. EAC values of LPG stratified charge (SCL) engine is given in table 3.2.

**Table 3.2:** EAC interval for SCL

|     | 1500( $\text{min}^{-1}$ ) | 2500( $\text{min}^{-1}$ ) | 3500( $\text{min}^{-1}$ ) | 4500( $\text{min}^{-1}$ ) | 5500( $\text{min}^{-1}$ ) |
|-----|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| HFK | 1,00122                   | 1,024683                  | 1,128949                  | 1,234543                  | 1,317494                  |

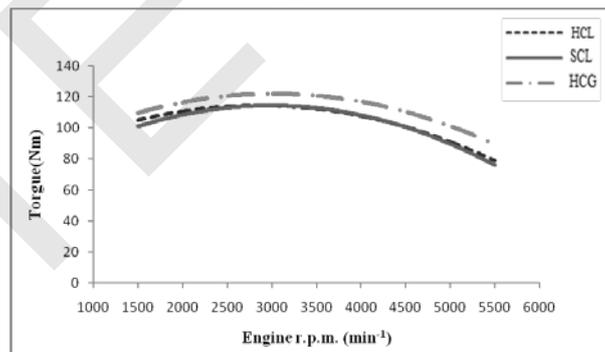
values in operating

It is known that in classical engines EAC decreases as rotation increases. However, table 3.2 clearly shows that EAC increases as rotation increases when SC is applied. In this study it is seen that SCL engine works in lean zone.

### Test Findings and Discussion

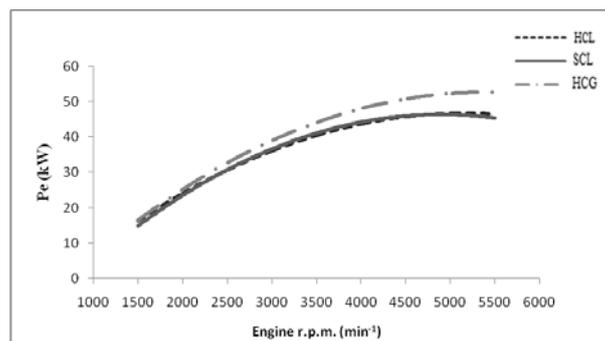
In this section the performance, fuel consumption and emission test results conducted at full load and different engine rotations have been provided when test engines were operated with Gasoline homogenous charge (HCG), LPG homogeneous charge (HCL) and stratified charge (SCL). Measured and calculated values are given in the form of table and graphics. Engine performance and exhaust emission of gasoline and LPG fuels have been compared and discussed.

The increase in both fuel types and the increase in engine moment while working on SC and HC is the result of the increase in the number of cycles in unit time. In figure 4.1, it can be seen that the changes in engine moment values for both engine rotations measured for both types of fuels in the case of operating with homogeneous and stratified mixture are close to each other.



**Figure 4.1:** Moment change graphic

The trend of change reflects the characteristic of a typical internal-combusted engine.

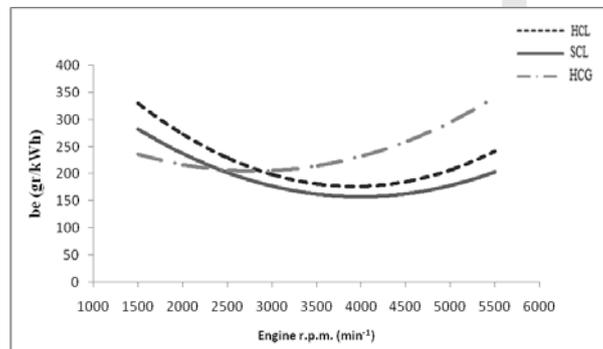
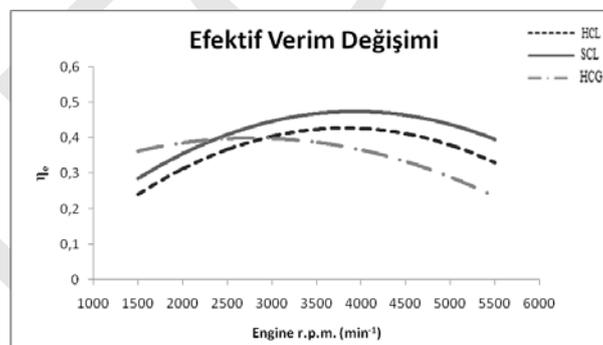


**Figure 4.2:** Effective power change

The relation between effective power and rotation is given in figure 4.2 as a graph. For all three operations, it can be seen that as the rotation of engine increases so does the engine power. As the rotation of engine increases so does the number of cycles in unit time; therefore, it is an expected and natural result that power will increase. It has been seen that working with SC does not have a noticeable positive effect on the effective power of the engine. The biggest positive effect of operating with SCL is witnessed at  $4000 \text{ min}^{-1}$  rotation. At this rotation, the effective power difference between SCL and HCL was determined as 8 percent.

When the graphs provided in figures 4.1, 4.2 and 4.3 are examined, it can be seen that moment and effective power values were almost very close to each other. Yet, decrease has been observed in all rotation intervals of the specific fuel consumption of SC engine, most of which was 25% at 4500 rotation. When the average of specific fuel consumption at variable rotations and total operating period is examined, some 15% decrease has been witnessed. Therefore when the power and fuel consumption obtained per cycle is taken into consideration and the graph provided in figure 4.4 is viewed, it can be seen that the highest change in effective yield was in SC engine.

Yes, Unthrottled, direct-injected, stratified-charge operation of a gasoline spark-ignited engine yields significant gains in thermal efficiency. This gain comes from a reduction or elimination of throttling losses, increased compression ratio and lean combustion. But, The challenge for the stratified-charge engine is meeting future Federal and California hydrocarbon and nitric-oxide emissions standards. This is due to high hydrocarbon emissions at light-loads and high nitric-oxide emissions at mid-load.


**Figure 4.3:** Change in specific fuel consumption

**Figure 4.4:** Change in effective yield

#### Fuel Economy (Relatively Easier to Demonstrate)

- Little or no Throttling losses (no pumping loop)
- Reduced heat losses (burning occurs with less contact with walls; overall temperature lower)
- Lean combustion (less heat used up in raising internal energy of charge so more available for useful work)
- Higher compression ratio (more knock tolerant because end-gas properties are favorably modified reduced thermal dissociation)

In internal-combustion engines, it is known that air movements have positive impact on mixture preparation and combustion. The increase in engine rotation increases the charge speed and gas movements within the cylinder. When figure 4.6 is examined, it can be seen that as the number of rotation increases, HC decreases for all three types of engines. The extra turbulence provided by directors at the entrance channels of SCL engine to the mixture meant lower HC values for this engine. The increase in EAC, which means that sufficient  $\text{O}_2$  is found for completion of combustion within the cylinder due to the mixture becoming leaner, causes decrease in CO values [16]. In the graph provided in figure 4.7, CO values tend to decrease for SCL can be explained by an increase in EAC.

Fuel injection occurs relatively early in the compression stroke; major mixing between fuel and air takes places before ignition; compression ratio is more knock-limited like conventional homogeneous-charge SI engines.

Expected gains in thermal efficiency were mostly realized. However, problems with high light-load hydrocarbon emissions, high mid-load nitric-oxide emissions and maximum power were encountered.

Hydrocarbons: Major source of engine-out hydrocarbon emissions is due to quenching of the flame in the overly lean fringes of the fuel-air cloud.

Nitric-oxide: major source of engine-out nitric-oxide emissions is stoichiometric combustion at local regions, within the combustion chamber.

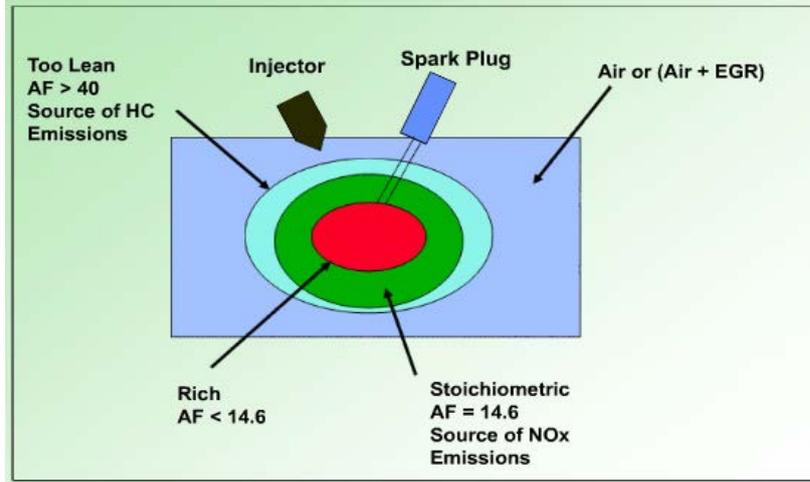


Figure 4.5: The distribution of the mixture in the combustion chamber

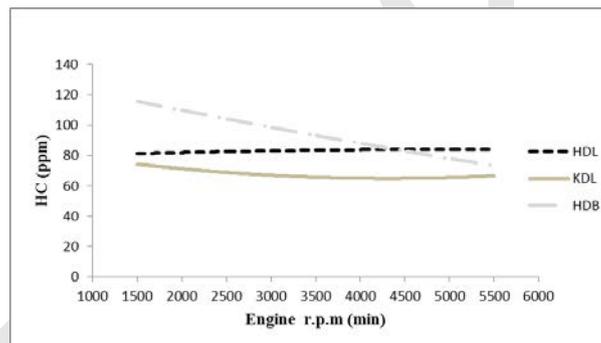


Figure 4.6: HC results measured as a result of tests

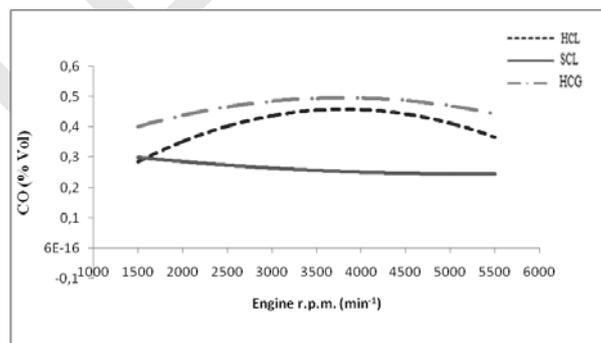


Figure 4.7: CO results measured as a result of tests

## Conculusion

As a result, although the operation interval of the engine is within lean zone, moment and effective power values for all engine types turned out to be close to each other with SC method; yet, when specific fuel consumption is examined, it can be seen that 15% decrease is obtained in SC engine and 10% decrease is obtained in emission rates.

Emissions (High Risk) Ideal properties of fuel-air cloud are difficult to attain, especially over entire load range.

Excessive lean fringes of cloud extinguish to cause a HC emissions problem.

Excessive stoichiometric regions of cloud cause NOx emissions problem.

Lean nature of combustion prevents use of a conventional 3-wat catalyst (and lean-NOx catalysts still under development).

Direct-Injection Stratified-Charge Gasoline Engines have significantly higher fuel economy than conventional throttled engines; but they also have significantly higher HC and NO<sub>x</sub> emissions. However, due to recent significant advances in Direct-Fuel-Injection system technology, engine control systems, and exhaust after treatment systems and understanding of lean and direct-injection combustion processes, revisiting the DISC engine is warranted. Engine Control Systems – Complex control systems needed for control of complex DISC combustion process are already here. Improved Understanding of Combustion Process – This is attributable to ongoing work and progress in understanding port-injected lean burn, and direct-injected two-stroke and four-stroke combustion processes.

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# STUDY OF THE EFFECT OF PESTICIDES ON SOME PHYSICO-CHEMICALS AND MICROBIOLOGICALS PARAMETERS OF SOIL AND WATER IN NORTH-EASTERN ALGERIA

Ouahiba Bordjiba<sup>1</sup> and Abdelhakim Belaze<sup>1</sup>

<sup>1</sup>BADJI Mokhtar Annaba University, P.O.Box 12, 23000 Annaba Algeria.  
Faculty of Sciences, Department of Biology  
Plant Biology and environmental Laboratory

E-mail: ouahiba\_bordjiba@yahoo.fr

**Abstract :** Among the chemicals most commonly used currently in our environment, Those are undoubtedly pesticides and related products. If pesticides are at first appeared beneficial, harmful side effects have been gradually revealed. Their toxicity, due to the molecular structure is not limited indeed to only species that we wish to eliminate. They are particularly toxic to the various components of the environment.

Our study aims to assess the degree of pollution of soil and surface water in farming areas situated in the North-Est of Algeria and subject to the effect of pesticides for several years. To do this, the physico - chemical characteristics of water and soil were determined. The analyzes have focused on pH, BOD5,COD, electrical conductivity, organic matter, nitrites and nitrates. The total microflora samples of water and soil was also evaluated. The physico-chemical parameters studied were analyzed by standard methods according to the general guidelines for storage and manipulation. The fungal microflora was determined using identification keys. The identification of isolated and purified bacteria was instead performed by a scan apiweb software (Api web Biomerieux France).

The results show that there is a pollution of water and soil. The values of some parameters often exceed the prescribed standards and especially those of nitrite and electrical conductivity. The isolated microflora consists of 97% whose most frequent are Bacillus and Micrococcus and 3% of fungi with a predominance of Aspergillus.

**Keywords:** pesticides, physico-chemical parameters, water, soil, microflora, bacteria, fungi.

## Introduction

Most pesticides used in developing countries are highly toxic chemicals. Approximately 73% of imports of pesticides belong to categories 1a (extremely toxic) and 1b (highly toxic) according to World Health Organization. Although the application of these pesticides ensures a certain quality of crop production (in particular the performance and phytosanitary quality), it contributes to contaminate the different compartments of the environment, especially soil and water resources.

Pesticides affect soil quality by reducing fertility (loss of nutrients and organic matter, reducing the total microbial biomass). Herbicides such as sulfonylureas, bensulfuron methyl (B) and metsulfuron methyl generate a considerable reduction of the soil microbial biomass (Taiwo and Oso, 1997; Boldt and Jacobsen, 2006; Baxter and al., 2008). Also Agricultural pesticides also pollute surface water and groundwater. This contamination is seasonal, the highest concentrations being measured during and after application of rainfall period (up to a few  $\mu\text{g} / \text{l}$  can then be measured in the samples analyzed). In recent years, various studies realized in Algeria have demonstrated the presence of many pesticides in water (Annaba, Algiers, Sétif) and also in our food: more than 50% of fruit and vegetables produced by intensive agriculture contain various molecules of pesticides. All these toxic compounds eventually end up in our organism, brought by the soil, water and food.

So ahead this situation, the main objective of our study was to check the quality of soils and waters surface in regions of north-eastern Algeria subject to the effect of several pesticides.

## Material and methods

### Collect of samples

Samples are taken from farming areas located in the north-eastern part of Algeria intended to the vegetable crops (tomato, potato, pepper and wheat) and subject to the effects of many pesticides. The main pesticides used are: bromuconazol, fluazifop- p butyl, cimoxanil, propineb, mancozeb, deltamethrine, pendimethaline and tebuconazol. Soil samples were collected in sterile tubes closed. They are then placed in the same conditions in which they are mixed to obtain a representative microflora, and then kept at 4 ° C until analysis. Water are collected in

bottles designed for water samples. These are stored at 4 ° C and transported to the laboratory on the same day with a view to analysis.

### ***Analysis of physico-chemicals parameters***

Regarding water, the analyzes focused on pH, electrical conductivity, BOD5, COD, nitrates and nitrites. The techniques used are those described by Rodier (1996). Regarding the soil, only the following parameters: organic matter, electrical conductivity, pH were evaluated by standard methods and compared with the scales reported in Soltner (1981), Gaucher (1981) and Durand et al., (1992).

### ***Evaluation of the total soil microflora***

The suspension is prepared by the dilution method described in the standard DIN 54379 for the total count of colonies.

1 g of soil from each sample was stirred in 100 ml of sterile Ringer's solution (Cassagne, 1966). The resulting suspension is diluted to 1/10th and 1/100th and 1/1000th from which 1 ml is taken that spread in a Petri dish and empty 10 ml of sterile culture medium. The dishes are incubated at 30 ° C temperature for 5 to 7 days.

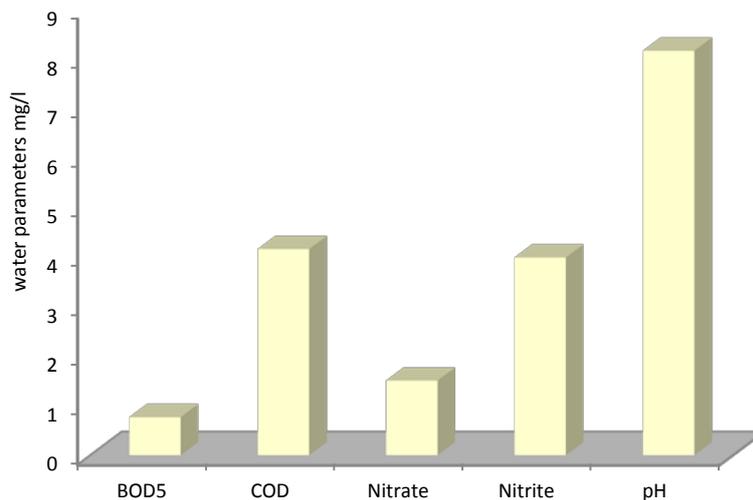
Isolation of fungal species is made on PDA and Muller-hinton method of Warcup (Parkinson and Waid., 1960) by seeding depth. Aliquots of soil are distributed in Petri dishes (90 mm diameter) and covered with sterile nutrient medium. The petri dishes in triplicate for each case were incubated at 30°C

### ***Identification of the microflora isolated***

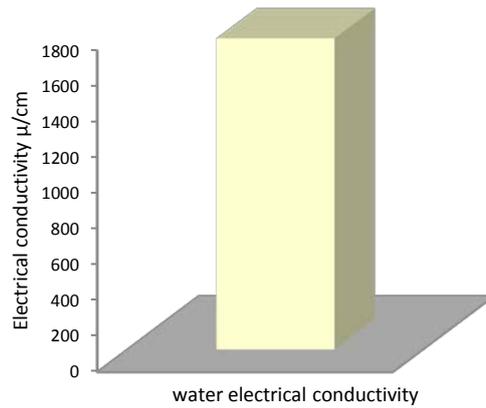
Bacterial isolates were purified by subculturing on Muller-Hinton. After studying the morphology, Gram staining and study of physico-chemical characteristics galleries with API 20 E and API 20 NE, identification is then performed by a scanning software API Web (Web API Biomerieux France). Regarding fungal strains after purification on Sabouraud medium, they are determined using identification keys de Botton et al., 1980 (Tome1 and 2)

## **Results and discussion**

### ***Analysis of water physico-chemicals parameters***



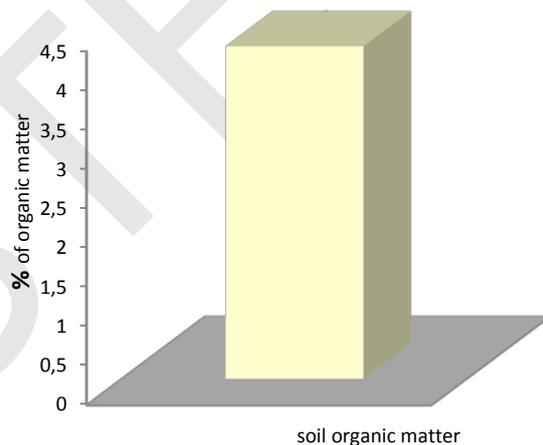
**Figure 1** : mean values of physico-chemicals parameters of waters analyzed



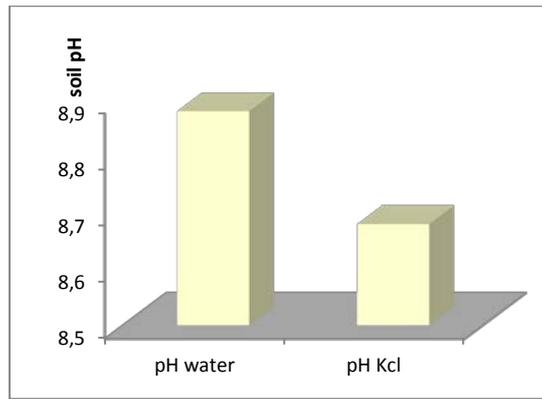
**Figure 2 :** Mean values of the electrical conductivity of waters analyzed

The physico-chemicals analyzes performed on water samples show firstly a high concentrations of nitrite (4 mg/l) above the allowable values which are between 1 and 3 mg/l, indicating the presence of toxic substances. Nitrites are toxic to organisms. It seems that the situation is very critical when a concentration is more than 3 mg/l of nitrite (Liseć, 2004). On the other hand, the values obtained for the electrical conductivity are also very high above international standards eligible with an average of 1745 $\mu$ /cm. These high values show the presence of salts dissolved in water (MSPE, 1987). Other analyzed parameters appear below the standards values.

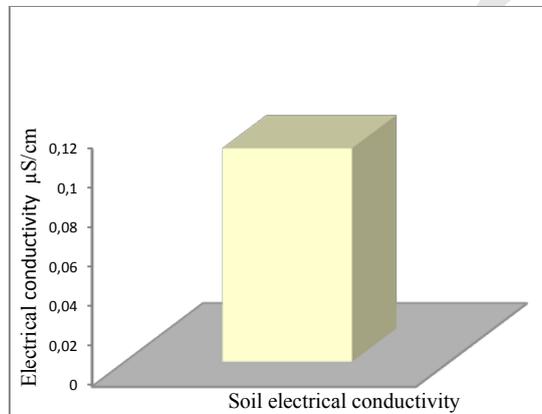
*Analysis of physico-chemicals soil parameters*



**Figure 3 :** Mean values of organic matter soils



**Figure 4 :** mean values of pH soils



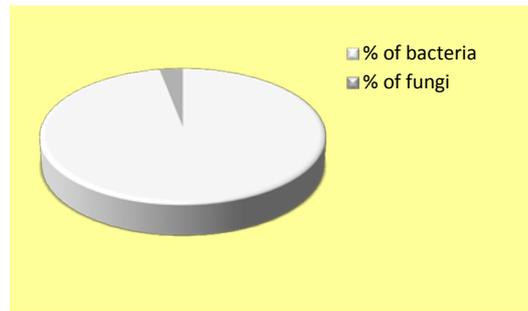
**Figure 5 :** Mean values of the electrical conductivity soils

The values of the parameters determined and compared with those of several authors scales indicated that the soil is rich in organic matter, with basic pH and unsalted poor in minerals with a very low conductivity probably due to the presence of pesticides.

### Evaluation of the total soil microflora

**Table 1:** Evaluation of fungal and bacterial microflora of different analyzed soils

| number of bacteria /gramme of soil | number of fungi / gramme of soil | Total |
|------------------------------------|----------------------------------|-------|
| 51407                              | 1088                             | 52495 |



**Figure 6 :** percentage of bacteria and fungi/ gramme of soil analyzed

**Table 2 :** Identification of isolated soil microflora

| bacterial strains  | fungual strains   |
|--|---|
| <i>Aeromonas</i><br><i>Bacillus</i><br><i>Chryseobacterium</i><br><i>Micrococcus</i><br><i>Pasteurella</i><br><i>Pneumotropica</i><br><i>Serratia</i><br><i>Vibrio</i> | <i>Absidia</i><br><i>Aspergillus</i><br><i>Fusarium</i><br><i>Penicillium</i><br><i>Trichoderma</i> |

The total microbial microflora isolated is composed of 52495 colonies / g soil, most of which consists of bacteria (97%). The bacteria appear to be more tolerant to the effects of pesticides sprayed on the ground. The fungal microflora appears to be more sensitive because it is less abundant with a much smaller number (3%). In addition, we find that there is not much difference from a sample to another, the same genera are present in almost all samples with higher or lower frequencies. The most common bacteria are mainly *Micrococcus*, *Bacillus*, *Aeromonas*, *Chryseobacterium* and *Serratia*. *Aspergillus*, *Penicillium* and *Trichoderma* are the most predominant among fungal microflora.

## Conclusion

This study allowed us to obtain a fairly rich microflora distributed almost uniformly throughout all sites. It is composed of several microbial species which may survive in the conditions of a highly polluted soil by the action of several herbicides, fungicides and insecticides. However, the growth of fungal species is sometimes inhibited in most samples. We think that this inhibition is probably due to the presence of pesticides in the treated soil. The accumulated doses following repeated treatments for several years, become toxic to the fungal strains. *Micrococcus*, *Bacillus* and *Aspergillus* particular are the most predominant microorganisms of the microflora. They are resistant to various pollutants and endure high concentrations of herbicides (Domsch and al., 1980; Sage and al., 1997; Steiman and al., 1992).

The distribution of the soil microflora is influenced by the characteristics of the habitat, such as, pH, organic matter content, humidity, soil texture and electrical conductivity.

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# STUDY ON SUPERCRITICAL FLUID EXTRACTION OF AROMATIC COMPOUND FROM ROASTED COCOA BEANS USING MULTILEVEL FACTORIAL DESIGN

Azila A.K.\* and Nur Aida, W.A.W.

Cocoa Innovation & Technology Centre, Malaysian Cocoa Board,  
PT12621, Nilai Industrial Area, 71800 Nilai, Negeri Sembilan, Malaysia

\*corresponding author; Tel: +606-7998873, Fax: +606-7941910, Email: [aziela@koko.gov.my](mailto:aziela@koko.gov.my)

## ABSTRACT

Extraction of aromatic compound from cocoa beans was carried out using Supercritical Fluid Extraction (SFE) in order to obtain natural cocoa extract for perfume formulation. The experiment was carried out by multilevel factorial design to investigate which factors; pressure (100, 125, 150 & 200 bar) and time (30, 45, 60 and 75 minutes), influence the extraction condition of cocoa aromatic (5-methyl-2-phenyl-2-hexenal), fatty acid (hexadecanoic acid) and alkaloid (caffeine) compounds. It was found out that the factors influence, significantly, yield of extract and extraction of fatty acid compound, while only pressure significantly affected amount of aromatic compound extracted. Extraction with high amount of aromatic compound (24.5mg/g extract) was obtained at 200 bar and 45 minutes. This result is used as a based to investigate further on the optimum condition to obtain high yield of aromatic compound in order to formulate the natural cocoa-scented perfume.

## INTRODUCTION

Cocoa aroma is contributed by at least by eleven groups of compounds (Table1), including pyrazines, esters, carbonyls, phenols and hydrocarbons (Jinap, et al. 1998; Jinap, et al. 2004). Acidic compounds such as acetic, isobutyric, isovaleric, hexanoic and pentanoic acids were reduced during roasting (Krysiak, et al. 2007). Van Praag, et al. (1968) suggested that cocoa aroma was contributed by aldehydes and pyrazines by extraction using steam distillation in three portions (acidic, neutral and basic). The basic fraction consists of compounds with nutlike smelling components such as alkyl substituted pyrazines, while the acidic fraction gave the slight phenolic odor. Among these three fractions, the neutral fraction was the most important as it contains 5-methyl-2-phenyl-2-hexenal which possess deep and bitter persistent cocoa note together with isovaleraldehyde and methyl disulfide. Furthermore, Bonvehi, et al. (2005) identified that 5-methyl-2-phenyl-2-hexenal gave the intense bitter taste to cocoa, as well as 4-methyl-2-phenyl-2-pentenal. In addition, chocolate aroma comes from 2,3,5,6-tetramethylpyrazine, while cocoa and roasted nuts aroma comes from 2,5-dimethylpyrazine. Caramelizing of sucrose during roasting increases furans compound in roasted cocoa beans.

Table 1: Examples of compounds contributes to cocoa aroma in roasted cocoa beans

| Group                       | Compounds (examples)   | Aroma attributes  | References   |
|-----------------------------|--|---|--|
| Pyrazines                   | 2,3,5,6-tetramethylpyrazine<br>2,5-dimethylpyrazine  | Chocolate, cocoa, coffee<br>cocoa and roasted nuts          | Jinap, et al (1998)<br>Bonvehi, et al (2002), Ducki, et al (2008)  |
| Esters                      | Butyl acetate<br>Ethyl benzoate  | Fruity taste and aroma<br>Fatty, fruity                     | Bonvehi, et al (2005)  |
| Carbonyls;<br>aldehydes     | 5-methyl-2-phenyl-2-hexenal<br>4-methyl-2-phenyl-2-pentenal  | deep and bitter persistent<br>cocoa note                    | Bonvehi, et al (2005)  |
| Phenols                     | Vanillin (phenolic aldehyde)   | vanilla   | Bonvehi, et al (2005)  |
| Alcohols                    | 2- heptanol<br>Linalool [3,7-dimethylocta-1,6-dien-3-ol]<br>Phenyl ethyl alcohol [2-phenylethanol] | fruity, herbal, sharp<br>flowery<br>aromatic chocolate note | Frauendorfer, et al (2008)   |
| Monoterpene<br>hydrocarbons | Pinene<br>Dimethyl-octane  | Lemon like  | Ducki, et al (2008)  |
| Alkaloids                   | Caffeine<br>Theobromine  | coffee  | Ducki, et al (2008)  |
| Furans                      | 2-methylfuran, tetrahydro-2-methylfuran  | Sweet and caramel-like<br>aroma of burnt sugar              | Krings, et al (2006)<br>Frauendorfer, et al (2008)                 |
| Acids                       | Acetic acid, Valeric acid, Butyric acid,<br>Hexanoic acid, Pentanoic acid                          | Vinegar   | Krysiak, et al (2007)<br>Krings, et al (2006), Ducki, et al (2008) |

Voight, et al. (1994) reported that the cocoa-specific aroma precursors were derived from the fermented cocoa seeds. The characteristic aroma of cocoa is a result of crude fermentation of fresh seeds, followed by drying and roasting (Bixler, et al. 1999). During the fermentation, fresh cocoa beans go through complex transformations: (1) the sugars from the mucilaginous pulp of the seeds are rapidly metabolized, producing volatile and nonvolatile organic acids; (2) the degradation of proteins to form peptides and free amino acids; (3) oxidation of polyphenols to form insoluble compounds, mainly *o*-quinones; and (4) hydrolysis of glycosides (mainly anthocyanins). In order for the aroma precursors to develop the cocoa aroma, the cocoa beans must undergo roasting processes. Alkalinization during roasting process diminishes the heterocyclic compounds of pyrones and furaneol in cocoa beans (Ziegler et al., 1991).

Supercritical fluid extraction (SFE) method has been widely used for the extraction of volatile components from plants due to its rapid, effective and solvent-free sample pre-treatment technique (Pourmortazavi, et al. 2007). SFE is highly recommended as an extraction method because it does not leave chemical residue, provide solvent-free product and the CO<sub>2</sub> gas can be recycled and used again as part of the unit operation (Otlés, et al. 2009). Determination of optimal condition in SFE is influenced, greatly, by operating temperature and pressure especially in critical region (Gomes, 2007), although other parameters such as sample particle size, flow rate of SFE solvent, extraction time and operation mode have some affects. The two former parameters change the density and viscosity of the SFE solvent mimicking the properties of various conventional solvent as in diagram of CO<sub>2</sub> (Figure 1). It was shown that by certain temperature of extraction and varying the vice versa, several density of extracting solvent (CO<sub>2</sub>) achieved resulting various compounds can be out of the samples, including fat, aromatic compound alkaloids. Most aromatic and flavor compounds have molecular weight below 250, which are soluble in SF CO<sub>2</sub> (Gomes, 2007) and normally can be extracted at pressure where SF CO<sub>2</sub> has low density (Reverchon,

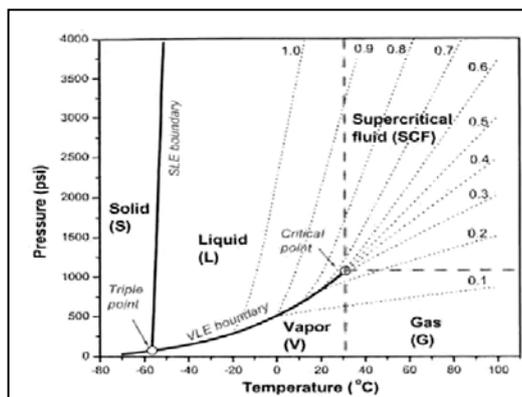


Figure 1: Density of SF CO<sub>2</sub> by Temperature & Pressure (Anonymous, 2012)

This method had successfully extracted sesame seed et al. 2010) and palm kernel oil (Zaidul, et al. 2007).

Nevertheless, cocoa butter, polyphenols and pyrazines were also successfully extracted *via* this method as Saldana, et al. (2002); Sarmiento, et al. (2008) and Sanagi, et al. (1997), respectively. Moreover, Sanagi et al (1997) conducted SFE at 200bar 60°C with modifier to completely extract the pyrazines compounds. Meanwhile, Mohamed, et al. (2002) used high pressure of CO<sub>2</sub> and ethane at more than 152 bar resulting high recovery of cocoa butter, caffeine and theobromine compounds from cocoa beans. In addition, research on SFE cocoa butter was in depth as carried out by Asep, et al. (2008) and as mentioned. Ducki, et al (2008) conducted a research on using solid-phase micro-extraction (SPME) for headspace analysis in cocoa products for identification of cocoa aromatic compounds. SPME coupled with GC-FID was also used by Hasny (2012) in his research work on detection of aromatic compound from roasted cocoa beans. Despite all, most of cocoa aromatic compounds were reported based on study using conventional extraction. Research reports focusing on extraction of cocoa aromatic compound using SFE for perfumery application was also not in extensive. Fragrance application of cocoa extracted using SFE was also scarcely documented (King and Bott, 1993). Therefore this research was carried out to extract the aromatic compound from roasted cocoa beans using SFE in order to develop natural cocoa-scented perfume.

## MATERIALS AND PROCEDURE

### Sample preparation

Fermented cocoa beans were collected from Cocoa Research and Development Centre at Jengka, Malaysia. clone of MCB, namely MCB C1, was selected in this preliminary study, whereas other clones will be subjected next phase of extraction. The beans were then roasted in at 135°C for 15 minutes. After shell removal, the beans ground using warring blender and sieved to 1.0-0.5mm size. Ground roasted beans were kept in tight container extraction using SFE.

### Supercritical Fluid Extraction

Extraction was carried out using SFE unit comprise of Intelligent HPLC Pump Model PU980 (Jasco Corporation, Tokyo, Japan) attached to cooling unit (Haake Fison DC 3). To achieve low temperature (-20°C), the cooling unit was operated with mixture of ethylene glycol-water (50:50 v/v). Ground cocoa beans at 10.15±0.16 grams were poured into sew white cloth and loaded into 25ml stainless steel tube (Thar Design, Inc., CL1043). To maintain temperature required, the column was inserted into Column Oven Model CO-960 (Jasco Corporation, Tokyo, Japan). Extraction pressure was controlled using Back Pressure Regulator (BPR) Model BP 880-81. Extraction was carried out using purified liquid carbon dioxide (CO<sub>2</sub>) obtained from Linde Malaysia Sdn. Bhd. The used gas was dispersed into the air and the liquid sample was collected in a vials. Figure 2 is the illustration of SFE Unit.

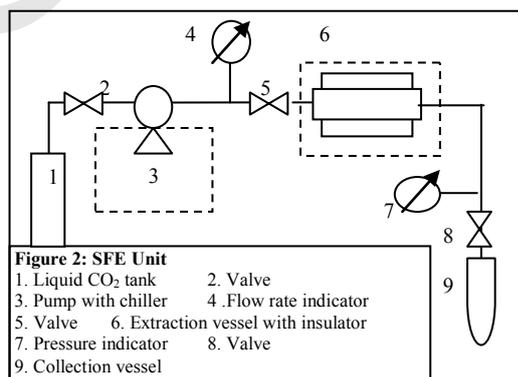


Figure 2: SFE Unit  
 1. Liquid CO<sub>2</sub> tank 2. Valve  
 3. Pump with chiller 4. Flow rate indicator  
 5. Valve 6. Extraction vessel with insulator  
 7. Pressure indicator 8. Valve  
 9. Collection vessel

A latest to the the oven were mesh until

## Experimental Design

| Run Order | Parameters     |            | Responses |                 |                   | Total compounds detected |                  |
|-----------|----------------|------------|-----------|-----------------|-------------------|--------------------------|------------------|
|           | Pressure (bar) | Time (min) | Yield (%) | Aromatic (mg/g) | Fatty acid (mg/g) |                          | Alkaloids (mg/g) |
| 1         | 125            | 45         | 0.70      | 5.25            | 85.05             | 7.70                     | 19               |
| 2         | 200            | 75         | 1.46      | 8.01            | 307.28            | 13.38                    | 16               |

Multilevel factorial design was chosen for this study prior to optimization. At this stage, two factors were considered, namely pressure (bar) and time of extraction (min). There are four levels for each factor, resulting multilevel factorial design as in Table 2. Sixteen runs of experiments were carried out according to the standard order. Constant temperature at  $35 \pm 2^\circ\text{C}$  was selected in this study, where the density of SF CO<sub>2</sub> was manipulated (Figure 1). Responses measured were the amount of aromatic, fatty acid and alkaloid compound which represented by 5-methyl-2-phenyl-2-hexenal (cocoa hexenal), hexadecanoic acid and caffeine, respectively. In addition, yield of the extract was also considered.

|    |     |    |      |       |        |        |    |
|----|-----|----|------|-------|--------|--------|----|
| 3  | 100 | 75 | 0.57 | 5.41  | 78.63  | 14.53  | 17 |
| 4  | 125 | 75 | 0.79 | 9.97  | 339.38 | 531.21 | 8  |
| 5  | 200 | 45 | 1.20 | 24.50 | 396.22 | 467.93 | 15 |
| 6  | 150 | 75 | 1.29 | 18.76 | 288.46 | 254.83 | 18 |
| 7  | 100 | 60 | 0.19 | 2.56  | 15.96  | 24.33  | 18 |
| 8  | 100 | 45 | 0.19 | 2.25  | 22.65  | 36.27  | 14 |
| 9  | 125 | 60 | 0.39 | 6.19  | 77.12  | 68.33  | 19 |
| 10 | 200 | 60 | 1.34 | 14.81 | 344.62 | 208.65 | 18 |
| 11 | 125 | 30 | 0.30 | 4.35  | 21.75  | 21.15  | 19 |
| 12 | 200 | 30 | 0.89 | 10.6  | 62.19  | 111.94 | 16 |
| 13 | 150 | 60 | 1.19 | 14.87 | 197.42 | 122.50 | 13 |
| 14 | 150 | 45 | 0.80 | 11.18 | 163.27 | 94.61  | 16 |
| 15 | 100 | 30 | 0.20 | 0.88  | 7.32   | 3.51   | 14 |
| 16 | 150 | 30 | 0.69 | 6.18  | 55.3   | 51.86  | 21 |

### Determination of compound in the extract

Absolute extract was transferred into gas chromatography (GC) vials by rinsing using 2.5ml n-hexane (Merck) followed by 2.5ml ethanol (HmbG). The calculation for amount of compound was based on the percentage area of each compound from the total yield of extract multiplying by the dilution factor (1:5) based on the solvent used to rinse the extract. Higher amount of compound extract indicated potential pressure and time to be used in further experimental works. Prior to GC-Mass Spectrophotometric (GC-MS) identification, the crude extract was filtered using C18-SepPak column (Supelco) with acetonitrile as the carrier to obtain clean extract. One  $\mu\text{l}$  sample was injected into the GC-MS system (Agilent Tech 7890A GC system). The GC-MS system has split-splitless column injector with mass spectrum detector (Agilent Tech System 5975C). Column of HP5MS (Agilent J&W) with dimension 30m x 0.25m i.d x 0.25 $\mu\text{m}$  was used in detection of compound. The condition was set at  $220^\circ\text{C}$ , 6.544 bar with helium as gas carrier. Library of National Institute of Standards & Technology (NIST 08) was used.

### Statistical analysis

Minitab software Release 14 was used for statistical design and data analysis in this study. For this study, all the results were categorized as significant when the p-value is less than 0.05. The values were reported by mean.

### RESULTS

From the statistical analysis, the pressure and time of extraction were significantly affecting the yield, at  $p=0.000$  and  $p=0.001$ , respectively. However, no interaction between the parameters was obtained. The linear model equation obtained, using linear regression analysis, for yield is,  $\text{YIELD} = -1.16 + 0.00954 * \text{PRESSURE} + 0.0105 * \text{TIME}$  ( $R^2=0.8700$ ). It was indicated from this equation that yield was proportional to the increasing of pressure at nearly ten times in ratio with the time of extraction. The main effect plot for yield was plotted in Figure 3. In addition, pressure at 200 and 150bar has higher effect to the yield in comparison with the lower pressures, which however affecting at longer extraction time.

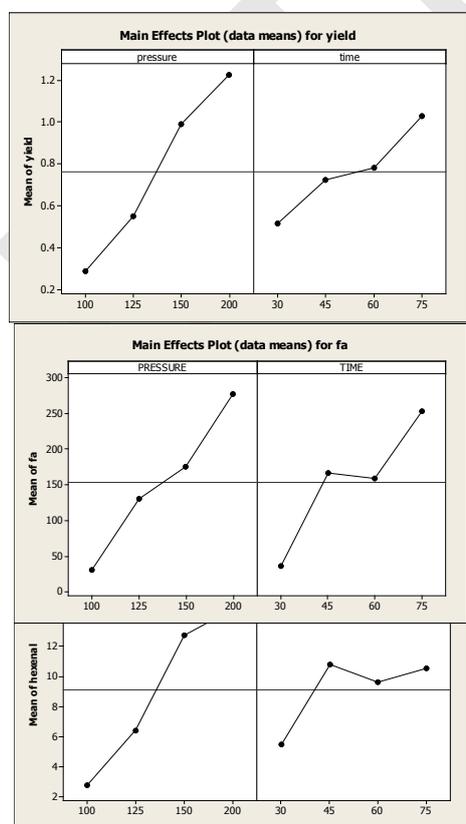
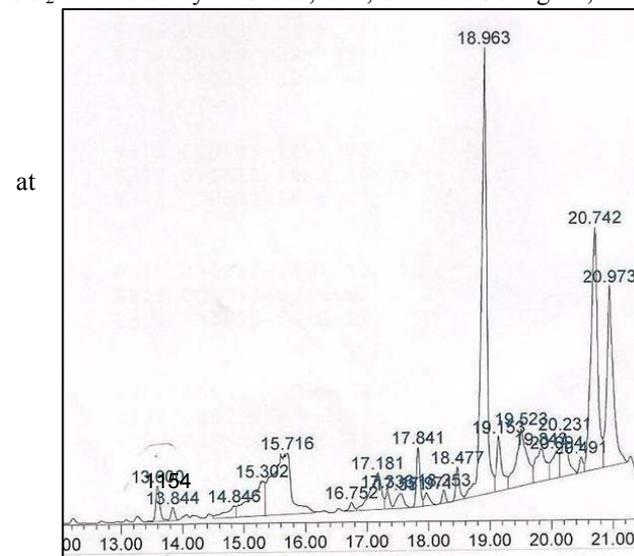


Figure 3: Plots for yield, fatty acid (fa) and aromatic (hexenal) compounds

Pressure and time of extraction was significantly affecting the amount of fatty acid compound extracted in this study at p-value of 0.015 and 0.032, respectively. The main effects were plotted separately in Figure 3 as there is no interaction between the two factors. Among these factors, only pressure has significant effect to the amount of aromatic compound extracted ( $p=0.022$ ), whereas alkaloids compound was not significantly affected. By referring to Figure 1, the density of SF CO<sub>2</sub> was identified according to operation pressure and temperature. As the temperature was constant, the density was proportional with the pressure. Density of SF CO<sub>2</sub> in this study was 700, 725, 815 and 900kg/m<sup>3</sup>, which significantly



affected the yield and amount of aromatic compounds  $p=0.001$  and  $0.015$ , respectively (at  $35 \pm 2^\circ\text{C}$ ).

The amount of fatty acid compounds

extracted by this method was significantly higher than the aromatic compounds. Reverchon (1997) reported that this is due to the SF CO<sub>2</sub> behavior of lipophilic solvent, but with adjustable selectivity, which extract lipid compound easily. It is also regarding to the position of paraffin and waxes substances on the surface and surrounding the vacuoles in plant materials which make its easily extracted using SFE. In addition, fat content in cocoa beans is more than 50% of the total weight of dry beans. Therefore, it was not surprising that extraction at any pressure point will result certain amount of fatty acid in the extract. There are two possible solutions worth trying at to overcome this condition, first, is by additionally using serial separators at different temperature and pressure are recommended to be applied to fractionate paraffin and waxes from aromatic compound extracted using SFE. Secondly, the extraction can be carried out at low pressure with high temperature to obtain low SF CO<sub>2</sub> density, where low molecular weight compounds, especially the aromatic compounds, can be extracted (Gomes, 2007).

Although the responses in this study was focusing on three compounds representing the numbers of compounds that being identified using GC-MS, there are few aromatic compounds mentioned in Table 1 were not detected in the extract. For example, Ziegler (1997) mentioned that high amount of linalool, contributed to the flowery and tea-like fragrance in flavor grade cocoa beans, which however absent in extract of cocoa bean in this study. Another key compound, 2,3,5-trimethyl-6-butylpyrazine was only detected at run 5 (pressure 200 bar, time of extraction 45 minutes). Low pyrazines compound was expected as alkalization process was omitted in sample preparation. Alkalization process is an essential step in cocoa processing to develop various color of cocoa powder and enhance the sensorial properties of final cocoa products. Figure 4 was the example of chromatogram for run 5. Other compounds listed in Table 1 were detected in each run (not discussed here). Total numbers of compounds detected for each run was listed in Table 2.

## CONCLUSION

Cocoa aromatic compound can be extracted at 200bar with time of extraction for 45minutes, which however resulting higher amount of fatty acid compounds which is interference in this study. To use this condition, the SFE unit has to be modified with the addition of serial separators to fractionate the extract. On the other hand, lower pressure can be implemented coupled with higher temperature to create SFCO<sub>2</sub> with low density that can expel out the aromatic compound that has low molecular weight. The progress on this research is underway to perform these methods in order to obtain high yield of cocoa aromatic compound for formulation of natural cocoa-scented perfume.

Figure 4: GC-Chromatogram for run 5

## ACKNOWLEDGEMENT

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# SUPPLEMENTAL IRRIGATION FOR IMPROVED WATER AND WATER USE EFFICIENCY OF WINTER WHEAT IN SUB-HUMID REGION OF ALGERIA.

Abdelkader Bouthiba<sup>1</sup>, F.Herda<sup>2</sup>, Abla Bouthiba<sup>1</sup>, A.Ababou<sup>1</sup>, D.Saidi<sup>1</sup>, M. M'hammedi Bouzina<sup>1</sup>

[Bouthiba\\_awk62@yahoo.fr](mailto:Bouthiba_awk62@yahoo.fr)

<sup>1</sup>University Hassiba Ben Bouali, Chlef, Algeria.

<sup>2</sup>INRAA, Baraki station, Algiers, Algeria.

**Abstract:** The role of nitrogen and water is essential in improving wheat yield and water productivity. However the use of these two factors must be done in an optimal way for economic and environmental reasons, The main objective of this study was to assess durum wheat (cv. CHEN'S) response to 4 splitted N-fertilization rates N0 (unfertilized), N50 (50kg ha<sup>-1</sup>), N100 (100kg ha<sup>-1</sup>), N150 (150kg ha<sup>-1</sup>) in combination with supplemental and deficit irrigation regimes. The exceptional rainfall amount of 800 mm recorded in 2011-2012 made that irrigation was not necessary. Therefore the study was limited to improve rainwater productivity under N-fertilization treatment as well as fertilizer efficiency. A split-plot design was selected for the study. Results showed that nitrogen factor had a significant effect on spike number, kernel number/m<sup>2</sup> above ground dry matter, 1000- kernel weight NUE, AE, WP, grain protein concentration and dry matter at maturity, while not having significant effect on straw yield. The unfertilized treatment was improved by 23.24 %, induced by N100, followed by N150 and N50 with 20.73% and 15.95% respectively. Grain yield was mainly determined by Spike number (p<0,001) and kernel number/m<sup>2</sup> (p<0,001). Among the total nitrogen involved in grain yield, N-fertilizer has constitute in average no more than 21.65% and 16.17 % in year 2 and year 1 respectively. The 1 kilogram of N-fertilizer in combination with N-soil was more efficient when applied at 50kg ha<sup>-1</sup> rate producing 93.77kg ha<sup>-1</sup> of grain. At the same rate the efficiency of 1 kg of N-fertilizer alone (AE) was more efficient comparing to other treatments with 21.2 kg kg<sup>-1</sup> (65.2%). Grain water productivity was 0.95kg m<sup>-3</sup> in average, the output in grain of 1 m<sup>3</sup> of water was 21 and 23.3% greater with 150 and 100 kg ha<sup>-1</sup> fertilization rate respectively. Comparing with fertilization rates recommended for subhumid region of Algeria, this study has matched the same yield target with less n-fertilizer.

**Key words:** Durum wheat, WUE, N-fertilizer, Grain yield

## Introduction

Low yields drive Algeria to be a major wheat importer in the world. As wheat production is mainly conducted under rainfed regime, reasons can be attributed to the climate, characterized by unfavorable rainfall distribution and heat stress. Besides, investments in production inputs per hectare such as nitrogen fertilization still very low comparing to other Mediterranean countries.

The challenge to Algerian policy makers is crystal clear; how increasing domestic wheat production in context of limited water resources, climate uncertainties and inefficiency of current irrigations management that exceeds crop requirements by 30–49% and in same time matching an increasing food demand? The recourse to water saving-irrigation technologies and improved irrigation management in order to ameliorate chain of efficiencies is an option.

Matching nitrogen supply to plant water availability is a determinant for successful grain yield, and can be ascribed to the variability in water use efficiency values, that is why optimization of supplemental irrigation combined to nitrogen fertilization as a tool for mitigating significant yield loss due to midseason and terminal drought is a center of interest in Mediterranean region.

The present study aims the evaluation of the effect of supplemental irrigation based on soil moisture monitoring and nitrogen supply and their interaction on grain yield, water and N-fertilizer use efficiency. The study will evaluate the effect of these factors on dry matter development before and after anthesis growth stage, on grain filling rate and on grain protein concentration.

The main objective aim of this study is to guide water and Nitrogen management in Durum wheat field located in the Northern Part of Algeria for optimal-yielding and water-saving production.

## Materials and method

The study took place in the National Institute of Agricultural Research (INRAA) (in Algiers, 36° 41' N, 3° 5' E, Altitude: 18m). Chen's' durum wheat cultivar was selected for the experiment, seeds were sown under field condition, the row spacing was 15 cm and plantation density of 160kg/ha. Sowing date was January 5, 2012. 150 Kg of fertilizer was applied as basal dressing (22% P2O5, 18% SO3 and 3% N. Additionally to 50 kg of NPK (15%))

The water supply treatments: rainfed, 1/3, 2/3, 3/3 of soil water deficit; are coupled with four (4) Nitrogen regimes (0, 50, 100, 150 kg N/ha).

A split plot experimental design was selected for the study, the main plots were assigned to irrigation and sub-plots to nitrogen. Four water levels and four nitrogen rates were randomly distributed in three replicates each, in total 48 sub-plots of (1,5x10 m) separated by rows of 2m wide and 3m separation between main plots.

The main growth observations stages were recorded when 50% of the plants in the sub-plot reaches the given stage.

Wheat response was assessed under 4 water regimes (rainfed, and 1/3, 2/3, 3/3 of the supplemental irrigation in combination with 4 nitrogen fertilizer levels (0 Kg/h, 50kg/ha, 100kg/ha, 150kg/ha).

Urea (46% of N) applied in two halves at tillering and booting growth stages. Before first nitrogen application, soil samples of each sub-plot (48) were collected in order to evaluate initial soil nitrogen state (Total Nitrogen,  $\text{NO}_3^- \text{NH}_4^+$ )

**Soil moisture monitoring:** Soil water monitoring was done by 20 cm increments down to 110 cm using CPN DR 503 neutron probe, at seedling, tillering and anthesis. From anthesis, measures were performed each 3 or 5 days. Unlike 2011-2012 trial, the moisture in the top 10 cm of soil is done gravimetrically.

**Dry matter accumulation and distribution:** At heading stage ground biomass samples (1 m<sup>2</sup>) were collected, and separated into leaf, stem, sheath and spike. Plant parts were dried in an oven at 80°C before being weighted separately. The same operation was carried out, at maturity. Parameters calculated were:

- Dry matter translocation amount after anthesis = dry weight at anthesis – dry weight at maturity;
- Dry matter translocation ratio after anthesis (%) = (dry weight at anthesis – dry weight at maturity) / dry weight at anthesis × 100;
- Dry matter translocation to grain after anthesis = grain dry weight at maturity – dry matter translocation amount after anthesis;
- Contribution of dry matter translocation to grain after anthesis (%) = dry matter translocation amount after anthesis / dry weight of grain at maturity × 100.

**Grain filling rate:** the grain-filling rate evaluation was done by collecting 20 spikes per plot from heading to maturity with 3 to 5 days interval (one part of 15m<sup>2</sup> was dedicated to destructive sampling). The spikes dry-weight were oven-dried at 80°C weighted.

**Grain Protein Concentration:** 48 samples of the previous harvest, weighting 350g each approximately, were subjected to a protein concentration analysis using the Infratec® 1229 Whole Grain Analyzer (FOSS Tecator)

Also other measurements were included such as: Grain and straw yield, Kernel/m<sup>2</sup>, Spike/m<sup>2</sup>, 1000 kernel weight (KW), Harvest index, Biomass at Anthesis and maturity, soil analysis, water productivity(WP), irrigation benefit (IB), nitrogen use efficiency (NUE), nitrogen agronomic efficiency

## Results and discussions

The cropping year 2011-2012 was exceptional (figure 1) in term of rainfall amount 800mm (590mm being the long term rainfall yearly average ) was received in whole year (545 mm from sowing to harvest) , remarkably, February, March and April were neatly in excess comparatively with 2001-2010 monthly average by 288%, 66, 4% and 269, 9% respectively.

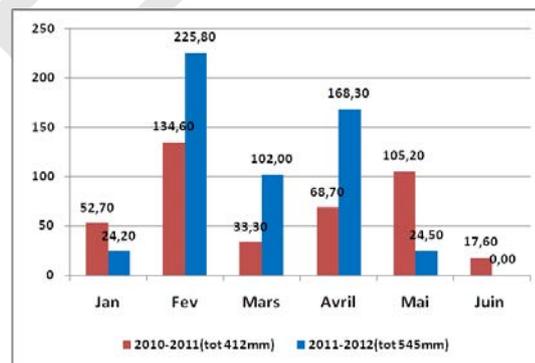


Figure 1. Rainfall amount received from sowing to harvest

**Soil moisture status:** Soil moisture condition was less stressful to crop in the whole season comparing to 2010-2011 (table 1). At anthesis growth stage for example, soil water content in the first 50cm of soil was 26, 5% (an average of 32.2% in the whole profile) no irrigation was needed. While in 2011, at the same stage it was 8,3% (40mm was provided as SI). The soil moisture was more favorable before anthesis and slightly less after, but without requiring any supplemental irrigation (considering the irrigation was provided only if soil water stock was below half plant available water content). Crop water consumption (ETR) was 533 mm (table 2).

Table 1. Variation of soil water content between seedling to maturity

| Horizon (cm) Day after sowing | 0-10 | 10-30 | 30-50 | 50-70 | 70-90 | 90-110 |
|-------------------------------|------|-------|-------|-------|-------|--------|
|-------------------------------|------|-------|-------|-------|-------|--------|

|                     |             |            |             |       |       |       |
|---------------------|-------------|------------|-------------|-------|-------|-------|
| 16 (seedling)       | 19.76       | 20.81      | 18.58       | 22.93 | 22.36 | 25.08 |
| 90                  | 20.25       | 25.78      | 31.90       | 38.42 | 37.31 | 37.55 |
| 93                  | 24.63       | 22.97      | 29.27       | 34.42 | 35.98 | 37.86 |
| 102 (Heading)       | 21.90       | 31.72      | 35.60       | 38.19 | 37.88 | 39.15 |
| 107 (Earl anthesis) | (3.71)21.19 | (7.4)25.68 | (13,4)32.57 | 37.21 | 37.49 | 38.82 |
| 111                 | 16.64       | 21.45      | 30.30       | 35.43 | 36.28 | 38.35 |
| 117 (watery ripe)   | 16.15       | 14.72      | 26.40       | 32.42 | 34.90 | 37.82 |
| 121(pluies)         | 17.01       | 13.27      | 24.82       | 30.95 | 33.21 | 37.60 |
| 125                 | 17.74       | 11.36      | 23.81       | 30.28 | 32.95 | 37.61 |
| 130                 | 13.24       | 7.75       | 21.91       | 28.42 | 30.92 | 36.35 |
| 137                 | 13.08       | 7.98       | 19.91       | 27.56 | 29.72 | 35.47 |
| 142                 | 13.08       | 3.32       | 18.27       | 25.95 | 28.14 | 34.11 |
| 146                 | 12.04       | *          | 18.80       | 26.25 | 28.14 | 34.00 |

Table 2. Evolution of soil water stock during cropping season and determination of plant water use

| $\Delta S_{0-10cm}$ | $\Delta S_{10-30cm}$ | $\Delta S_{30-50cm}$ | $\Delta S_{50-70cm}$ | $\Delta S_{70-90cm}$ | $\Delta S_{90-110cm}$ | $\Delta S_{110cm}$ | P (mm)     | ETR= $\Delta S_{110}+P$ |
|---------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|--------------------|------------|-------------------------|
| x                   | x                    | x                    | x                    | x                    | x                     | x                  | 64.10      |                         |
| <b>0.59</b>         | 5.97                 | 15.99                | 18.59                | 17.94                | 14.97                 | 74.05              | 366.20     | 440.25                  |
| <b>5.25</b>         | -3.37                | -3.16                | -4.80                | -1.60                | 0.37                  | -7.32              | 0.80       | -6.52                   |
| <b>-3.28</b>        | 10.50                | 7.60                 | 4.52                 | 2.28                 | 1.55                  | 23.17              | 140.10     | 163.27                  |
| <b>-0.85</b>        | -7.25                | -3.64                | -1.18                | -0.47                | -0.40                 | -13.78             | 6.60       | -7.18                   |
| <b>-5.46</b>        | -5.08                | -2.72                | -2.14                | -1.45                | -0.56                 | -17.41             | 0.00       | -17.41                  |
| <b>-0.59</b>        | -8.08                | -4.68                | -3.61                | -1.66                | -0.64                 | -19.25             | 3.20       | -16.05                  |
| <b>1.03</b>         | -1.74                | -1.90                | -1.76                | -2.03                | -0.26                 | -6.66              | 6.80       | 0.14                    |
| <b>0.88</b>         | -2.29                | -1.21                | -0.80                | -0.31                | 0.01                  | -3.73              | 6.80       | 3.07                    |
| <b>-5.40</b>        | -4.33                | -2.28                | -2.23                | -2.44                | -1.51                 | -18.19             | 0.00       | -18.19                  |
| <b>-0.19</b>        | 0.28                 | -2.40                | -1.03                | -1.44                | -1.06                 | -5.84              | 10.90      | 5.06                    |
| <b>0.00</b>         | -5.59                | -1.97                | -1.93                | -1.90                | -1.63                 | -13.02             | 0.00       | -13.02                  |
| <b>-1.25</b>        | -0.28                | 0.64                 | 0.36                 | 0.00                 | -0.13                 | -0.66              | 0.00       | -0.66                   |
|                     |                      |                      |                      |                      |                       | $\Sigma \Delta S$  | <b>ETR</b> | <b>532.76</b>           |

**Effect of treatments on yields:** In general, Nitrogen factor had a significant effect on durum wheat spike number, aboveground dry matter, 1000- kernel weight and nitrogen use efficiency, water productivity biomass at anthesis and fertilizer agronomic efficiency, while not having significant effect on straw yield (table 3).

Table 3: effect of treatments on yields.

| Nitrogen treatment                                  | N0    | N50    | N100    | N150   | P      | LSD (5%)       | CV%  |
|---|-------|--------|---------|--------|--------|----------------|------|
| Grain Yield (t/ ha-1)                               | 4.39a | 5.09b  | 5.41bc  | 5.30b  | 0.005  | 0.581.6 t ha-1 | 13.8 |
| Spike number/ m2                                    | 226   | 254    | 291     | 311    | <0.001 | 30.1           | 13.3 |
| Kernel number                                       | 8301a | 10658b | 12136bc | 12606c | <0.001 | 1597           | 14.6 |
| 1000-kernel weight (g)                              | 48.4  | 46.9   | 45.0    | 42.3   | 0.016  | 3.78g          | 9.9  |
| Dry matter at harvesting (t ha-1)                   | 9.39a | 10.49b | 11.42c  | 11.80c | <0.001 | 0.856 t ha-1   | 9,5  |
| Dry matter at anthesis (kg ha-1)                    | 15933 | 19733  | 19050   | 20783  | 0.002  | 2389.2 kgha-1  | 15.2 |
| Straw yield (kg ha-1)                               | 3309  | 3597   | 3573    | 3539   | 0.388  | 374.2 kgha-1   | 12.8 |
| Harvest index (HI)                                  | 0.464 | 0.485  | 0.474   | 0.452  | 0.0437 | 0.460          | 18.4 |
| NUE grain(kg /kgN-1)                                | -     | 93.77  | 54.12   | 35.37  | <0,001 | 15.88          | 30.9 |
| NUE adm(kg/ kgN-1)                                  | -     | 209.87 | 114.17  | 78.67  | <0,001 | 9.971          | 8.8  |
| AENgrain (kg /kgN-1)                                | -     | 21.20  | 12.83   | 7.89   | 0.012  | 8.332 kg/kg N  |      |
| Grain Water productivity (kg m-3)                   | 0.82  | 0.96   | 1.02    | 1.00   | 0.005  | 0.109 kgm-3    | 13.8 |
| Water productivity above ground dry matter (kg m-3) | 1.76  | 1.97   | 2.14    | 2.22   | <0,001 | 0.161 kgm -3   | 9.5  |

The analysis of variance (table 4) shows that the effect of nitrogen fertilizer on grain yield (GY) was significant at  $p=0.005$ . The average yield in 2011-2012 cropping season was 5.05 t ha-1, 12.5% greater than 2010-2011 yield (4.49 t

ha<sup>-1</sup>). The greater difference was induced by 100 kg N ha<sup>-1</sup> (N100) that improved unfertilized treatment (N0) by 23.24 % followed by N150 and N50 with 20.73% and 15.95% improvement respectively. The differences between N50-N100 and N50-N150 and N100-N150 were not statistically significant at 5% probability level.

Table 4. N-Treatment effect on durum wheat aboveground dry matter

| N- treatment Variable   | N0                 | N50                | N100               | N150               | P      | LSD                        | CV (%) |
|---|--------------------|--------------------|--------------------|--------------------|--------|----------------------------|--------|
| Aboveground dry matter at maturity (t ha <sup>-1</sup> )              | 9.39 <sup>a</sup>  | 10.49 <sup>b</sup> | 11.42 <sup>c</sup> | 11.80 <sup>c</sup> | <0,001 | 0.581(t ha <sup>-1</sup> ) | 9.5    |
| Aboveground dry matter at anthesis <sup>1</sup> (t ha <sup>-1</sup> ) | 2.52 <sup>a</sup>  | 2.99 <sup>a</sup>  | 3.9 <sup>b</sup>   | 5.03 <sup>c</sup>  | <0,001 | 0.725(t ha <sup>-1</sup> ) | 23.9   |
| Fresh matter at anthesis (t ha <sup>-1</sup> )                        | 15.93 <sup>a</sup> | 19.73 <sup>b</sup> | 19.05 <sup>b</sup> | 20.78 <sup>b</sup> | <0,001 | 1.829(t ha <sup>-1</sup> ) | 11.8   |

Durum wheat's aboveground matter (adm) production at harvesting was in average 10.78 t ha<sup>-1</sup>. The differences were highly affected by nitrogen treatments ( $p < 0.001$ ). Production range was 2.41 t ha<sup>-1</sup>, the greatest yield 11.80 t ha<sup>-1</sup> recorded for (N150) and the lowest one 9.39 t ha<sup>-1</sup>(N0). N50, N100 and N150 improved significantly unfertilized treatment by 11.72%, 21.62% and 25.56% respectively. Unlike GY, differences in adm induced by treatment were significant except for N100-N150. Similarly dry matter at anthesis was highly impacted by nitrogen treatment inducing significant improvement comparing to N<sub>0</sub> of 54% and 99.6% by N<sub>100</sub> and N<sub>150</sub> respectively. Nitrogen addition beyond 100 kg N ha<sup>-1</sup> gave significant gain of dry matter in average estimated at 29%. Given plant response amplitude to fertilization, we can state in first analysis, that till anthesis growth stage nitrogen still a limiting factors for durum wheat and play a primary role in dry matter accumulation, which gains under fertilization effect are greater comparing to those accumulated at maturity stage (comparing to N0, treatment increments induced clearly higher adm gains at anthesis 18.7%, 54%, 99.6% versus 11.72%, 21.62% and 25.56% at maturity)

Table 5. Effect of N-treatments on yield variables

| Treatment Variable     | N0                 | N50                | N100                | N150               | P      | LSD                | CV(%) |
|------------------------|--------------------|--------------------|---------------------|--------------------|--------|--------------------|-------|
| Grain yield t ha-1     | 4.39 <sup>a</sup>  | 5.09 <sup>b</sup>  | 5.41 <sup>bc</sup>  | 5.30 <sup>b</sup>  | 0.005  | 0.581 <sup>b</sup> | 13.8  |
| Spike number           | 226 <sup>a</sup>   | 254 <sup>a</sup>   | 291 <sup>b</sup>    | 311 <sup>b</sup>   | <0,001 | 30                 | 13.3  |
| Kernel number          | 8301 <sup>a</sup>  | 10658 <sup>b</sup> | 12136 <sup>bc</sup> | 12606 <sup>c</sup> | <0,001 | 1597               | 14.6  |
| 1000-kernel weight (g) | 48.44 <sup>b</sup> | 46.85 <sup>b</sup> | 44.98 <sup>ab</sup> | 42.35 <sup>a</sup> | 0.01   | 3.776              | 9.9   |

Kernel number (KN) and spike number (SN) (table 5) per surface area have determined grain yield in large extent (correlated at 0,76 and 0,60 respectively) they both increased with the increasing of nitrogen fertilization rate. In average they were 271 and 10925 respectively. Kernel number responded well to fertilization and improved significantly N0, by 28.40%, 46,20%, 51,86% for N50, N100 and N150 respectively. The extent of improvement was not similarly important concerning spike number, N100 improved N0 by 28.76% (N50 and N150 being not significant)

1000-kernel weight (TKW) was 45.66g in average; it has decreased with the increasing of fertilization rate. The greatest TKW was recorded for unfertilized treatment with 48.44g and the lowest for N150 with 42.35g. TKW was inversely correlated to SN and KN ( $r = -0.40$  and  $r = -0.36$  respectively).

Harvest index (HI) mean value was 0.470 (Table 6 ), the differences were not explained by the fertilization treatments ( $p=0.382$ ).

Table 6. Durum wheat harvest index function of nitrogen fertilization

|               | N0                 | N50                | N100               | N150               | P     | LSD   | CV(%) |
|---------------|--------------------|--------------------|--------------------|--------------------|-------|-------|-------|
| Harvest index | 0.464 <sup>a</sup> | 0.489 <sup>a</sup> | 0.474 <sup>a</sup> | 0.452 <sup>a</sup> | 0.382 | 0.382 | 11.2  |

**Nitrogen use and agronomic efficiency:** Nitrogen use efficiency is referred here as the total biomass or grain yield produced per unit of applied fertilizer (Guohua Xu and al, 2012). The Variance analysis shows that differences due to nitrogen treatments of NUEadm, NUEgrain and AEGrain were highly significant (<0,001) (Table 7).

In Average, the output of 1 kilogram of nitrogen (with indigenous-N contribution) was always higher when applied at the rate of 50 kg ha<sup>-1</sup> comparing to other's treatments' outputs. Thus when applied at 50 kg ha<sup>-1</sup> each 1 kg of N-fertilizer produced (with N-soil contribution) 209.9 kg ha<sup>-1</sup> and 93.77 kg ha<sup>-1</sup> of adm and grain respectively. Nitrogen use efficiency at 50 kg ha<sup>-1</sup> was better (gain) 73% and 165% than the efficiencies of 100 and 150 kg ha<sup>-1</sup> rates respectively, like it was 83% and 165% more efficient in producing aboveground dry matter.

The differences in AE<sub>grain</sub> were highly affected (<0,001) by fertilization treatments. The efficiency of N-fertilizer alone (without N-soil contribution) was 13.54 kg kg<sup>-1</sup> in average the first increment (50 kg ha<sup>-1</sup>) of fertilizer treatments was the most efficient with 21.2 kg kg<sup>-1</sup> that is to say 8.37 kg kg<sup>-1</sup> (+ 65.24%) and 14.64 kg kg<sup>-1</sup> (+113.87%) more than agronomic efficiencies at N100 and N150 rates respectively (figure 2).

Table 7: Nitrogen use and agronomic efficiency

|   | N0 | N50                | N100               | N150               | P      | LSD   | CV(%) |
|---|----|--------------------|--------------------|--------------------|--------|-------|-------|
| NUE <sub>adm</sub> (kg kg <sup>-1</sup> )   | x  | 209.9 <sup>c</sup> | 114.2 <sup>b</sup> | 78.7 <sup>a</sup>  | <0,001 | 9.97  | 8.8   |
| NUE <sub>grain</sub> (kg kg <sup>-1</sup> ) | x  | 93.77 <sup>c</sup> | 54.12 <sup>b</sup> | 35.37 <sup>a</sup> | <0,001 | 15.88 | 30.9  |
| AE <sub>grain</sub> (kg kg <sup>-1</sup> )  | x  | 21.20 <sup>b</sup> | 12.83 <sup>a</sup> | 6.59 <sup>a</sup>  | <0,001 | 7.94  | 68.4  |

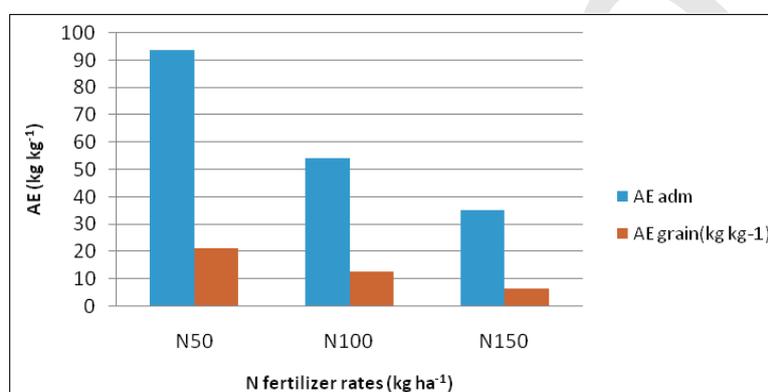


Figure 2: Nitrogen agronomic efficiency in durum wheat above ground dry matter and grain production

Among the total nitrogen involved in grain yield formation N-fertilizer has constitute in average no more than 21.65% and 16.17 % in 2011-2012 and 2010-2011 cropping seasons respectively. The contribution in first season was less significant because the study was subsequent to fallow, the soil fertility was relatively better due to organic matter mineralization while in the second season it was subsequent to wheat.

**Water productivity:** The average value of water productivity (WP) was 0.95 and 2.02 kg m<sup>-3</sup> for grain and aboveground dry matter (table 8).

Table 8. Grain and aboveground dry matter as affected by fertilization rates

| N-treatment Variable                      | N0                 | N50                 | N100               | N150               | P      | LSD <sub>5%</sub> | CV (%) |
|---|--------------------|---------------------|--------------------|--------------------|--------|-------------------|--------|
| WP <sub>grain</sub> (kg m <sup>-3</sup> ) | 0.824 <sup>a</sup> | 0.956 <sup>ab</sup> | 1.016 <sup>b</sup> | 0.996 <sup>b</sup> | 0.005  | 0.109             | 13.8   |
| WP <sub>adm</sub> (kg m <sup>-3</sup> )   | 1.763 <sup>a</sup> | 1.970 <sup>b</sup>  | 2.143 <sup>c</sup> | 2.215 <sup>c</sup> | <0,001 | 0.161             | 9.1    |

Nitrogen treatments have induced significant differences of crop water productivity. The cubic meter of water used was best valorized under fertilization that increased WP values with the increase of N rates. Concerning adm, WP of unfertilized treatment was improved by 11.74%, 21.55% by N50 and N100 treatment respectively nitrogen addition beyond N100 did not significantly increase WP. In the other hand, grain water productivity was 16.02% improved by the application of 50 kg ha<sup>-1</sup> of nitrogen fertilizer. Beyond this rate, additional fertilizer did not induce significant improvement of WP. (Grain WP for N100 was 1.016, N50-N100 difference was not significant, an average fertilization rate between this two rates would improve WP by 19.66%)

The WP values measured in this study are within the spectrum of measured WP (0.6-1.7 kg m<sup>-3</sup>) reviewed in (zwart, Bataaaseen 2004) and within 0.11-1.15 kg m<sup>-3</sup> and 0.32-1.06 kg m<sup>-3</sup> reviewed for Mediterranean region by (Katerji, Mastrorilli and al, 2008). The values are superior to those measured in (Karam, Kaban and al, 2009) (0.66-0.83 kg m<sup>-3</sup>)

3) under N-fertilized treatments (100, 150 and 200 kg ha<sup>-1</sup>) and to those found in (Karrou and Oweis, 2012) where it was found a WP values ranging between 0.23-0.67 kg m<sup>-3</sup> in rainfed regime under 140kg ha<sup>-1</sup> fertilization rate. WP values smaller than those in (Chennarfi and al, 2006) with two-irrigations regime (1.15kg m<sup>-3</sup>) but closer (0.87-1kg m<sup>-3</sup>) in 1-irrigation regime and better (0.64 kg m<sup>-3</sup>) under rainfed regime.

Finally, water productivity values measured in this study were greater than those measured for the same durum wheat variety (cv. CHEN'S) in Bouthiba and al, 2008). 0.46-0.75 kg m<sup>-3</sup> (Table 9).

Table 9. Comparison with Durum wheat's mean WP values (kg m<sup>-3</sup>) in Algeria (Eastern high plateaus and Cheliff) evaluated under rainfed, 1-irrigation, 2-irrigations and full irrigation regimes.

| Author                   | Soil                                   | Sowing Density (plant/ha) | Stem Elongation                               | Heading                                       | Stem Elongation + Heading                     | Rainfed                                       |
|--------------------------|--|---------------------------|---|---|---|---|
| (Chennarfi, et al. 2006) | Clay: 45%<br>Sand: 14%<br>Silt: 41%    | 212 (Waha)                | 0,87  | 1   | 1,15  | 0,64  |
| (Bouthiba, et al. 2008)  | Clay: 32,7%<br>Sand: 26%<br>Limon: 41% | 300                       | 0,77 (Vitron)<br>0,76 (Waha)<br>0,75 (Chen's) | 0,64 (Vitron)<br>0,66 (Waha)<br>0,64 (Chen's) | 1,60 (Vitron)<br>1,80 (Waha)<br>0,96 (Chen's) | 0,46 (Vitron)<br>0,53 (Waha)<br>0,47 (Chen's) |

**Durum wheat dry matter accumulation and distribution during 2011-2012 cropping season:** Whether in anthesis or maturity, total dry matter was considered in the study as the total accumulation of aboveground dry matter (the addition of leave, spike and stem+sheath dry weights, excluding roots) per square meter. The analysis of variance of total accumulated aboveground dry matter at anthesis growth stage didn't indicate that there is a significant differences between treatments (p=0.113), the average weight was 848.15 g m<sup>-2</sup>. Likewise, the treatments didn't induce a significant differences of durum wheat vegetative part except for spikes (p=0.005). (Table 7)

Table 10. Accumulation and distribution adm at anthesis growth stage as affected by nitrogen fertilization

| Nitrogen variable          | N0                 | N50                | N100                | N150                | P     | LSD   | CV (%) |
|----------------------------|--------------------|--------------------|---------------------|---------------------|-------|-------|--------|
| Aboveground dry matter (g) | 310.2 <sup>a</sup> | 359.4              | 339.9 <sup>ab</sup> | 358.3 <sup>b</sup>  | 0.113 | 46.01 | 15.5   |
| Leaves (g)                 | 65.96 <sup>a</sup> | 76.32 <sup>b</sup> | 74.23 <sup>b</sup>  | 75.98 <sup>b</sup>  | 0.017 | 7.13  | 11.8   |
| Stem+sheath(g)             | 178.8 <sup>a</sup> | 192.0 <sup>a</sup> | 178.2 <sup>a</sup>  | 181.2 <sup>a</sup>  | 0.630 | 22.85 | 14.4   |
| Spike (g)                  | 81.11 <sup>a</sup> | 95.58 <sup>b</sup> | 99.35 <sup>b</sup>  | 101.01 <sup>b</sup> | 0.005 | 11.77 | 15     |

At maturity differences in total adm were significant (0.027), the average weight was 848.15g. Fertilization treatments affected spike weight at maturity (0.002). The greatest development at maturity in adm and spike was recorded for 100kg h<sup>-1</sup>. (Table 10)

Table 11. Accumulation and distribution adm at Maturity growth stage as affected by nitrogen fertilization

| Nitrogen Variable | N0     | N50     | N100   | N150   | P     | LSD    | CV (%) |
|-------------------|--------|---------|--------|--------|-------|--------|--------|
| Adm (g)           | 781.1a | 828.5ab | 898.6b | 884.4b | 0.027 | 82.64g | 11.7   |
| leaves (g)        | 54.80  | 56.20   | 56.70  | 64.00  | NS    |        |        |
| Stem+sheath(g)    | 278.1a | 303.5a  | 300.6a | 289.9  | 0.423 | 33.20g | 13.6   |
| spike (g)         | 438.9a | 510.7b  | 541.2b | 530.5b | 0.002 | 56.10g | 13.3   |

The distribution of wheat dry matter's vegetative parts (except root system) was in average as follow: 22.34% (leave), 53.48% (stem), 27.52 % ( spike) at anthesis growth stage and 6.84% (leave), 34.61% (stem) and 59.5% (spike) at maturity) (table 11, figure 3).

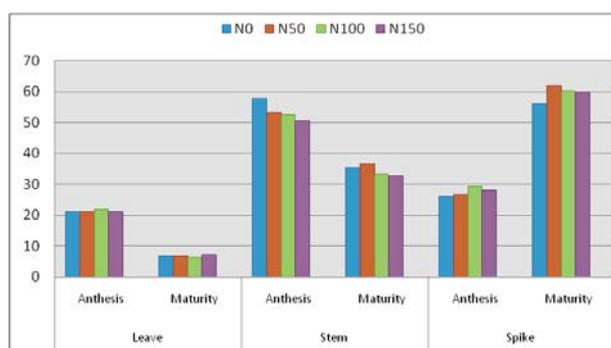


Figure 3: Durum wheat aboveground matter accumulation and distribution

**Durum wheat grain filling:** The analysis of differences of spike dry matter during durum wheat grain filling indicates that N-fertilization did have a little or no effect between treatments (Table 12) This could be explain by the fact that the final grain was more due to the differences of the number spike/m<sup>2</sup> and number of kernel/m<sup>2</sup> variables than to the unit of grain weight. As such the difference in weight could be more visible in the m<sup>2</sup> than in 20 spikes (the size of successive samples).

Table 3. Durum wheat grain filling as affected by nitrogen fertilization.

| N-treatments after sowing | Day | NO                  | N50                | N100               | N150                | P     | LSD    | CV   |
|---------------------------|-----|---------------------|--------------------|--------------------|---------------------|-------|--------|------|
| 108 (anthesis)            |     | 9.51 <sup>a</sup>   | 9.48 <sup>a</sup>  | 8.97 <sup>a</sup>  | 9.98 <sup>a</sup>   | 0.565 | 1.14g  | 17.7 |
| 113                       |     | 15.44a <sup>b</sup> | 16.33 <sup>b</sup> | 15.18 <sup>a</sup> | 15.95 <sup>ab</sup> | 0.079 | 0.943g | 7.3  |
| 117                       |     | 17.17 <sup>a</sup>  | 18.65 <sup>a</sup> | 18.19 <sup>a</sup> | 18.79 <sup>a</sup>  | 0.378 | 2.002g | 13.2 |
| 121                       |     | 23.55 <sup>a</sup>  | 23.97 <sup>a</sup> | 23.43 <sup>a</sup> | 25.08 <sup>a</sup>  | 0.472 | 2.32g  | 11.7 |
| 126                       |     | 32.64 <sup>a</sup>  | 33.64 <sup>a</sup> | 32.31 <sup>a</sup> | 34.97 <sup>a</sup>  | 0.417 | 3.475g | 12.6 |
| 130                       |     | 42.81 <sup>a</sup>  | 43.16 <sup>a</sup> | 43.53 <sup>a</sup> | 44.58 <sup>a</sup>  | 0.850 | 4.182g | 11.6 |
| 135                       |     | 58.81 <sup>a</sup>  | 66.34 <sup>b</sup> | 59.72 <sup>a</sup> | 64.08 <sup>ab</sup> | 0.038 | 5.837g | 11.3 |
| 154                       |     | 65.58               | 68.18              | 66.20              | 69.40               | 0.238 | 4.083g | 6.96 |
| 142                       |     | 73.84 <sup>a</sup>  | 69.80 <sup>a</sup> | 68.41              | 68.92 <sup>a</sup>  | 0.394 | 6.97   | 12.0 |
| 156 (harvest)             |     | 72.11 <sup>a</sup>  | 71.61 <sup>a</sup> | 69.51 <sup>a</sup> | 69.76 <sup>a</sup>  | 0.834 | 6.197g | 10.7 |

The grain filling process took 48 days approximately (between 105 and 156 day after sowing), in average the sample weight gain was 8,64g /day, that reaches 18.1g/day between 121 and 135 days after sowing (table 13).

Table 13. Grain dry matter gain and contribution to the final weight

| Days after anthesis | Average grain weight (g) | Weight gain (g) | Final weight (%) |
|---------------------|--------------------------|-----------------|------------------|
| 1                   | 9.485                    |                 |                  |
| 5                   | 15.725                   | 6.240           | 8.820            |
| 9                   | 18.200                   | 2.475           | 3.500            |
| 13                  | 24.008                   | 5.807           | 8.210            |
| 18                  | 33.390                   | 9.382           | 13.260           |
| 22                  | 43.520                   | 10.130          | 14.320           |
| 27                  | 62.236                   | 18.717          | 26.460           |
| 34                  | 67.340                   | 5.102           | 7.210            |
| 46                  | 70.243                   | 2.902           | 4.100            |
| 48                  | 70.748                   | 0.505           | 0.710            |

A relatively more active grain filling period was between 13 and 27 days after anthesis (DAA) where dry weight kept increasing, contributing thus by 3.50%, 8.21% and 26.46% successively to the final dry weight from 27 DAA (figure 4)

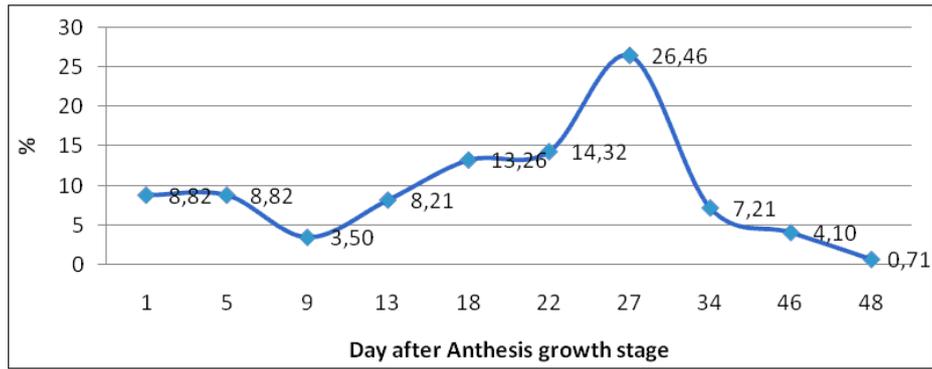


Figure 4: Grain dry matter during grain failing

**Grain protein concentration:** N-fertilization has induced highly significant differences in grain protein concentration. The average concentration was 14.01%. Unfertilized treatment was improved 24.38%, 32.45% and 38.17% by N50, N100 and N150 respectively (figure 5).

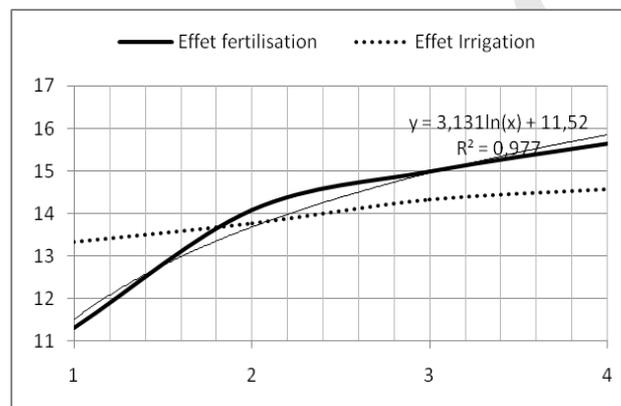


Figure 5. Durum wheat grain protein concentration (%) as affected by N-treatment

## Conclusion

For economic and Environment sake , it would be wise to choose 50 kg ha<sup>-1</sup> as N-fertilization rate given it has the best nitrogen use efficiency (93.77 kg kg<sup>-1</sup>), and fertilizer agronomic efficiency (21.20 kg kg<sup>-1</sup>) and it improved significantly the use of m-3 of rain water against a little yield loss comparing to 100kg ha<sup>-1</sup> rate . This is said, we have to consider that CHEN'S is a stable cultivar but may not be the best, when it comes to valorize fertilizer and water(year 1) as the experiment has shown; that is why a multi-varietal field experiment including relatively high potential cultivar would be interesting to conduct. Besides, this 2 years study has shown there is room to secure some fertilizers amount comparing to the rates for subhumid regions recommended by the national body for cereals development.

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# SUPPLIER SELECTION FOR AUTOMOTIVE INDUSTRY USING MULTI-CRITERIA DECISION MAKING TECHNIQUES

Özer Uygun<sup>1</sup>, Hasan Kaçamak<sup>1</sup>, Gizem Aysim<sup>2</sup>, Fuat Şimşir<sup>3</sup>

<sup>1</sup> Department of Industrial Engineering, Sakarya University, Serdivan, Turkey

<sup>2</sup> Undergraduate Student, Department of Industrial Engineering, Sakarya University, Serdivan, Turkey

<sup>3</sup> Department of Industrial Engineering, Karabük University, Karabük, Turkey

ouygun@sakarya.edu.tr, gizem.aysim@sakarya.edu.tr, hkacamak@sakarya.edu.tr, fuatsimsir@gmail.com

**Abstract:** This paper is aimed to suggest an approach for evaluating and selecting suppliers for an automotive manufacturing company, based on multi-criteria decision making methods. As an initial step, main criteria and sub-criteria which affect the evaluation and selection process of a supplier are identified. Secondly, DEMATEL approach is implemented to the main criteria in order to expose cause and effect interrelationship among them which is required by Analytic Network Process (ANP) method. At the third step, ANP methodology is applied for calculating the weights of each sub-criterion. After obtaining the weights of the sub-criteria, alternative suppliers are evaluated and ranked using TOPSIS method. At the end, the supplier with the highest performance indices is selected as the best supplier.

**Key words:** Supplier selection, multi-criteria decision making, DEMATEL, ANP, TOPSIS.

## 1. Introduction

An automotive manufacturing corporation is a global organization. It requires various technologies to produce a vehicle such as electronics, mechanics, engine technology, tire technology and so on. Each of these technologies is an industry in itself which needs special expertise. It is almost impossible for a main manufacturer to own all the technologies needed to produce such vehicle. Thus, as Razmi et al. (2009) indicated, these organizations must concentrate on their main operations and organizational goals, and outsource all non-strategic operations. To be competitive in a global marketplace, especially in automotive industry, supplier evaluation and selection is a vital process. Proper purchasing strategies, and especially proper suppliers, can play a key role in management of successful organizations and it is worthwhile to invest on making appropriate decision on supplier selection (Razmi et al., 2009).

The studies on supplier selection have begun in 1960s. Dickson (1966) has made an analysis of vendor selection and identified 23 different factors such as quality, delivery, price, performance history, warranties, technical capability, etc. His study showed that quality is the most important criteria and it is followed by delivery and then performance history.

There are several approaches for supplier evaluation and selection. Some of these approaches are data envelopment analysis (Wu et al., 2007; Saen, 2007; Ross et al., 2006), mathematical programming (Ng, 2008; Karpak et al., 2001; Wadhwa and Ravindran, 2007) such as linear programming, goal programming, multi-objective programming, analytic hierarchy process (Hou and Su, 2007), analytic network process (Gencer and Gürpınar, 2007), case-based reasoning (Choy and Lee, 2002) and genetic algorithms (Ding et al., 2005). Ho et al. (2010) mentions that there are several articles reviewing the literature about supplier evaluation and selection models up to 2000 and they have extended them by surveying the multi-criteria supplier evaluation and selection approaches from 2000 to 2008.

The selection process mainly involves evaluation of different alternative suppliers based on different criteria. This process is essentially considered as a multiple criteria decision-making (MCDM) problem which is affected by different tangible and intangible criteria (Önüt et al., 2009).

In this study, hybrid multi-criteria decision making approach is proposed and implemented for evaluating and selecting the most suitable supplier in automotive industry. This approach includes DEMATEL technique for revealing cause and effect interaction among criteria, analytic network process for obtaining the weights of the sub-criteria based on the result of the DEMATEL method, and TOPSIS method for evaluating and ranking the alternative suppliers according to the sub-criteria and the weights. Main criteria and their related sub-criteria are investigated and determined as given in Fig. 1.

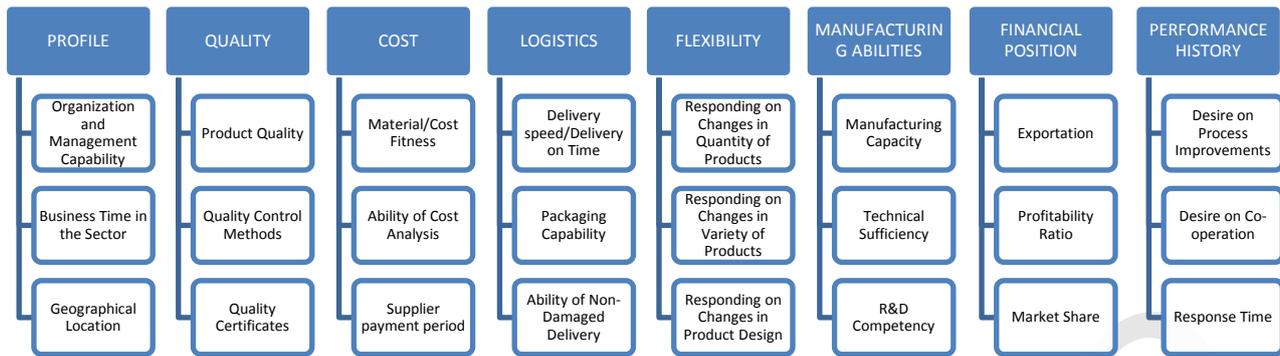


Fig. 1. Main criteria and related sub-criteria for supplier selection model.

## 2. Literature Review

A number of alternative approaches have been proposed for supplier evaluation and selection, called mathematical programming models, multiple attribute decision aid methods, cost-based methods, statistical and probabilistic methods, combined methodologies and other methods (Önüt et al., 2009). However, supplier selection process mainly involves evaluation of several alternatives based on different criteria. For that reason, multi-criteria decision-making (MCDM) approaches are used to deal with the selection process.

Extensive multi-criteria decision making approaches have been proposed for supplier selection, such as the analytic hierarchy process (AHP), analytic network process (ANP), case-based reasoning (CBR), data envelopment analysis (DEA), fuzzy set theory, genetic algorithm (GA), mathematical programming, simple multi-attribute rating technique (SMART), and their hybrids (Ho et al., 2010).

Gencer and Gürpınar (2007) developed a model aiming the usage of ANP in supplier selection owing to the evaluation of the relations between supplier selection criteria in a feedback systematic. The proposed model was implemented in an electronic company. Demirtas and Üstün (2008) proposed an integrated approach of ANP and multi-objective mixed integer linear programming for considering both quantitative and qualitative factors in choosing the best suppliers and defining the optimum quantities among selected suppliers to maximize the total value of purchasing and minimize the budget and defect rate. They evaluated four different plastic molding firms working with a refrigerator plant according to fourteen criteria that are involved in the four clusters: benefits, opportunities, costs and risks (BOCR).

Ming-Lang et al. (2009) proposed a novel hierarchical evaluation framework to assist the expert group to select the optimum supplier with ANP and choquet integral with reference to multiple conflicting criteria in supply chain management system (SCMS).

Dalalah et al. (2011) proposed a hybrid fuzzy model for group multi-criteria decision making. A modified fuzzy DEMATEL model was presented to deal with the influential relationship between the evaluation criteria. In addition, a modified TOPSIS model was proposed to evaluate the alternatives according to each criterion. Hsu and Hu (2009) presented an ANP approach to incorporate the issue of hazardous substance management (HSM) into supplier selection. In their study they proposed a multi-criteria decision model in which identification of criteria of HSM competence is categorized into four dimensions.

There are also studies concerning fuzzy set theory integrated with multi-criteria decision making methods. Some of the literature review about fuzzy multi-criteria decision making applications is given in the following part of this section.

Kilinci and Onal (2011), investigated the supplier selection problem of a washing machine company in Turkey, and a fuzzy AHP based methodology was used to select the best supplier firm providing the most customer satisfaction for the criteria determined. Lee (2009) also proposed fuzzy AHP to evaluate various aspects of suppliers and selecting them under fuzzy environment which incorporates the BOCR concept. A case study of backlight unit supplier selection was presented for a TFT-LCD manufacturer in Taiwan. Vinodh et al. (2011) used fuzzy ANP approach for the supplier selection process and the case study has been carried out in an Indian electronics switches manufacturing company. Razmi et al. (2009) aimed to develop a fuzzy ANP model to evaluate the potential suppliers and select the best one(s) with respect to the vendor important factors. They have augmented the model with a non linear programming model to elicit eigenvectors from fuzzy comparison matrices.

Chang et al., (2011) claims that their study pioneers in using the fuzzy decision-making trial and evaluation laboratory (DEMATEL) method to find influential factors in selecting suppliers. They designed a fuzzy DEMATEL questionnaire which is sent to seventeen professional purchasing personnel in the electronic industry.

Önüt et al. (2009) developed a supplier evaluation approach based on the ANP and TOPSIS methods to help a telecommunication company in the GSM sector in Turkey under the fuzzy environment. Boran et al. (2009) proposed TOPSIS method combined with intuitionistic fuzzy set to select appropriate supplier in group decision making environment. Intuitionistic fuzzy weighted averaging (IFWA) operator is utilized to aggregate individual opinions of decision makers for rating the importance of criteria and alternatives. They have given a numerical example for supplier

selection to illustrate application of intuitionistic fuzzy TOPSIS method. Wang et al. (2009) simplified the complicated metric distance method which was introduced by Chen and Chang (2005) and they proposed an algorithm to modify Chen's (2000) Fuzzy TOPSIS. From experimental verification, Chen directly assigned the fuzzy numbers  $\tilde{1}$  and  $\tilde{0}$  as fuzzy positive ideal solution (PIS) and negative ideal solution (NIS). They claimed that Chen's method sometimes violates the basic concepts of traditional TOPSIS. Thus their study proposed fuzzy hierarchical TOPSIS, which can provide more objective and accurate criterion weights, while simultaneously avoiding the problem of Chen's Fuzzy TOPSIS.

### 3. Methodology

In this study, hybrid DEMATEL, ANP and TOPSIS methods are implemented in a combined way. Thus these methods are explained in this section.

#### 3.1. DEMATEL Method

The Battelle Geneva Institute created DEMATEL in order to solve difficult problems that mainly involve interactive man model techniques as well as to measure qualitative and factor linked aspects of societal problems. (Gabus and Fontela, 1972). It analyzes the influential status and strength between the factors and convert them into an explicit structural mode of a system (Lin and Wu, 2008). The mathematical concepts are then evolved and adapted in many academic fields, such as industrial strategy analysis, competence evaluation, solution analysis, selection, and etc. It has been proven as a useful method to solve complicated problems.

The DEMATEL methodology construction process is described below;

*Step 1: Generating the direct-relation matrix.*

A group of experts is asked to make pairwise comparisons in terms of influence between criteria. An evaluation scale of 0, 1, 2, 3, and 4 is used for comparison, representing "no influence", "low influence", "medium influence", "high influence" and "very high influence", respectively. The results of these evaluations form an  $n \times n$  matrix for each respondent expert where the  $a_{ij}$  is the score given by the  $k$ th expert indicating the influential level that factor  $i$  has on factor  $j$ . To incorporate all opinions from  $K$  experts, the direct-relation matrix  $A$  is calculated using Eq. (1) by averaging each expert's scores.

$$a_{ij} = \frac{1}{K} \sum_{k=1}^K a_{ij}^{(k)} \quad (1)$$

*Step 2: Normalizing the direct-relation matrix.*

The normalized direct-relation matrix  $M$  can be obtained by normalizing  $A$  using Eqs. (2) and (3).

$$m_{ij} = \frac{a_{ij}}{n} \quad (2)$$

$$m_{ij} = \frac{a_{ij}}{\left( \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}}, \frac{1}{\max_{1 \leq j \leq n} \sum_{i=1}^n a_{ij}} \right)} \quad (3)$$

*Step 3: Obtaining the total-relation matrix.*

The total-relation matrix  $T$  can be obtained by using Eq. (4), where  $I$  denotes the identity matrix.

$$T = M + M^2 + M^3 + \dots = \sum_{i=1}^{\infty} M^i = M(I - M)^{-1} \quad (4)$$

where  $M = [m_{ij}]_{n \times n}$ ,  $i, j = 1, 2, \dots, n$ .

*Step 4: Compute the dispatcher group and receiver group.*

The vectors  $D$  and  $R$  represent the sum of rows and columns of matrix  $T$  respectively, as shown in Eqs. (5) and (6).  $D + R$  value indicates the degree of importance that the corresponding criterion plays in the entire system. The factor having greater value of  $D + R$  has more interrelationships with other factors. On the other hand, criteria having positive values of  $D - R$  are on the cause group and dispatches effects to the other criteria. On the contrary, criteria having negative values of  $D - R$  are on the effect group and receive effects from the other criteria.

$$D = \sum_{j=1}^n t_{ij} \quad (5)$$

$$R = \sum_{i=1}^n t_{ij} \quad (6)$$

*Step 5: Set up a threshold value to obtain the causal diagram.*

Since the total-relation matrix  $T$  provides the information on how one criterion affects another, decision maker group should set up a threshold value in order to filter out some negligible relationships. This way enables the decision maker to choose only the relationships greater than the threshold value and to map the cause-effect relationship accordingly. The causal diagram can be acquired by mapping the dataset of the  $(D + R, D - R)$  where the horizontal axis



where  $w_i$  is the weight of the  $i$ th criterion and  $\sum_{i=1}^n w_i = 1$ . Then the  $V$  matrix is formed as follows:

$$V = \begin{bmatrix} v_{11} & \dots & v_{1n} \\ \vdots & \ddots & \vdots \\ v_{n1} & \dots & v_{nn} \end{bmatrix}$$

*Step 3. Determine the positive-ideal and the negative-ideal solutions.* The positive-ideal denoted as  $V^+$  and the negative-ideal denoted as  $V^-$  alternatives are defined as:

$$V^+ = \{v_{1j}^+, \dots, v_{nj}^+\} = \{(\max_i v_{ij} | v_{ij} \in V), (\min_i v_{ij} | v_{ij} \in V)\} \quad (9)$$

$$V^- = \{v_{1j}^-, \dots, v_{nj}^-\} = \{(\min_i v_{ij} | v_{ij} \in V), (\max_i v_{ij} | v_{ij} \in V)\} \quad (10)$$

where  $v_{ij}^+$  is associated with benefit criteria, and  $v_{ij}^-$  is associated with cost criteria.

$v_{ij}^+$  indicates the most preferable solution and similarly  $v_{ij}^-$  indicates the least preferable solution.

*Step 4. Calculate the separation measure.* The separation of each alternative from the positive-ideal solution and negative-ideal solution are calculated using  $n$ -dimensional Euclidean distance method. The distances from the positive-ideal solution and negative-ideal solution can be calculated as follows:

$$d_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_{ij}^+)^2}, \quad i = 1, \dots, n, \quad (11)$$

$$d_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_{ij}^-)^2}, \quad i = 1, \dots, n. \quad (12)$$

*Step 5. Calculate the relative closeness to the ideal solution.* The relative closeness of alternative  $V_i$  with respect to  $V^+$  is calculated as follows:

$$c_i^* = d_i^- / (d_i^+ + d_i^-), \quad i = 1, \dots, n \quad (13)$$

where  $0 \leq c_i^* \leq 1$ .

If  $V_i = V^+$  then  $c_i^*$  is equal to 1 and if  $V_i = V^-$  then  $c_i^*$  is equal to 0.

*Step 6. Rank the preference order.* The best alternative can be now decided according to the preference rank order of  $c_i^*$ . Therefore, the best alternative is the one that has the shortest distance to the ideal solution.

## 4. Implementation

The case study is implemented in an automotive factory in Bursa, Turkey. First, interactions among the main criteria are obtained asking experts working for the company and using DEMATEL approach. Then ANP method is implemented according to the experts' opinions in order to calculate the local weights of the sub-criteria. After determining the weights, four SMEs are investigated and graded according to each sub-criterion. As a result, each SME is scored implementing TOPSIS method.

The evaluation of one of the experts in terms of the effect between the main criteria is given in Table 1. Similarly, all of the evaluations from the rest of the experts are obtained and then averages of numbers are calculated using Eq. (1). The average values are given in Table 2. The normalized direct-relation matrix is obtained using Eqs. (2 and 3). After calculating the normalized direct-relation matrix, the total-relation matrix is obtained using Eqs. (4, 5, and 6). The total-relation matrix is shown in Table 3. Then  $(D + R)$  and  $(D - R)$  values are calculated and also shown in Table 3. The threshold value is determined as 0.51 according to the experts' opinions. The values above the threshold are represented in bold in the table which gives the cause and effect relationship among the main criteria.

**Table 1.** Evaluation of an expert in terms of effect among the criteria

|    | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 |
|----|----|----|----|----|----|----|----|----|
| C1 | 0  | 3  | 2  | 2  | 2  | 3  | 4  | 4  |
| C2 | 3  | 0  | 4  | 2  | 1  | 3  | 3  | 2  |
| C3 | 1  | 4  | 0  | 2  | 2  | 2  | 4  | 1  |
| C4 | 3  | 1  | 3  | 0  | 1  | 1  | 3  | 2  |
| C5 | 2  | 3  | 4  | 2  | 0  | 4  | 2  | 2  |
| C6 | 3  | 3  | 4  | 1  | 4  | 0  | 3  | 2  |
| C7 | 3  | 1  | 1  | 2  | 1  | 4  | 0  | 2  |
| C8 | 3  | 3  | 2  | 4  | 2  | 3  | 2  | 0  |

**Table 2.** The initial direct-relation matrix (average values of the evaluations of the experts)

|    | C1   | C2   | C3   | C4   | C5   | C6   | C7   | C8   |
|----|------|------|------|------|------|------|------|------|
| C1 | 0.00 | 3.33 | 2.33 | 2.33 | 2.33 | 3.33 | 3.33 | 4.00 |

|    |      |      |      |      |      |      |      |      |
|----|------|------|------|------|------|------|------|------|
| C2 | 2.67 | 0.00 | 3.00 | 1.67 | 1.67 | 1.67 | 3.67 | 2.00 |
| C3 | 1.33 | 3.33 | 0.00 | 1.33 | 1.67 | 1.67 | 3.67 | 1.33 |
| C4 | 2.67 | 1.33 | 2.67 | 0.00 | 1.00 | 1.00 | 3.00 | 1.67 |
| C5 | 1.67 | 2.33 | 3.00 | 1.33 | 0.00 | 3.33 | 2.00 | 1.33 |
| C6 | 2.33 | 2.33 | 4.00 | 1.33 | 4.00 | 0.00 | 3.00 | 1.67 |
| C7 | 2.67 | 1.33 | 1.00 | 2.00 | 1.00 | 4.00 | 0.00 | 1.67 |
| C8 | 3.67 | 2.67 | 2.67 | 4.00 | 2.67 | 2.67 | 2.33 | 0.00 |

**Table 3.** The total-relation matrix

|    | C1           | C2           | C3           | C4           | C5           | C6           | C7           | C8           | D     | D+R   | D-R    |
|----|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------|-------|--------|
| C1 | 0.485        | <b>0.613</b> | <b>0.620</b> | 0.504        | <b>0.517</b> | <b>0.650</b> | <b>0.728</b> | <b>0.563</b> | 4.679 | 8.467 | 0.892  |
| C2 | 0.489        | 0.372        | <b>0.527</b> | 0.387        | 0.394        | 0.477        | <b>0.615</b> | 0.400        | 3.660 | 7.407 | -0.086 |
| C3 | 0.390        | 0.461        | 0.351        | 0.331        | 0.353        | 0.426        | <b>0.557</b> | 0.331        | 3.199 | 7.294 | -0.896 |
| C4 | 0.426        | 0.371        | 0.445        | 0.262        | 0.312        | 0.382        | <b>0.512</b> | 0.336        | 3.046 | 6.192 | -0.101 |
| C5 | 0.418        | 0.446        | 0.505        | 0.344        | 0.304        | 0.508        | <b>0.517</b> | 0.346        | 3.388 | 6.648 | 0.127  |
| C6 | <b>0.513</b> | <b>0.518</b> | <b>0.617</b> | 0.403        | <b>0.526</b> | 0.449        | <b>0.641</b> | 0.418        | 4.086 | 8.102 | 0.069  |
| C7 | 0.446        | 0.388        | 0.410        | 0.362        | 0.340        | <b>0.518</b> | 0.407        | 0.351        | 3.221 | 7.873 | -1.431 |
| C8 | <b>0.620</b> | <b>0.576</b> | <b>0.620</b> | <b>0.555</b> | <b>0.515</b> | <b>0.607</b> | <b>0.677</b> | 0.391        | 4.559 | 7.693 | 1.425  |
| R  | 3.788        | 3.746        | 4.095        | 3.147        | 3.260        | 4.016        | 4.652        | 3.134        |       |       |        |

Threshold value = 0.51

According to the cause and effect relationship extracted from the DEMATEL method, the weights of the sub-criteria are calculated following ANP approach in order to form the supermatrix. For example, since “C1: Profile” effects “C2: Quality”, the evaluation of importance of sub-criteria of C2 (C21, C22 and C23) in terms of C11 is given in Table 4. Then geometric average is taken after obtaining evaluations of the rest of the experts in order to calculate the local weights. The result is shown in Table 5.

The rest of the local weights are calculated in the same way based on the interaction obtained from the DEMATEL. The supermatrix is formed for the sub-criteria and the local weights calculated are placed into the matrix accordingly. The unweighted supermatrix is presented in Table 6. Then, unweighted supermatrix is normalized to transform it to the weighted supermatrix in which each of its columns sums to 1. The power of the weighted supermatrix is taken until the values of each column are stabilized and equal. These calculations are implemented using MATLAB software and the limit supermatrix is obtained which is given in Table 7. Any column of the matrix shows the weights of corresponding sub-criteria.

**Table 4.** Pairwise comparison matrix of an expert in terms of C11: Organization and Management Capability

|     | K21  | K22  | K23  |
|-----|------|------|------|
| K21 | 1.00 | 0.33 | 0.20 |
| K22 | 3.00 | 1.00 | 0.33 |
| K23 | 5.00 | 3.00 | 1.00 |

**Table 5.** Geometric average of all the expert evaluations, and the weights

|     | K21  | K22  | K23  | Wi           |
|-----|------|------|------|--------------|
| K21 | 1.00 | 0.26 | 0.17 | <b>0.089</b> |
| K22 | 3.87 | 1.00 | 0.33 | <b>0.272</b> |
| K23 | 5.92 | 3.00 | 1.00 | <b>0.639</b> |

**Table 6.** The unweighted supermatrix

|     | C11  | C12  | C13  | C21  | C22  | C23  | C31  | C32  | C33  | C41  | C42  | C43  | C51  | C52  | C53  | C61  | C62  | C63  | C71  | C72  | C73  | C81  | C82  | C83  |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| C11 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .705 | .677 | .534 | .000 | .000 | .000 | .694 | .509 | .516 |
| C12 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .145 | .180 | .341 | .000 | .000 | .000 | .219 | .307 | .325 |
| C13 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .150 | .143 | .125 | .000 | .000 | .000 | .088 | .185 | .158 |
| C21 | .089 | .686 | .623 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .333 | .443 | .534 | .000 | .000 | .000 | .106 | .724 | .633 |
| C22 | .272 | .079 | .147 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .333 | .443 | .341 | .000 | .000 | .000 | .260 | .083 | .106 |
| C23 | .639 | .235 | .230 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .333 | .114 | .125 | .000 | .000 | .000 | .633 | .193 | .260 |
| C31 | .114 | .357 | .720 | .680 | .443 | .659 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .680 | .452 | .150 | .000 | .000 | .000 | .552 | .443 | .235 |
| C32 | .364 | .149 | .088 | .225 | .443 | .170 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .094 | .458 | .705 | .000 | .000 | .000 | .332 | .114 | .407 |
| C33 | .522 | .493 | .192 | .094 | .114 | .170 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .225 | .089 | .145 | .000 | .000 | .000 | .116 | .443 | .358 |
| C41 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .659 | .623 | .652 |
| C42 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .170 | .147 | .097 |
| C43 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .170 | .230 | .252 |
| C51 | .092 | .111 | .623 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .671 | .114 | .073 | .000 | .000 | .000 | .623 | .089 | .698 |
| C52 | .341 | .328 | .230 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .130 | .299 | .228 | .000 | .000 | .000 | .147 | .272 | .216 |
| C53 | .567 | .561 | .147 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .198 | .587 | .699 | .000 | .000 | .000 | .230 | .639 | .086 |
| C61 | .116 | .213 | .292 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .333 | .125 | .680 | .213 | .105 | .633 |
| C62 | .332 | .418 | .511 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .333 | .534 | .094 | .418 | .540 | .260 |
| C63 | .552 | .369 | .197 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .333 | .341 | .225 | .369 | .355 | .106 |
| C71 | .193 | .213 | .333 | .321 | .690 | .680 | .097 | .098 | .300 | .434 | .677 | .659 | .225 | .252 | .341 | .106 | .448 | .190 | .000 | .000 | .000 | .213 | .341 | .330 |
| C72 | .178 | .369 | .333 | .104 | .134 | .094 | .652 | .413 | .427 | .106 | .143 | .170 | .094 | .097 | .125 | .260 | .282 | .449 | .000 | .000 | .000 | .418 | .125 | .168 |
| C73 | .629 | .418 | .333 | .575 | .176 | .225 | .252 | .489 | .272 | .459 | .180 | .170 | .680 | .652 | .534 | .633 | .270 | .361 | .000 | .000 | .000 | .369 | .534 | .502 |
| C81 | .199 | .199 | .106 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| C82 | .312 | .489 | .260 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |
| C83 | .489 | .312 | .633 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 |

**Table 6.** The limit supermatrix

|     | C11  | C12  | C13  | C21  | C22  | C23  | C31  | C32  | C33  | C41  | C42  | C43  | C51  | C52  | C53  | C61  | C62  | C63  | C71  | C72  | C73  | C81  | C82  | C83  |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| C11 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 | .043 |



**Table 8.** The weighted normalized decision matrix and positive and negative ideal solutions

|     | A     | B     | C     | D     | A*    | A <sup>-</sup> |
|-----|-------|-------|-------|-------|-------|----------------|
| C11 | .0218 | .0231 | .0193 | .0223 | .0231 | .0193          |
| C12 | .0085 | .0105 | .0025 | .0045 | .0105 | .0025          |
| C13 | .0051 | .0017 | .0078 | .0006 | .0006 | .0078          |
| C21 | .0182 | .0132 | .0168 | .0156 | .0182 | .0132          |
| C22 | .0148 | .0126 | .0129 | .0131 | .0148 | .0126          |
| C23 | .0106 | .0064 | .0127 | .0085 | .0127 | .0064          |
| C31 | .0301 | .0304 | .0261 | .0268 | .0304 | .0261          |
| C32 | .0212 | .0161 | .0172 | .0243 | .0243 | .0161          |
| C33 | .0126 | .0126 | .0063 | .0095 | .0126 | .0063          |
| C41 | .0005 | .0006 | .0005 | .0005 | .0006 | .0005          |
| C42 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001          |
| C43 | .0002 | .0002 | .0002 | .0002 | .0002 | .0002          |
| C51 | .0129 | .0139 | .0100 | .0117 | .0139 | .0100          |
| C52 | .0086 | .0100 | .0075 | .0092 | .0100 | .0075          |
| C53 | .0163 | .0175 | .0187 | .0202 | .0202 | .0163          |
| C61 | .0701 | .0789 | .0570 | .0614 | .0789 | .0570          |
| C62 | .0475 | .0545 | .0417 | .0500 | .0545 | .0417          |
| C63 | .0445 | .0428 | .0496 | .0556 | .0556 | .0428          |
| C71 | .0248 | .0341 | .0434 | .0496 | .0496 | .0248          |
| C72 | .0363 | .0537 | .0435 | .0624 | .0624 | .0363          |
| C73 | .0735 | .0433 | .0865 | .0649 | .0865 | .0433          |
| C81 | .0010 | .0009 | .0012 | .0011 | .0012 | .0009          |
| C82 | .0019 | .0022 | .0018 | .0017 | .0022 | .0017          |
| C83 | .0019 | .0023 | .0027 | .0034 | .0034 | .0019          |

**Table 9.** Final performance indices of supplier alternatives.

|   | $\square_+$ | $\square_-$ | $\square_+$ | Rank |
|---|-------------|-------------|-------------|------|
| A | .0422       | .0363       | .4626       | 3    |
| B | .0500       | .0351       | .4125       | 4    |
| C | .0367       | .0488       | .5708       | 2    |
| D | .0298       | .0469       | .6111       | 1    |

## 5. Conclusion

The purpose of this paper is to suggest an approach for evaluating and selecting suppliers for an automotive company, based on hybrid multi-criteria decision making methods. First, main and sub-criteria that affect the evaluation and selection process of a supplier are identified. Then, DEMATEL approach is implemented to the main criteria in order to obtain cause and affect interaction among them which is required by ANP method. After deriving cause and effect interrelationship, ANP methodology is applied for calculating the weights of each sub-criterion. And then, as far as obtaining the weights of the sub-criteria, alternative suppliers are evaluated and ranked using TOPSIS method. At the end, the supplier with the highest performance indices is selected as the best supplier. The proposed approach can be implemented in different multi-criteria decision making problems.

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# SÜRDÜRÜLEBİLİR İŞLETME BAĞLAMINDA ÇEVRESEL MALİYETLERİN YÖNETİMİ

Haluk Duman  
Aksaray Üniversitesi  
İktisadi ve İdari Bilimler F.  
İşletme Bölümü  
halukduman70@hotmail.com

M. Yılmaz İçerli  
Aksaray Üniversitesi  
İktisadi ve İdari Bilimler F.  
İşletme Bölümü  
yilmazicerli@hotmail.com

Mehmet Yücenurşen  
Aksaray Üniversitesi  
Ortaköy M.Y.O.  
İktisadi ve İdari Programlar  
yucenursen@hotmail.com

İbrahim Apak  
Aksaray Üniversitesi  
İktisadi ve İdari Bilimler F.  
İşletme Bölümü  
apakibrahim@gmail.com

**Özet:** Son elli yılda gerek araştırmacılar ve gerekse işletmeler için önemli bir kavram olan ‘sürdürülebilir kalkınma’; gelecek nesillerin ihtiyaçlarından ödün vermeden, insan ihtiyaçlarının göz ardı edilmediği ve toplumun her kesiminin temel ihtiyaçlarını etkin bir şekilde karşılayabilmeyi amaçlayan bir kavramdır. Bu bağlamda işletmelerin gerçekleştirmiş oldukları faaliyetler daha önemli hale gelmektedir.

İşletmelerin insana ve çevreye duyarlı birer örgüt haline gelmeleri, sürdürülebilir işletme açısından önemlidir. Sürdürülebilir işletme, üretim faktörlerini sağlayan çevrenin korunmasını gerektirmektedir. İşletmelerin çevresel maliyetlere kayıtsız kalarak mal üretip satmaları kısa vadede kâr elde etmelerini sağlamakta ancak uzun vadede başta işletmeler olmak üzere çevrenin zararına yol açmaktadır. İşletmeler faaliyetlerini gerçekleştirirken, ürünlerinin hammaddeden nihai ürüne dönüşümü sürecinde çevreye verdiği zararları azaltacak önlemler almaları sürdürülebilir işletmenin bir gereğidir.

İşletmelerin faaliyetlerini etkin ve verimli olarak yürütebilme, piyasa değerini yükseltebilmesi ve geleceğe sağlıklı olarak taşıyabilmesi bağlamında çevresel maliyetlerin yönetimi teorik olarak incelenecektir. Bu bağlamda çalışmada hem işletme faaliyetlerinin sürdürülebilir olması hem de çevreye duyarlı organizasyon olmaları halinde organizasyon yapısı, faaliyetler ve çevresel maliyetler üzerindeki etkileri açıklanmaya çalışılacaktır.

**Anahtar Kelimeler:** *Sürdürülebilir İşletme, Çevresel Maliyet Yönetimi, Çevre Yönetim Muhasebesi*

## Environmental cost management within the sustainable business

**Abstract:** In the last fifty years, the concept of sustainable development which has important notions for researchers and businesses, without disregarding the needs of future generations, not ignoring the human needs, is a concept that aims to provide the basic needs of all society effectively. Thus, the activities that have been carried out by businesses are becoming more important.

Within the sustainable business, to become an organization environment and human friendly is important. Sustainable business needs protecting the environment which provides the factors of production. In short term, producing and selling goods without concerned with environmental costs makes profit to the business, but in long term, makes disadvantage initially to the business and environment. Throughout the activities of business, taking measures to reduce for harmful effects on the environment during the process of transformation from raw material to final product is a necessity of sustainable business.

In this study, the environmental cost management is analyzed within the activities of business to realize efficiently and effectively, to elevate market value and carrying to future. Moreover, organizational structure, activities and their effects on the environmental costs will be explained in the case that the activities of business to be sustainable and environment friendly organization.

**Key Words:** *Sustainable Business, Environmental Cost Management, Environmental Management Accounting*

## Giriş

İşletmelerin sürdürülebilirlik anlayışına bağlı olarak vizyonlarını oluşturmaları gerekmektedir. Sürdürülebilir işletme vizyonuna sahip işletmelerin gerçekleştirecekleri faaliyetler işletme çevresinin ve faaliyet gösterdiği toplumun kalkınmasına katkıda bulunacaktır. Ancak söz konusu faaliyetlerin sürdürülebilmesi için çevresel faktörlerinde göz önünde bulundurulması gerekmektedir. Günümüzde işletmeler için önemli maliyet kalemlerinden birini oluşturan çevresel maliyetlerin işletmelerce sürdürülebilirlik kapsamında değerlendirilmesi ve yönetilmesi büyük önem arz etmektedir.

Ekonomik büyüme ile ekolojik sürdürülebilirlik kavramları amaçlarının çatışmaya başladığı 1970’li yıllardan itibaren, ekonomik büyüme ve gelişmenin toplum refahının sağlanması konusunda tek başına yeterli olmadığı anlaşılmıştır. Çevrenin de diğer üretim faktörleri gibi bir kaynak ve zamanla kirlenip tükenilecek bir değer olduğu,

sanayileşmenin yol açtığı çevre sorunları sonucunda ortaya çıkmış ve bunun yanı sıra herhangi bir kaynağı kullanırken işletmelerin katlandıkları maliyetler gibi, çevreyi kullanmanın da bir maliyeti olduğu bu süreçte anlaşılmıştır (Çelik, 2007).

## 1. Sürdürülebilirlik ve Sürdürülebilir Kalkınma

Sürdürülebilirlik, literatürde henüz genel kabul görmüş bir tanımı olmayan dinamik bir kavramdır. Son yıllarda başta akademisyenler, işletmeler ve çevresi olmak üzere toplumun belli kesimlerinin daha fazla ilgisini çekmektedir (Roosa Stephen, 2010:81). Ancak sürdürülebilirlik toplumun tüm kesimlerini ilgilendiren bir kavramdır.

Sanayileşmeyle birlikte ortaya çıkan sera gazı salınımı artışı, iklim değişiklikleri vb. faktörler ve küresel bazda hissedilen çevre felaketlerini beraberinde getirmiştir. Bu gelişen süreçte devletler klasik ekonomik kalkınma modelinin yerine yeni bir model arayışına girmiştir. Bu arayışların ilk neticesi olarak, 1987 yılında Birleşmiş Milletler Stockholm İnsan ve Çevre Konferansı'nda sürdürülebilir kalkınma ilk kez gündeme gelmiştir. Bu raporda sürdürülebilirlik "Kendi ihtiyaçlarını karşılamak için gelecek nesillerin ihtiyaçlarından ödün vermeden günümüzün ihtiyaçlarını karşılayan gelişme" olarak tanımlanmıştır (WCED, 1987).

Bir başka tanımda sürdürülebilir kalkınma; çevresel, sosyal ve ekonomik gelişmenin sürdürülebilirliği konusunda bir uyum oluşturulması yoluyla bugünün ve gelecek kuşakların refahı için kıt olan kaynakları yok etmeden verimli bir şekilde kullanmayı hedeflemektedir (Hall, Daneke ve Lenox, 2010). Bu tanıma göre çevresel, sosyal ve ekonomik gelişmenin uyumlu bir şekilde gerçekleşmediği takdirde sürdürülebilirlikten söz etmek mümkün değildir.

## 2. Sürdürülebilir İşletme

Sürdürülebilir kalkınmanın gerçekleşmesinde temel aktör, işletmelerdir. İşletmelerin, insan ihtiyaçlarını karşılamak amacıyla doğal kaynakları kullanan; ekonomik, sosyal ve çevresel gelişmelere katkı sağlayan iktisadi birimler olduğu göz önünde bulundurulursa, sürdürülebilir kalkınmadaki rolü daha iyi anlaşılabilir. Sürdürülebilirlik kavramı sosyal, ekonomik ve çevresel boyutlarda ele alınmaktadır. Aras (2012)'a göre sürdürülebilirlik, "İşletmenin sadece kendi içsel faktörleri değil, onu etkileyen bütün dışsal faktörleri ve bunların değerlendirilmesini içeren son derece önemli bir göstergedir."

İşletmeler açısından sürdürülebilirlik kavramı sosyal, ekonomik ve çevresel boyutlarda ele alınmaktadır. Aras (2012)'a göre sürdürülebilirlik, "İşletmenin sadece kendi içsel faktörleri değil, onu etkileyen bütün dışsal faktörleri ve bunların değerlendirilmesini içeren son derece önemli bir göstergedir."

İşletmelerin hammadde tedariki ile başlayan nihai mal ve hizmetin tüketiciye ulaşmasına kadar olan zincir boyunca ilişkide bulunduğu aktörler ile çevresel duyarlılığa bağlı olan girişimlerde ortak bir yol belirlemesi sürdürülebilirlik adına son derece önemlidir. Günümüzde küreselleşme ile birlikte işletme faaliyetlerinin etkileri buldukları yerin ve zamanın ötesine geçmektedir. Bu bağlamda işletmeler faaliyetlerini gerçekleştirirken sadece ekonomik bir bakış açısıyla değil, sürdürülebilir işletme vizyonu ile hareket etmelidirler. Söz konusu vizyona sahip işletmeler bu süreci çevresel duyarlılık çerçevesinde yönetmektedirler (Altuğ ve diğ., 2012).

İşletmelerin temel amacı kısa dönemde kârlarını maksimize etmek ve uzun dönemde ise hissedarlarının servetlerini maksimize etmektir. Ancak bir işletmenin faaliyet sonuçları ile ilgili sadece sahip ve ortakları değil aynı zamanda toplum, çeşitli kurum ve kuruluşlar da etkilenmektedir (Şengel, 2011). İşletmelerin faaliyetleri bu grupların baskısı altındadır. Günümüzde çevresel faktörlere bağlı olarak baskı gün geçtikçe artmaktadır (Aydın, 2012). Bu bağlamda işletmelerin, gerçekleştireceği faaliyetlerde sadece ekonomik boyutu değil sosyal ve çevresel boyutları da göz önünde bulundurması gerekir (Nowduri ve Al-Dossary, 2012: Okka, 2005: 15).

**Şekil-2-1:** Sürdürülebilir İşletme Boyutları



**Kaynak:**

Yıldız T., 2006,

İşletme faaliyetlerinin sürdürülebilir olması için gereken faktörler şunlardır (Benn ve diğ., 2006):

- Hissedarlarıyla iletişim halinde olmak,
- Gelecek için bir yol haritası çizmeye yönelik vizyon sahibi olmak,
- Yenilikçi kapasiteyi temiz enerji yoluyla elde etmek,
- Çevreye verilen zararı önleyerek ve kârı artırarak riski azaltma becerisi ve kapasitesine sahip olmak.

Sürdürülebilir işletme geliştirme aşamaları Tablo 2-2'de sunulmuştur;

**Tablo-2-2:** Sürdürülebilir İşletme Geliştirme Aşamaları

| AŞAMA                         | SOSYAL BOYUT   | ÇEVRESEL BOYUT   |
|-------------------------------|--|--|
| <b>Aşama 1: Reddetme</b>      | Çalışanlar ve taseronlar sömürülmekte, toplumun bu konudaki endişeleri reddedilmektedir. | Bedelsiz olarak sömürülen çevresel kaynaklar iyi kabul edilmektedir. |
| <b>Aşama 2: Cevap Vermeme</b> | Toplumsal kaygılardan, finansal ve   | Karar verme sürecinde çevresel                                       |

|  |  |  |
|--|--|--|
|  | teknolojik faktörler dışlanmaktadır.   | faktörler bu sürecin dışında tutulmaktadır.  |
| <b>Aşama 3: Uyumluluk</b>              | Endüstriyel ilişkiler ve güvenlik konusundaki yasal gerekliliklere uyum sağlamaktadır.                           | Olası çevresel sorunlar yok sayılarak, toplumun dikkati dağıtılmaktadır.                   |
| <b>Aşama 4: Verimlilik</b>             | Toplumsal projeler ve çalışan kalitesini artıracak stratejilere sadece maliyet avantajı olduğunda sıcak bakılır. | Verimliliği azaltan ya da maliyetleri artıran çevre sorunları yok sayılır.                 |
| <b>Aşama 5: Stratejik Pro-Aktivite</b> | Stratejik avantaj sağlamak için ürünlerde entellektüel ve sosyal yenilikler yapılır.                             | Proaktif çevresel stratejiler rekabet avantajı sağlayıcısı olarak görülmektedir.           |
| <b>Aşama 6: Sürdürülebilir İşletme</b> | İşletmenin iç ve dış hedefleri arasında insan refahı ve eşitlik önemli bir hale gelmiştir.                       | İşletme ekolojik denge ve sürdürülebilirlik projelerinde toplum ile birlikte hareket eder. |

**Kaynak:** Benn S. ve diğ., 2006

Sürdürülebilir gelişme; sosyal, çevresel ve etik konuları ile ilişkilendirilirken; işletme açısından kurumsal yönetim, kurumsal sosyal sorumluluk ve sosyal muhasebe ile ilişkilendirilir ve işletmeye entegre edilebilir (Mei, 2011).

### 3.Çevre Muhasebesi

Yeşil Muhasebe olarak adlandırılan çevre muhasebesi, literatürde farklı terimlerle ifade edilmektedir. Örneğin: Çevre Muhasebesi (Environmental Accounting), Doğal Kaynak Muhasebesi (Natural Resource Accounting – NRA), Çevre Yönetim Muhasebesi (ÇYM) (Environmental Management Accounting – EMA), Tam Maliyet Muhasebesi (Full-Cost Accounting) vb.

17. yüzyıldan sonra hızlı sanayileşme, düzensiz kentleşme, çevre kirliliğine bağlı olarak ortaya çıkan iklim değişikliği, nüfus artışı ile tarım arazilerinin yerleşime açılması çevre sorunlarını ortaya çıkarmıştır. Başka bir ifade ile insan ihtiyaçlarının karşılanması amacıyla gerçekleştirilen üretim faaliyetleri, beraberinde çevre sorunlarını da getirerek tüm dünyada kendini belirgin bir biçimde hissettirmeye başlamıştır. Çevre ile ilgili uluslararası politikaların dönüm noktası olarak kabul edilen 5 Haziran 1972 Stockholm Konferansı, çevre sorunlarına yerel veya bölgesel düzeyde değil, evrensel düzeyde sahip çıkılması gereğini ortaya koymuştur (Kırılıoğlu ve Yıldız, 2004).

20. yüzyılın ikinci yarısında çevresel konular, akademisyenler ve iş dünyasına ilişkin düzenlemelere ve araştırmalara konu olmuştur. 1970’li yıllardan itibaren çevre muhasebesi kavramı ve ilgili konular gelişerek günümüze kadar gelmiştir (Todae ve diğ., 2011).

20. yüzyılın son çeyreğinde yaşanan Bhopal kimya (1984) ve Exxon Valdez petrol felaketleri (1989) gibi çevre felaketleri, işletmelerin benimsedikleri salt kâr politikasının devam ettirilmesi durumunda sürdürülebilirliğin gerçekleşmeyeceğini ortaya koymuştur (Erkuş ve Ateş, 2008, s.265). 2010 yılında Meksika Körfezi’nde British Petroleum (BP)’un sondaj kulesinde gerçekleşen patlama ile 87 gün sonunda 4.9 milyon varil (779 milyon litre) petrol denize sızmıştır. Çevreyi ve biyoçeşitliliği tehdit eden sızıntıyı önlemek için 48.000 kişi çalışmış ve 2010 yılı sonuna kadar 17.7 milyar dolar harcama yapılmıştır. 2012 yılında süren davaların neticesinde ABD Adalet Bakanlığı BP’ye 4.5 milyar dolar para cezası vermiştir. Meksika Körfezi bugün temizlenmiş olsa bile, bozulan ekolojik dengenin geri dönüşümü yıllar alacaktır.

Günümüzde çevreyle sürekli ilişki içinde açık bir sistem olan muhasebenin, sosyal ve çevresel sorunlara ilgisiz kalamayacağı açıktır (Çelik, 2007). Çevre muhasebesi, maliyet muhasebesinin bir alt dalı veya bağımsız bir dal olarak kabul edilebilir (Yakhou ve Dorweiler, 2004).

Çevre kuruluşları, ulusal bazda yapılan çevresel düzenlemeler, toplumda çevre bilincinin oluşması ve işletmelerin çevresel konulara önem vermesinde önemli rol oynamaktadır. Akademik konferansların sürekli olarak gündeminde bulunmasına, akademisyenlerin ve çeşitli çevre koruma örgütlerinin yayınlarında yer almasına karşın, çevre muhasebesi, iş dünyasında henüz yeterli düzeyde yasallığa sahip değildir (Çelik, 2007).

Çevre muhasebesi; işletmelerin çevre üzerindeki fiziksel etkileri ile bu çevresel etkileri minimize edecek çabalara ilişkin elde edilen finansal ve finansal olmayan bilgilerin kamuya sunulmasıdır (Antheaume, 2004).

Çevre muhasebesine ilişkin literatürde farklı tanımlar bulunmaktadır. Amerikan Çevre Koruma Ajansı (US EPA)<sup>1</sup> çevre muhasebesini (1995):

- Finansal muhasebe ve raporlama kapsamında, çevreyle ilişkili finansal bilgilerin belirlenmesi ve kamuya açıklanması,
- Çevre yönetim muhasebesi kapsamında, çevreyle ilişkili fiziksel ve mali verilerin belirlenmesi ve kullanımı,
- Dış çevrenin etkileri ve maliyetlerin tahmini,
- Kalan ve kullanılan doğal kaynakların fiziksel ve parasal olarak muhasebesi,
- Genel muhasebenin amaçları doğrultusunda muhasebe verilerinin, doğal kaynak muhasebesi bilgilerinin ve firma düzeyinde diğer bilgilerin toplanması ve raporlanması,

<sup>1</sup> US EPA – United States Environmental Protection Agency

- Çevre muhasebe kapsamında, çevreye ilişkin fiziksel ve mali verilerin göz önünde tutulması, olarak tanımlanmıştır.

Bartolomeo vd. (2000), “Çevre muhasebesi, içe dönük olarak, fiyatlama kararlarında, maliyet kontrolünde ve sermaye bütçelemesinde bilgi sağlarken; dışa dönük olarak, halk ve finans çevreleri için çevre hakkında kamuyu aydınlatma raporlarına veri sağlar” şeklinde ifade etmiştir.

İşletmelerin faaliyetlerini sürdürdüğü çevreye ve kullandıkları doğal kaynaklara ilişkin fiziksel ve mali bilgileri muhasebe bilgi sistemi içerisinde ayrı bir raporlamayla kamuya açıklaması gerekmektedir. İşletme faaliyetlerinin çevreye verebileceği olası zararları mali boyutlarıyla ve bu zararları önleyici amaçla gerçekleştirilen harcama ve girişimlerin boyutlarının, işletmeler tarafından kamuyu aydınlatma ilkesi kapsamında kamuya tam olarak açıklanması gerekmektedir.

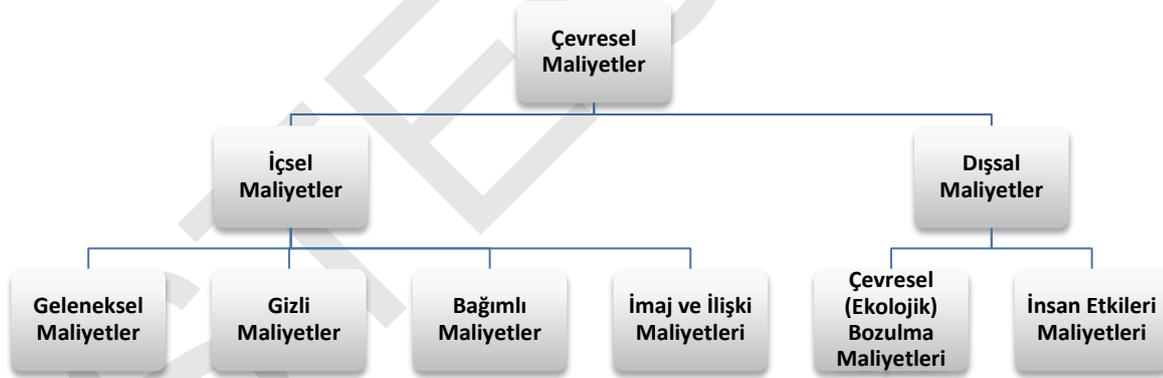
Çevre muhasebesi, ticari aktivitelere bağlı olarak ortaya çıkacak kirliliğin sorumlularının belirlenmesi ve tahmin edilen çevresel etkilere ve harcamalara ilişkin karar almaya yardımcı olur. Bunun yanısıra çevre muhasebesi, farklı tüketim yapıları ile çevresel harcamaların düşürülmesinde planlama için ihtiyaç duyulan bilgileri üretmektedir (Bailey ve Soyka, 1996). Bu durum parasal boyutun yanında işletmenin fiziksel birimleri/faaliyetleri ile ilişkilidir (Lintott, 1999). Ayrıca çevre muhasebesi; çevresel maliyetlere kaynak tahsis edilmesi, maliyetlerin ölçülmesi, ticari kararlara entegre edilmesi ve dış çevreye bilgi verilmesine yardımcı olur (Stanko, Brogan ve Alexander, 2006)

#### 4.Çevresel Maliyetler

Günümüzde yaşanan çevre felaketlerine bağlı olarak toplumda çevre bilincinin oluştuğu görülmektedir (Masanet ve Llodra, 2006). Çevre bilincinin oluşturulması ve çevrenin korunması hususunda bireylerin yanısıra işletmelerde çaba sarf etmek durumundadır. Bu açıdan, çevre muhasebesini “İşletmelerce yeterli çevresel performansın temini için çevresel maliyetlerin tanımlanması ve ölçülmesinde kullanılan bir araçtır.” (Todae vd., 2011) şeklinde tanımlayabiliriz.

Amerikan çevre koruma ajansı, çevresel maliyetleri temel olarak ikiye ayırmaktadır. Birincisi, işletmelerin doğrudan etkilendikleri, müdahale edebilecekleri içsel maliyetlerdir. İkincisi ise, işletmelerin sorumlu olmadıkları, müdahale edemedikleri dışsal maliyetlerdir. Bu tanımlama genel başlıklarıyla şu şekilde ifade edilebilir (Todae, 2011);

**Şekil-4-1: Çevresel Maliyetler**



Todae ve diğ., 2011, s.653

Kaynak:

*Geleneksel maliyetler*, makine teçhizat, hammadde ve tüketim mallarından kaynaklanan maliyetlerdir.

*Gizli maliyetler*, endirekt çevresel maliyetleri veya gelecekte ortaya çıkacak bağımlı maliyetleri ifade etmektedir. Gizli maliyetler kapsamında, yasal yükümlülük ve gönüllü eylemler sonucu ortaya çıkan çevresel maliyetler yer almaktadır. Bu maliyetler bir sürecin, sistemin veya tesisin faaliyetlerinin yürütülmesi sırasında ortaya çıkan maliyetlerdir. Pek çok işletme bu maliyetleri dönem gideri olarak değerlendirmekte ve bu maliyetlere işletme kararlarında ve günlük faaliyetlerinde gerekli önemi vermemektedir (EPA, 1995:Todae, 2011).

*Bağımlı maliyetler*, gelecekte gerçekleşmesi muhtemel çevresel etkilere bağlı olarak ortaya çıkacak maliyetleri ifade etmektedir. Örneğin, çeşitli kazalar sonucu oluşan petrol sızıntılarına karşılık ödenmesi gereken cezalar ve neden olunan çevresel zararların çözümüne ilişkin harcamalar bağımlı maliyetleri oluşturmaktadır (EPA, 1995:Todae, 2011).

*İmaj ve ilişki maliyetleri* (Halkla İlişkiler), diğer maliyetlere oranla daha soyut yapıdadırlar. Bu maliyetler; yöneticilerin, müşterilerin, çalışanların, kamunun ve hükümetlerin öznel algılarına dayanan soyut yapıdaki maliyetler olduğu için diğer çevresel maliyetlere kıyasla ölçümü daha güç olan maliyetlerdir. Bu maliyetlere örnek olarak yıllık çevre raporlarına, yerel halk ile ilişkilere ve gönüllü olarak gerçekleştirilen çevre faaliyetlerine ilişkin maliyetler verilebilir (EPA,1995:Todae, 2011).

*Dışsal maliyetler*, işletmelerin doğrudan sorumlu olmadıkları ancak çevre üzerinde olumsuz etkiler meydana getiren faaliyetlerden kaynaklanan maliyetlerdir. Bu olumsuz sonuçları doğuran faaliyetler yasalarla önlenemeyen faaliyetlerdir. Bunun yanı sıra, dışsal maliyetlerin gerçek değerlerinin ölçülmesi oldukça zordur. Buna rağmen, bazı işletmeler bu maliyetleri çevre muhasebesi sistemleri içerisinde maliyet kalemi olarak almaya çalışmaktadırlar (Todae, 2011). Amerikan Çevre Koruma Ajansı'na göre çevresel maliyet türleri Tablo: 4-2'de gösterilmiştir.

*Potansiyel gizli maliyetler*, işletme yöneticileri tarafından görülemeyen çevresel maliyetleri ifade etmektedir. Bu maliyetler yasal yükümlülüklerden, gönüllü eylemlerden ve işletmelerin sürdürdükleri faaliyetlerden kaynaklanan çevresel maliyetlerdir. Her ne kadar bu maliyetler genel gider veya araştırma geliştirme giderleri olarak sınıflandırılrsa da işletme yöneticileri yapılacak yatırımların kullanma maliyetlerine odaklandıkları için faaliyet öncesi bazı maliyetler gözden kaçabilmektedir (EPA, 1995).

Meydana gelen çevresel maliyetler, ortaya çıkma biçimlerine göre farklı sınıflandırmalara tabi tutulabilmektedir. Bazı çevresel maliyetler çevreyi koruma, sürdürülebilirlik sağlama amacına yönelik olarak gerçekleştirilen faaliyetlerin sonucunda ortaya çıkarken, bir kısım maliyetler ise kaynakların üretim faaliyetlerinde kullanımları sonucunda meydana gelmektedir. Bunun yanı sıra, bazı çevresel maliyetler, işletmelerin neden olduğu çevresel kirlilikten kaynaklanmaktadır. Bu kapsamda çevresel maliyetler; önleme maliyetleri, kullanma maliyetleri ve etkileme maliyetleri olmak üzere üç başlık altında incelenebilir (Çelik, 2008)

*Önleme maliyetleri*, çevreyi koruma ve çevreye verilebilecek zararları en aza indirme amacı ile ürünün tasarım aşamasından, üretilmesi, kullanılması, ömrünü tamamlayıp yok edilmesi sürecinde katlanılan maliyetlerdir (Çelik, 2008). Ürün yaşam seyri içerisinde katlanılan maliyetler;

- Çevre planlaması maliyetleri,
- Ürün tasarımında çevre uyumlaştırma maliyetleri,
- Geri dönüştürme maliyetleri,
- Çevre dostu ambalajlama maliyetleri,
- Çevre yönetim maliyetleri, atık kontrolü, yok edilmesi veya arıtma maliyetleri,

önleme maliyetleri kapsamındadır. Bu maliyetler işletme yönetiminin kararları doğrultusunda belirlenebilen maliyetlerdir.

*Kullanma maliyetleri*, işletme faaliyetlerinde faydalanılan kamusal doğal zenginliklerin bedeli olarak tanımlanabilir. Hava, su, toprak ve madenler gibi doğal kaynakların kullanımı bu tür maliyetlerdendir. Doğal kaynakların işletmelere kullanılmasından oluşan kullanma maliyetleri, bu varlıkların kullanılması sonucu kamunun uğradığı çevre zararları yasaların izin verdiği limitlerin altında kaldığı için işletmelerin bir bedel ödeme zorunluluğu olmayabilmektedir (Çelik, 2008).

*Etkileme maliyetleri*, önceki safhaların başarısızlığının yol açtığı çevre zararlarına ilişkin maliyetlerdir. Bu maliyet unsurları ise; hava, su ve toprağa salınan atıklar nedeniyle ortaya çıkan zararlar ile fauna ve floradaki azalmalar olarak tanımlanmaktadır (Çelik, 2008). Çevrenin kirletilmesi ve doğal dokunun zarar görmesinden sonra alınan tedbirler etkili olmadığı gibi büyük ekonomik kayıplara da yol açmaktadır. Bu bağlamda çevre sorunlarının ortaya çıkmadan yönetilmesi gerekir (Kırımhan, 2005:113)

**Tablo-4-2: Çevresel Maliyet Türleri**

| POTANSİYEL GİZLİ MALİYETLER (Potentially Hidden Costs) |                               |                                  |
|--|-------------------------------|----------------------------------|
| Yasal Yükümlülükler                                    | Faaliyet Öncesi               | Gönüllü Eylemler                 |
| Tebliğatlar  | Kuruluş Yeri Araştırması      | Halkla İlişkiler                 |
| Raporlama  | Kuruluş Yeri Hazırlık         | Gözlem/Analiz                    |
| Gözlem/Analiz  | Kuruluş İzinleri              | Eğitim                           |
| Araştırma/Tasarım                                      | ARGE                          | Denetim                          |
| İyileştirme  | Teknik ve Tedarik Hazırlıklar | Satıcı Tanımlama                 |
| Kayıtlama  |                               | Yıllık Çevre Raporları           |
| Planlama   |                               | Sigorta                          |
| Eğitim   |                               | Planlama                         |
| Denetleme  | <b>Geleneksel Maliyetler</b>  | Fizibilite Çalışmaları           |
| Bildirme   | Duran Varlıklar               | İyileştirme                      |
| Etiketleme   | Hammadde                      | Gerİ Dönüşüm                     |
| Hazırlık   | İş Gücü                       | Çevre Gözetimi                   |
| Koruyucu Ekipmanlar                                    | Yardımcı Tesisler             | ARGE                             |
| Tıbbi Gözetim  | Hurdalar                      | Doğal Hayatı Koruma              |
| Sigortalama  |                               | Çevre Düzenlemeleri              |
| Finansal Güvence                                       |                               | Diğer Çevre Çalışmaları          |
| Kirlilik Kontrolü                                      |                               | Çevreci Gruplara Finansal Destek |
| Atık Kontrolü  | <b>Faaliyet Sonrası</b>       |                                  |
| Atık Su Kontrolü                                       | Faaliyetten Çekilme           |                                  |
| Atık Yönetimi  | Varlıkların Elden Çıkarılması |                                  |
| Vergiler/Harçlar                                       |                               |                                  |
| <b>BAĞIMLI MALİYETLER</b>                              |                               |                                  |
| Yasal Değişiklik Maliyetleri                           | İyileştirme                   | Mahkeme Giderleri                |

| Cezalar                           | Maddi zarar                 | Doğal Kaynak Zararları          |
|-----------------------------------|-----------------------------|---------------------------------|
| Düzenlemelere İlişkin Maliyetler  | Kişisel yaralanma zararları | Ekonomik Kayıp Zararları        |
| <b>İMAJ ve İLİŞKİ MALİYETLERİ</b> |                             |                                 |
| İşletme İmajı                     | Yöneticiler ile İlişkiler   | Borç Verenlerle İlişkiler       |
| Müşteri İlişkileri                | Çalışanlar ile İlişkiler    | Yerel Halk ile İlişkiler        |
| Yatırımcı İlişkileri              | Tedarikçiler ile İlişkiler  | Kamu Yöneticileri ile İlişkiler |

Kaynak: US EPA, 1995, s.9

İşletmeler açısından bazı çevresel maliyetler ödenmemekte ve/veya dikkate alınmamaktadır. Bu sebeple bu maliyetler finansal raporlarda ve kayıtlarda yer almamaktadır. Örneğin, işletmeler çevreye yaydıkları gürültüyü, canlılara ve bitkilere verdikleri zararları dikkate almazlar. Diğer bir örnek ise yer altı sularının bedelsiz olarak kullanılması ve bu suların doğaya bırakılmasıdır. Buna karşın işletmelerin kaynak kullanımı ve doğaya bırakması ile ortaya çıkan zararları ayrıntılı olarak hesaplaması, maliyetlendirmesi ve raporlarında sunması gerekir (Haftacı ve Soylu, 2008).

İşletme faaliyetleri sonucunda ortaya çıkması muhtemel çevresel riskleri en aza indirme ve çevreyi koruma amacıyla yapılan faaliyetler ve buna bağlı olarak oluşan maliyetler işletme üzerinde yapısal ve finansal değişimlere yol açabilir. Bu değişimler (Epstein, 1996);

- Üretim sürecinin yeniden tasarımı ile maliyetler düşürülür,
- Ürün tasarımının değişimi ile maliyetler düşürülür,
- Fiyatlar artar,
- Tam bir maliyet ve fiyat tespiti için ilk aşamada düşük bir fiyat kabul edilebilir,
- Ürünün piyasada kabulü için bir çıkış stratejisi geliştirilir.

İşletmeler bir varlık alımında çevresel etkileri göz önünde bulundurarak seçim yaptığı takdirde ortaya çıkan maliyet farklarının nasıl muhasebeleştirileceği de çevre muhasebesinin kapsamındadır. Bu kapsamda çevreye ilişkin katılan maliyetler ayrıntılı olarak hesaplanmakta ve mali raporlarda finansal etkileri gösterilmektedir. Finansal olmayan çevresel riskler ise ayrıntılı olarak faaliyet/çevre raporlarında ve mali rapor dipnotlarında ayrıntılı olarak gösterilmesi gerekir (Haftacı ve Soylu, 2008).

## 5.Çevre Yönetim Muhasebesi (ÇYM)

İşletmelerde çevre yönetimi, geleneksel yönetim muhasebesine bir bilgi girişi olarak ortaya çıkmıştır. Çevreye ilişkin finansal maliyetlerin daha iyi anlaşılması isteği konuya olan ilgiyi artırmıştır. Bu gelişmede teşvik edici nokta, çevresel faktörlerin kârlılık ve finansal durum üzerinde etkilerinin olmasıdır (Bartolomeo vd. 2000).

Bir kuruluş, kendi çevre yönetim sistemi kapsamında çevre boyutlarının ne olduğunu; halen ve geçmişte yürüttüğü faaliyetler, ürünler ve hizmetler, planlanmış veya yeni gelişmeler, yeni veya değiştirilmiş faaliyetler, ürünler ve hizmetlerle ilgili girdi ve çıktıları (istenen veya istenmeyen) dikkate alarak belirlemelidir. Bu işlem, mantıklı olarak öngörülebilir acil durumlar da dahil, normal ve normal olmayan işletme şartlarını, devreden çıkarma ve devreye alma şartlarını göz önünde bulundurmalıdır (ISO 14001, 2005).

Çevre yönetim muhasebesinin (Environmental Management Accounting - EMA) genel olarak kabul edilmiş bir tanımı bulunmamaktadır. IFAC'ın<sup>2</sup> yaptığı tanıma göre, ÇYM, “*kabul edilebilir çevre muhasebesi sistem ve tekniklerinin geliştirilmesi, uygulanması sürecinde çevresel ve ekonomik performansın yönetimidir.*” Bazı kesimlerce bu tanıma raporlama ve denetim de ilave edilmektedir (EPA, 1995).

IFAC'ın yapmış olduğu tanımlamanın yanısıra, Birleşmiş Milletler Uzman Çalışma Grubu, ÇYM'yi, “*içe dönük kararlar için bilgileri tanımlama, bir araya getirme, analiz ve kullanma süreci*” olarak tanımlamaktadır. Bu süreçte kullanılan bilgileri iki gruba ayırmaktadır (IFAC, 2005). Bunlar;

- Enerji, su ve diğer materyallerin (atıklar) kullanım, dolaşım ve sevk edilmesine ilişkin fiziksel bilgiler ve
- Çevreyle ilişkili maliyetler, geri dönüşüm ve koruma ile ilgili mali bilgiler.

Geleneksel muhasebe sistemi, çevresel konularda yetersiz kalmaktadır. Bu yetersizlik, işletme faaliyetlerinden kaynaklanan çevresel maliyetlerin geleneksel muhasebe sistemi içinde ayrı ayrı incelenmeyip, dönem/üretim giderleri içerisinde gösterilmesidir. Bu durum, işletme yöneticilerinin çevresel maliyetlerin farkına varamamasına ve bu maliyetlerin yönetilmesi için yeterli bilgiye ulaşamamasına yol açmaktadır. Gerekli şekilde ölçülemediği için, işletme yöneticileri, bu maliyetlerin düşürülmesinde etkili olamamaktadırlar (Erkuş ve Ateş, 2008:270).

Benzer şekilde, ABD'de yönetim muhasebecileri tarafından yapılan bir araştırmada, işletme kararlarında çevresel maliyetlerin yeterince göz önünde bulundurulmadığını ortaya koymaktadır. Araştırmada katılımcılara bir maliyet listesi verilerek yatırım yaparken hangi maliyetleri göz önünde bulundurdularına yanıt aranmış ve sonuç olarak atık su, çevreyle ilgili personelin harcadığı zaman ve cezalar vb. çevresel maliyetlerin alt sıralarda yer aldığı görülmüştür (Erkuş ve Ateş, 2008:270).

<sup>2</sup>Uluslararası Muhasebeciler Federasyonu – International Federation of Accountants

## 6.Çevre Yönetim Muhasebesi: Uygulama, Fayda ve Kullanım Alanı

Genel amacı çevresel bilgi üretmek olan ÇYM, ürettiği bilgilerle esasında insan ile çevre arasındaki etkileşimi açıklamaya çalışmaktadır. Çevresel bilgi üretimini makro düzeyde sınırlamak, bu bilgilerin mikro düzeyde alınacak çevresel kararlara katkısını azaltabilir ve çevresel yaşam kalitesinin artırılmasında beklenen çevresel faydayı sağlamayabilir. Bu nedenle çevre muhasebesi yalnızca makro düzeyde değil, mikro düzeyde de gerekli yararlı bilgiyi üretebilmelidir (Kırhoğlu ve Can, 2004). Çevre ilişkilerini mikro düzeyde düşündüğümüzde işletmeler bu etkileşimin önemli bir tarafını oluşturmaktadır. Çevreye duyarlılığın mikro düzeyde başarılı olabilmesi için aynı zamanda devletin çevreye duyarlı ulusal bir politika oluşturması ve işletmeler ile uyumlu ve işbirliği içinde olması gerekmektedir (Çakar, 2007).

Çevre yönetim muhasebesi, enerji, hammadde, atık vb. varlıkların tüketiminin ölçülmesi, doğrulanması, fiyatlanması ve maliyetlenmesi süreci üzerine odaklanmaktadır. Buna bağlı olarak, muhasebe sisteminde bu varlıklar tanımlanır, kullanımı sonucunda çevreye verdiği zararların ve yol açtığı maliyetlerin düşürülmesine yönelik faaliyetler yürütülmektedir (Masanet ve Llodra, 2006).

Çevre finans muhasebesi, çevresel yükümlülüklerle ve diğer çevresel yükümlülüklerle ait faaliyetlere ilişkin maliyetlerin raporlanması ile; işletme dışı çevresel finansal bilgi ile ilgilenenlere bilgi sunumuna odaklanmaktadır. Çevre yönetim muhasebesi ise; yönetim muhasebesinin bir parçası olarak hammadde, enerji akışı vb. hakkında şirket içi karar vericilere bilgi aktarımı üzerinde odaklanmaktadır. Bu durumda çevre finans muhasebesi işletmenin dışa dönük yüzünü, çevre yönetim muhasebesi ise içe dönük yüzünü temsil etmektedir (Xiaomei, 2004; Wilmschurt ve Frost, 2001). Başka bir ifadeyle çevre finans muhasebesi içsel maliyetleri; çevre yönetim muhasebesi ise dışsal maliyetleri ifade etmektedir.

Çevre yönetim muhasebesinin alt dalı olan çevre muhasebesinin uygulaması dört adımdan oluşmaktadır Birinci adım, yasal zorunluluk ve şirket imajı açısından ihtiyaç duyulan çevresel politikalara göre işletme politika ve stratejilerinin oluşturulmasıdır. İkinci adım, işletmenin üretim süreçlerine çevresel maliyetlerin eklenmesi ve bu maliyetlerin raporlanmasıdır. Üçüncüsü, gerçekleştirilen çevresel uygulamaların kapsam ve yeterlilik düzeyinin denetlenebilmesi için dışa dönük çevresel raporlama yapılmasıdır. Son adım ise, çevreye yönelik teknik ve yasal akademik desteğin sağlanıp; gelecekte çevre muhasebesi uygulayıcıları olacak öğrencilerin eğitilmesidir (Yakhou ve Dorweiler, 2004). Gerçekleştirilen bu akademik desteğin yanısıra, çevresel konulara, işletmeler de bazı katkılar sağlayacak ve aynı zamanda izledikleri çevre muhasebesi politikalarıyla bazı faydalar elde edecektir. Bunlar:

- Kaynak verimliliğinin artırılması ve çevresel maliyetlerin yönetilmesi,
- Çevreyle ilgili yasal mevzuata daha kolay uyum sağlanması,
- Çevresel maliyetlerin azaltılması,
- Daha fazla bilgiye dayalı karar alma,
- Fırsatların ortaya konulması,
- Ürünlerin daha iyi fiyatlandırılması,
- İç ve dış raporlamada yardım,
- İşletmenin itibarının artması,
- Personel sadakati ve personel çekebilme,
- Sosyal faydaların üretilmesi (Erkuş ve Ateş, 2008),
- Çevresel maliyetlerin belirlenmesi ve çevreye ilişkin sorunların daha iyi yönetilmesi/izlenmesi,
- Yatırımların çevresel etkilerine ilişkin ihtiyaç duyulan bilginin üretilmesidir (Carrera ve Iannuzzi, 1998).

ÇYM'nin çevresel konulara odaklanması nedeniyle, özellikle işletme yönetimine fayda sağlamaktadır. Çevre dostu ürün/üretim, çevre dostu ürün veya hizmet tasarımı ve çevre yönetim sistemleri, çevre yönetim muhasebesinin odaklandığı çevresel konulara örnek olarak gösterilebilir. Benzer şekilde, çevre yönetim muhasebesinin sağladığı bilgiler dışı dönük raporlamalarda da kullanılmaktadır. Bu nedenle ÇYM sadece tek taraflı çevresel yönetim aracı değildir. ÇYM pek çok çevresel yönetim faaliyetlerinin başarısı için temel bilgileri sağlayan genel prensip ve yaklaşımlar bütünüdür. Karar almada çevresel konuların etkileri artan eğilim gösterdiğinden beri, gerek çevresel yönetim kararlarında, gerekse tüm diğer yönetim faaliyetlerinde ÇYM daha önemli konuma gelmiştir (IFAC, 2005). ÇYM'nin geldiği bu konum itibarıyla, işletme yönetiminde kullanım alanlarını şu şekilde sıralayabiliriz (UNSD, 2001):

- Yıllık çevresel maliyetleri/harcamaları değerlendirme,
- Ürün fiyatlandırma,
- Sermaye bütçeleme,
- Yatırım alternatiflerini değerlendirme, tutarlarını hesaplama,
- Çevre projelerinin maliyetlerini, avantajlarını hesaplama,
- Çevre yönetim sistemlerinin tasarımı ve uygulaması,
- Çevresel performans ölçümü ve kıyaslama,
- Performans hedeflerinin belirlenmesi,
- Çevresel harcamaların, yatırımların ve yükümlülüklerin beyan edilmesi,
- Çevresel raporların veya sürdürülebilirlik raporlarının hazırlanması,
- Yerel idareciler ve istatistik kurumları için diğer çevre bilgilerinin raporlanmasıdır.

Çevre yönetim muhasebesinin çok sayıda kullanım alanı ve faydası vardır. Bunları genel olarak üç başlık altında ifade edebiliriz (IFAC, 2005):

*Uyumluluk:* ÇYM, işletmenin yasal düzenlemelere ve çevre politikalarına uyumunu sağlayarak çevrenin korunmasını maliyet etkinliğini desteklemektedir.

*Eko-verimlilik:* ÇYM, maliyetleri azaltma ile eşzamanlı olarak işletme içi faaliyetlerde ve nihai ürünlerde enerji, su ve kaynakların daha etkin ve verimli kullanılmasını desteklemektedir.

*Stratejik Durum:* ÇYM, işletmenin uzun vadede stratejik durumunu güvence altına almasını desteklemektedir. Bunun yanı sıra işletmenin maliyet etkinliğinin ölçülmesi ve çevresel ilgi programlarının değerlendirilmesinde kullanılmaktadır.

## 7. Sonuç

İşletmelerin, amaçlarına yönelik olarak faaliyetlerini sürdürürken, çalışanlarına, paydaşlarına ve kamuya karşı gözetmesi ve yerine getirmesi gereken sorumlulukları vardır. Bu sorumluluklar kapsamında çevre önemli bir konuma sahiptir. Çevreyi kullanarak faaliyetlerini sürdüren işletmelerin, sürdürülebilirliğin bir gereği olarak, bugünkü tüketici ihtiyaçlarını karşılarken gelecek kuşakları da gözetmeleri, faaliyetlerini bu düzlemde gerçekleştirmeleri gerekmektedir.

İşletme sürekliliğinin sağlanması ve tüketici taleplerinin karşılanması hususunda üretim faktörlerinin varlığı kadar çevre de önemlidir. Sürdürülebilirlikte önemli bir konu olan çevrenin yönetilmesi ve çevreye verilen zararın en alt seviyeye indirilmesi gerekmektedir. Dönem içerisinde yapılacak faaliyetlerin meydana getireceği çevresel maliyetlerin tanımlanması, ölçülmesi ve olası çevresel maliyetlerin en aza indirilmesi çevre yönetim muhasebesi ile mümkün olmaktadır.

Çevre yönetim muhasebesi, işletmelerin dönem içerisinde gerçekleştirdikleri esas ve diğer faaliyetlerin çevre üzerindeki etkilerini planlamalarını ve ortaya çıkan maliyetlerin etkin yönetilmesini gerektirmektedir. Bunun yanı sıra işletmelere faaliyet gösterdikleri çevrenin ekolojik yapısının korunması ve sürdürülebilirliğinin sağlanması çevre yönetim muhasebesi ile sağlanabilecektir.

Çevre yönetim muhasebesinin başarılı bir şekilde uygulanabilmesi ve çevresel maliyetlerin yönetilebilmesi için; işletme bünyesinde bağımsız çevre departmanı kurulması ve diğer birimlerle etkili iletişimin sağlanması

gerekmektedir. Pazarlama, yönetim, AR-GE giderlerinin izlendiği hesaplar gibi, çevresel maliyetlerin izleneceği ana hesaplar ve alt/muavin hesapların açılması; muhasebe tek düzen hesap planında fonksiyonel olarak yer alması gerekmektedir. Ayrıca işletmelerin faaliyet gösterdiği sektörle ilgili faaliyet sonuçlarının çevreye ait etkileri ile gelecekte planlanan yatırım projelerine bağlı olarak ortaya çıkacak çevresel problemlerin ve çözüm planlarının çevre raporlarıyla ortaya konulması gerekmektedir. Bu sayede işletmenin finansal durumunun yanında mevcut ve geleceğini etkileyebilecek finansal olmayan çevresel risklerden doğması muhtemel olaylar hakkında kamuya yeterli bilgi sunulabilecektir. Kamu bu sayede işletmenin mevcut ve gelecekte karşılaşılabilecek riskleri ölçme ve değerlendirme konusunda yeterli bilgiye sahip olabilecektir.

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## SYNTHESIS OF NANO CRYSTALLINE BARIUM TITANATE POWDERS

Oguzhan Avcıata, Ali Erdogmus  
Yildiz Technical University  
Turkey  
avciata@yahoo.com

**Abstract** : Barium Titanate ( $\text{BaTiO}_3$ ) ceramic powders showing good piezoelectric and ferroelectric properties were synthesized by solution chemistry method in nano-size scales. Aqueous solutions of barium and titanium were used to prepare  $\text{BaTiO}_3$  in nano structure and synthesized by solution chemistry method at low temperatures.  $\text{BaTiO}_3$  structure were analysed by X-ray diffraction (XRD) and scanning electron microscopy (SEM) techniques. Analyzes helped to examine and to determine in which form of  $\text{BaTiO}_3$  is synthesized, the interval of particle size and morphology respectively.

**Key words:** Synthesis, nano, barium titanate, powder.

# ŞERİT DÖKME TEKNİĞİ İLE ERİMİŞ KARBONAT YAKIT HÜCRESİ (EKYH) ELEKTRODUNUN ÜRETİMİNDE DÖKÜM ÇAMURUNUN REOLOJİK ÖZELLİKLERİ

Göksel ÖZKAN\*, Çağrı Erkay\*\*, Gülay Özkan\*\*

\* Gazi Üniversitesi Mühendislik Fakültesi Kimya Mühendisliği Bölümü

\*\* Ankara Üniversitesi Mühendislik Fakültesi Kimya Mühendisliği Bölümü

gozkan@eng.ankara.edu.tr

**Özet:** Günümüzde özellikle ince seramik kaplama, polimerik kaplama, gözenekli ince metal ve alaşım kaplama ve plaka üretiminde şerit döküm tekniği yaygın kullanılmaktadır. Son yıllarda yakıt pili elektrot ve elektrolit malzemelerinin üretiminde de bu tekniğin yoğun kullanım alan bulduğu bilinmektedir. Özellikle polimerik membranlı (PEMFC), erimiş karbonatlı (MCFC) ve katı oksit (SOFC) yakıt hücrelerinin membran, elektrotları ve elektrolitik matrikslerinin hazırlanmasında bu teknik kullanılmaktadır. Bu çalışmada MCFC ve SOFC sistemlerinde kullanılan anot ve katot malzemelerinden Ni anot şeritlerinin şerit döküm yöntemiyle deneysel ölçekte üretimlerinin ilk aşaması olan ham şerit üretimi gerçekleştirilmiştir. Yöntemin ilk aşaması olan döküm çamurunun hazırlanması, nihai ürünü doğrudan etkilemektedir. Bu nedenle ham şeritlerinin hazırlanmasında; çözücü türü ile bağlayıcı, dağıtıcı ve plastikleştirici oran ve miktarlarını değiştirerek döküm çamurunun viskozitesi belirlenmiştir.

**Anahtar kelimeler:** Erimiş Karbonatlı Yakıt Hücresi, Ham Şerit, Viskozite

## Özet

Dünyadaki hızlı nüfus artışından dolayı, gerek duyulan enerji miktarı da artmaktadır. Fakat, gerek ekonomik durumlar, gerekse fosil yakıtların günden güne azalması ve çevreye bir takım zarar vermelerinden dolayı, ülkeler temiz kaynak arayışına girmişlerdir. Bu durumda alternatif kaynak olarak karşımıza  $H_2$  çıkmaktadır.  $H_2$ , çevre dostu olduğu gibi, aynı zamanda en önemli uygulama alanlarından biri yakıt hücreleridir. Elektrolit cinsine bağlı olarak çalışma koşulları ve uygulama alanları farklılık gösteren beş farklı tip yakıt hücresi vardır. Bunlardan biride erimiş karbonat yakıt hücresidir.

Erimiş karbonat yakıt hücresi (EKYH) kimyasal enerjiyi elektrik enerjisine dönüştürerek en çok gelecek vaat eden bir enerji dönüşüm aygıtıdır (Bıyıkoğlu, A., 2003). Yüksek verimli ve çevresel bakımdan temiz bir kaynak olması sebebiyle EKYH dünyada geniş bir yankı uyandırmıştır. Hava koşullarındaki nikel ham şeridin oksidasyonundan elde edilen geçirgen nikel ve nikel oksit, hem ucuz hem de oldukça iyi elektrokimyasal performansla olduklarından EKYH için yaygın olarak anot ve katot materyali olarak kullanılır.

EKYH'lerinde kullanılan hücre bileşenleri için 1960'ların ortalarına kadar elektrot malzemesi olarak kıymetli metaller kullanılmıştır. Daha sonraları ise nikel ve nikel oksit malzemeleri kullanılmaya başlanmıştır. Günümüzde bu kullanım devam etmektedir (Appleby, A.J ve ark, 1998).

1980'lerde elektrolit üretiminde sıcak presleme (hot pressing) yöntemi kullanılmıştır. Bu yöntem ile geniş alanlı elektrolit üretimi verimli olmamıştır. Seramik sanayisinde kullanılan şerit döküm (tape casting) yönteminin kullanımı ile bu sorunlar aşılmıştır. Elektrolit üretiminde olduğu gibi anot ve katot üretiminde de şerit döküm yöntemi kullanılmaktadır.

Ham şeridin özellikleri, sinterlenen şeridin son ürününe aynı nitelikte yansıtılır. Bu yüzden çözücü cinsi, seyreltici içeriği, bağlayıcı/plastikleştirici sistem optimize edilmelidir.

Şerit dökme, yüzey cilası ve kalınlık kontrolü iyi olan yüksek kaliteli laminant materyallerin üretimi için düşük fiyatlı bir prosestir. Şerit, hareketli dış yüzeyi çamur ile kaplı kazıyıcı doktor bıçağı (doctor blade) ile şekillendirilir. Halen, bu metal sadece seramik materyallerin dış yüzeyini düzleştirmek için değil, ayrıca verilen koşullarda sinterlenen ve daha sonra EKYH için elektrot olarak kullanılan karbonil nikel ham şerit üretiminde de kullanılır (Geçkinli, A. E., 1991). Tipik bir nikel çamuru, metalik toz partikülü, çözücü, bağlayıcı ve çeşitli katkı maddeleri içerir. Şerit dökme için, susuz karbonil nikel çamurunda, organik katkı maddeleri önemli bir rol oynar. Ham şeridin her yerinde toz partiküllerinin dağılımı, düzenini, esnekliğini ve direncini etkilerler. Ham şeridin özellikleri, sinterlenen şeridin son ürüne aynı nitelikte yansıtılır. Bu yüzden çözücü cinsi, seyreltici içeriği, bağlayıcı/plastikleştirici sistem optimize edilmelidir.

Şerit dökümde, kullanılan katkı maddeleri çok önemlidir. Çamurun reçetesi şu nedenlerden dolayı araştırılmalıdır (Özçelik, E, 2004).

Organikler hangi sıcaklıkta ve koşullarda yapıdan uzaklaştırılacaktır?

Viskozite aralığı ne olmalıdır?

Çözücü kullanımı ve tipinde ne gibi sınırlamalar vardır?

Kurutma nasıl olmalıdır?

Çevre ve sağlık koşulları nelerdir?

Organikler, taşıyıcıdan ayrılabilir mi?

Döküm yüzeyi ile ilgili bir kısıtlama var mı?

Üretilecek malzemenin maliyeti nedir?

Şerit dökme yönteminde organik katkı maddelerinin kullanımı şeridin özgül özelliklerini geliştirmektedir. Bağlayıcı, çamurdaki inorganik taneciklerin üzerinde bir film oluşturarak taneciklerin birbirine yapışmasını sağlar. Bu amaçla genellikle polivinil butinal (PVB) ve çeşitli akrilik polimerler kullanılır. Alüminyum oksit ve birçok diğer oksitler için giliseral triolat etkin dağıtıcılardır. Dibütil fitalat ve polietilen glikol (PEG) genellikle plastikliği arttırmak için kullanılan malzemelerdir.

Katı haldeki bağlayıcılar, uygun bir çözücüde çözünerek çamurun istenilen viskoziteye ulaşması sağlanır. Çeşitli alkoller ve aromatik hidrokarbonlar ve kloratlı çözücüler genellikle sulu olmayan çamurlarda kullanılır. Şeridin, kuruma hızını kontrol etmek için genellikle çözücülerin karışımı kullanılır. Şerit dökümde daima kuruma hızının fazla olması istenir. Çok hızlı kurutma neticesinde istenmeyen gaz habbecikleri yapıda yer alabilir.

Bazı akrilikler suda çözünür ve şerit üretiminde bağlayıcı olarak kullanılır. Su, şüphesiz organik bağlayıcıdan hem ucuz, hem de emniyetlidir. Fakat, yapıdaki suyu uçurmak için daha yüksek sıcaklıklara çıkmak icap etmektedir. Bu da; daha büyük bir döküm makinesinin kullanımını gerektirmektedir. Üretimde, alkol-su karışımının kullanımı da söz konusudur (Özçelik, E, 2004).

1970'lerin sonunda şerit döküm prosesi, sağlık ve çevreye olan etkisi nedeniyle çözücü olarak su kullanımına dayalı birçok reçete literatürde yer aldı. Ancak, çözücü olarak su kullanımı bazı problemlere yol açmaktadır. Bütün bu problemlere rağmen, çevre ve sağlık nedeniyle sulu sistemlerde çalışmalar devam etmektedir. Bu durumda, bütün suyla çalışan proseslerde olduğu gibi işlemin her aşamasında, pH kontrolü gerekmektedir. Su kullanılması halinde, aynı zamanda, ısıtıcı sisteme de ihtiyaç duyulmaktadır.

Literatürde bazı yapılan çalışmalara bakacak olursak,

*Yamamasu Yoshikazu ve ark. ,1992* yapmış oldukları çalışma ile geliştirilmiş akma direncine sahip ve mikroyapısı sabit olan, kullanılan alaşım elementlerinin yoğunluk farkından dolayı ayrı fazların oluşmadığı, Alümina ve alüminyum ile elektrotun kuvvetlendirildiği ve ömrünün uzatıldığı bir yakıt hücresi anodu üretim yöntemi geliştirmişlerdir.

*Jin-Eok Kim ve arkadaşlarının 2005 yılında yapmış oldukları çalışmanın amacı: matris malzemesi olarak  $\alpha$ -LiAlO<sub>2</sub>, katkı maddesi olarak Al ve Li<sub>2</sub>CO<sub>3</sub> parçacıklarının kullanıldığı, matrisinin mekanik direncinin yükseltildiği ve uzun süreli işlemlerde kararlılığının artırıldığı bir elektrolit üretmektir.*

*Min Hyuk Kima ve arkadaşları 2006 yılında Co/Ce kaplı Ni tozlarının kullanıldığı, böylelikle katod (NiO) çözünürlüğünün düşürüldüğü, kararlılığı ve performansı yüksek, ticari değeri ve ömrü yüksek, bir katoda sahip erimiş karbonatlı yakıt hücresi üretmişlerdir.*

*Athula Wijayasinghe ve arkadaşları 2006 yılında üçlü LiFeO<sub>2</sub>-LiCoO<sub>2</sub>-NiO ve ikili LiFeO<sub>2</sub>-NiO bileşimlerinin, katodun, elektrik iletkenliğine gözenek yapısına etkilerini incelemişlerdir.*

Sonuç olarak, ülkeler hem yenilenebilir hem ucuz hem de daha temiz kaynak arayışındadır. Erimiş karbonat yakıt hücresi, bu konuda iddialı bir alternatif olmasının yanı sıra, çalışmalar hala hızlı bir şekilde sürdürülmekte ve diğer 4 yakıt hücresiyle kıyaslandığında, çalışma sıcaklığının yüksek olması sebebi ile daha büyük proseslerde kullanılabilir. Ayrıca atık ısının kullanılması EKYH’nde enerji tasarrufu sağlamaktadır. Karbondioksit kullanımı ile çevresel dostluğu ve yüksek maliyetli elektrolit malzeme kullanılmaması nedeniyle EKYH kullanımı uygundur.

Bu çalışmada şerit dökme metodu ile yakıt hücrelerinden biri olan EKYH elektrotlarının üretimi için susuz nikel çamurlarının akış davranışları göz içinde bulundurulmuştur.

## Deneysel Çalışmalar

Erimiş karbonat yakıt hücresinin her iki elektrodunun plaka şeklinde ana maddesinin üretimi için nikel tozu kullanılmıştır. Uygun bir polimerizasyon tekniği ile nikel ham şeritlerin üretimi sağlanmıştır. Şerit üretiminde kullanılan malzemeler, Çizelge 1’de verilmiştir.

Şeridin üretilmesinde, şerit döküm yöntemi kullanılmıştır. İlk olarak nikel tozu, çözücü ve seyreltici mekanik karıştırıcıda 2 saat boyunca karıştırılmış, ikinci aşamada bağlayıcı ve plastikleştirici maddeler eklenerek, 4 saat boyunca karıştırma işlemi devam ettirilmiştir. Çamurların karıştırılması ve homojenleştirilmesi tamamlandıktan sonra kap içindeki çamurun akış özellikleri incelenmiş daha sonra havası alınıp, doktor bıçağı ile farklı kalınlıklarda polietilen kaplı cam plaka üzerine dökülerek kurutulmuştur. Şerit içindeki çözücü buharlaştıktan sonra, ham nikel şerit elde edilmiştir.

**Çizelge 1.** Kullanılan kimyasal maddeler

| Bağlayıcı                  | Çözücü                                   | Sentez maddesi     | Seyreltici       | Plastikleştirici        |
|----------------------------|--|--------------------|------------------|-------------------------|
| PVB<br>(polivinil bütiral) | etilhegzanol/<br>Bütanol<br>(1:1 oranda) | Ni tozu<br>(nikel) | Gliserol triolat | Polietilen glikol (PEG) |

## Sonuçlar ve Tartışma

Gerçekleştirilen deneylerde; çözücü, plastikleştirici, bağlayıcı ve nikel tozunun oranları değiştirilerek, bu değişimlerin şeritlerin fiziksel özelliklerinde ne gibi değişikliklere sebep olduğu incelenmiştir. Çözücü olarak 1:1 oranda bütanol ve etil hegzanol kullanılmıştır. Bağlayıcı olarak PVB ve plastikleştirici olarak PEG 1:1 oranda karışım içerisinde eklenmiştir. Seyreltici oranı bütün karışımlarda aynı tutulmuştur.

Çalışma kapsamında 7 adet deney gerçekleştirilmiş olup, her bir deneyde kullanılan karışımların bileşim değerleri Çizelge 2 ile verilmiştir.

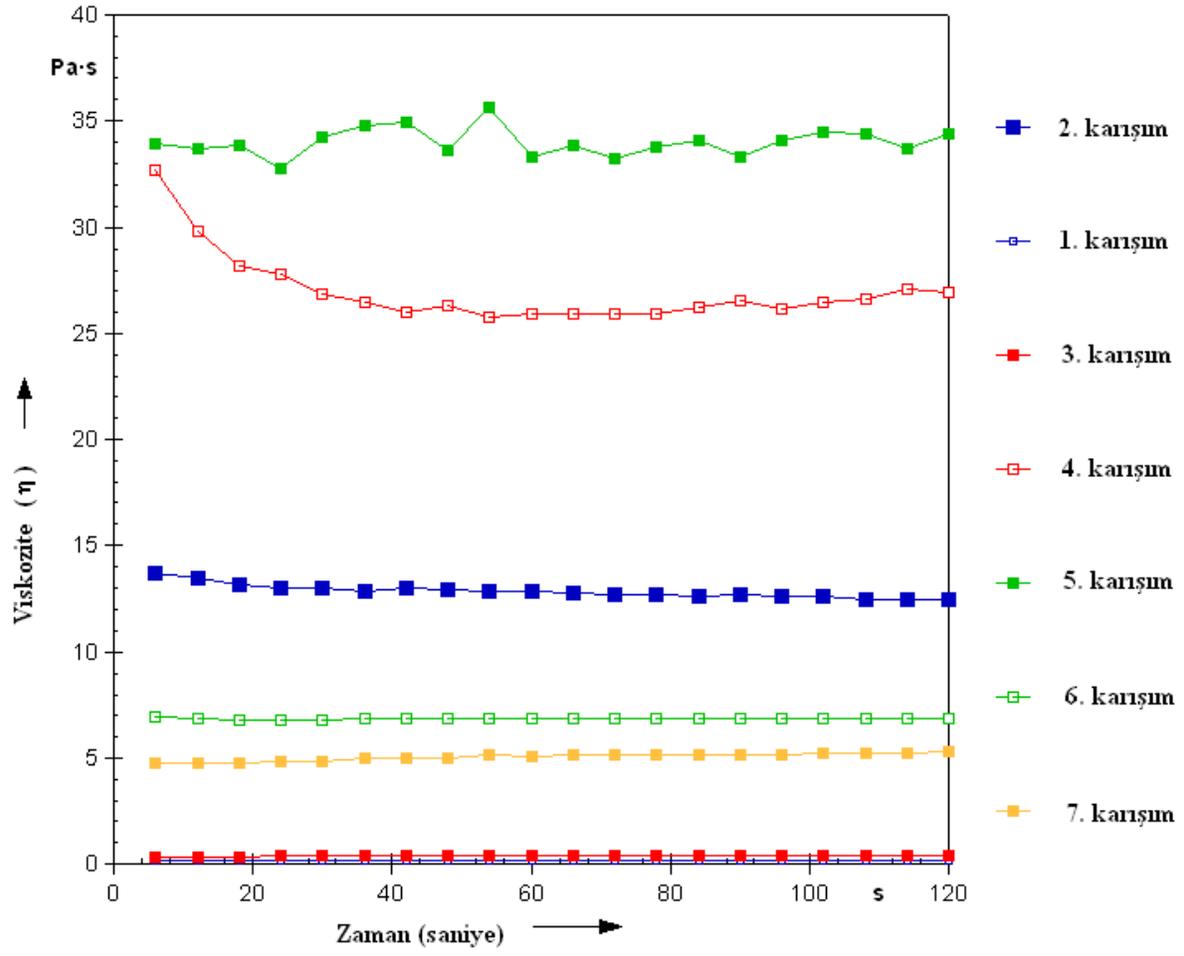
**Çizelge 2 .** Deneylerde kullanılan karışımların bileşim değerleri

| Ağırlıkça % değerleri                | 1. karışım | 2. karışım | 3. karışım | 4. karışım | 5. karışım | 6. karışım | 7. karışım |
|--------------------------------------|------------|------------|------------|------------|------------|------------|------------|
| Nikel tozu                           | %20        | %50        | %20        | %50        | %56        | %35        | %35        |
| Bütanol (çözücü)                     | %37        | %22        | %34        | %19        | %17,5      | %28        | %26,5      |
| Etil hegzanol (çözücü)               | %37        | %22        | %34        | %19        | %17,5      | %28        | %26,5      |
| Polivinil butiral (bağlayıcı)        | %2         | %2         | %5         | %5         | %3,5       | %3,5       | %5         |
| Polietilen glikol (plastikleştirici) | %2         | %2         | %5         | %5         | %3,5       | %3,5       | %5         |
| Gliserol triolat (seyreltici)        | %2         | %2         | %2         | %2         | %2         | %2         | %2         |

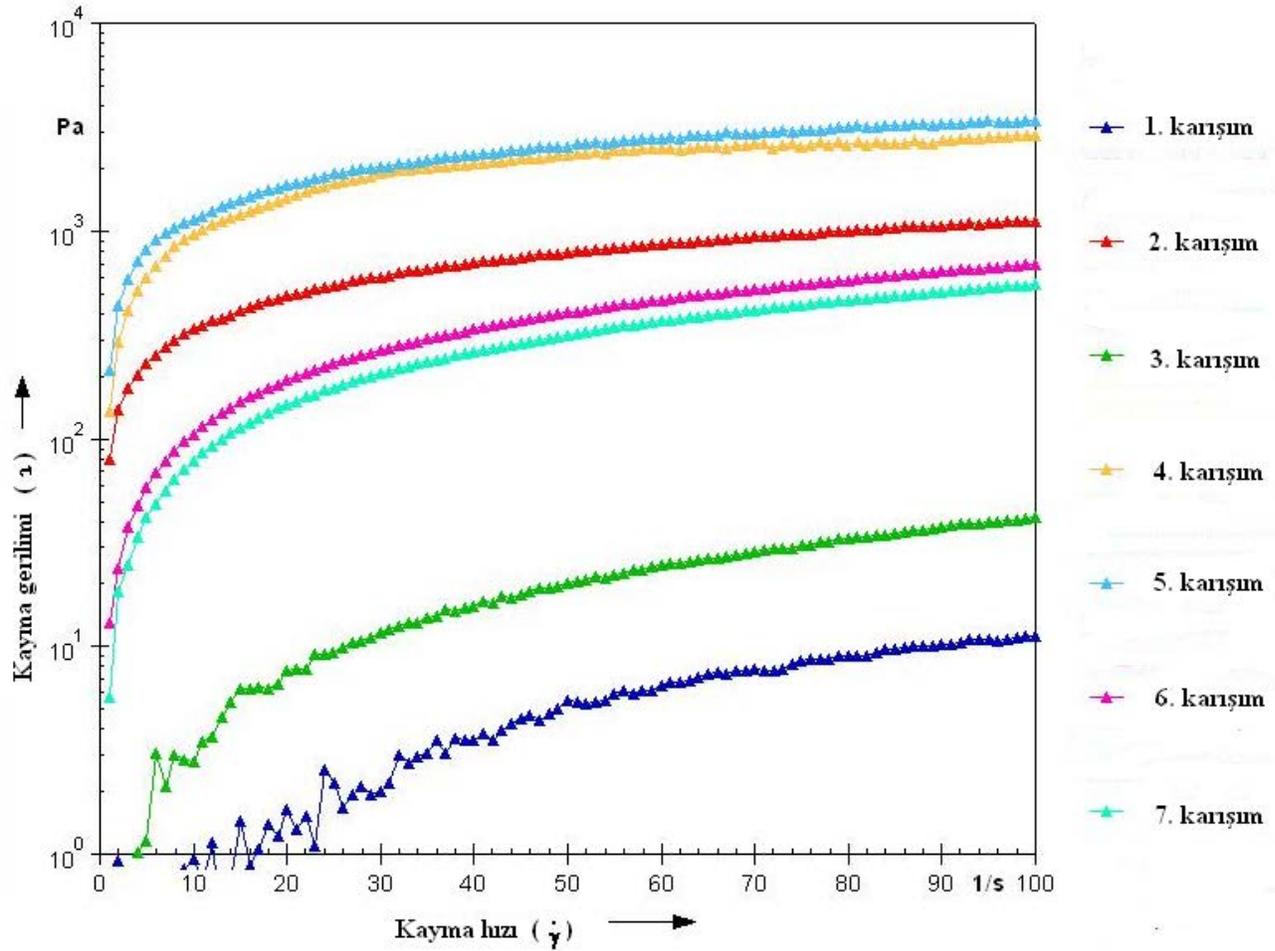
Bu bileşim değerlerinde hazırlanan karışımlar Anton Pear marka reometre cihazına yerleştirilerek ölçümleri yapılmıştır. Bilgisayar ortamına bağlı bu reometre cihazı yardımıyla zamana karşı viskozite [Şekil 1] ve kayma hızına karşı kayma gerilimi [Şekil 2] grafikleri çizdirilmiştir.

Bileşim oranları ve elde edilen Şekiller beraber düşünüldüğünde; nikel oranındaki artışın hem viskoziteyi hem de kayma gerilimini arttırdığı görülmektedir. Aynı zamanda, plastikleştirici ve bağlayıcı oranının artması da yine viskozite ve kayma gerilimini arttırmıştır.

Şekil 1’de görüldüğü üzere viskozitesi yüksek olan karışımlar (4. ve 5. karışım) kararlı bir eğri verememiştir. Buradan yola çıkarak; viskozite düştükçe homojenliğin ve kararlılığın arttığını söylenebilir. Bunların yanı sıra; plastikleştirici ve bağlayıcı oranını yükselttikçe, elde edilen ham şeritlerin daha esnek ve kırılmaz oldukları gözlemlenmiştir. Çözücü oranının fazla olması, hazırlanan karışımın çabucak dağılmasına ve kuruduktan sonra çatlayarak kurumasına sebep olmuştur. Bu sebeplerden dolayı, tüm bileşenlerin optimum düzeyde olduğu bir karışım elde edilmeye çalışılmıştır. Sonuç olarak; hem şekillerden görüldüğü üzere, hem de kuruduktan sonraki esnekliği ölçüldüğünde, 7 numaralı karışımın en ideal ham şeridi verdiğini söyleyebiliriz.



Şekil 1. Zamana karşı viskozite eğrileri



Şekil 2. Kayma hızına karşı kayma gerilimi eğrileri

### Teşekkür:

12B4343006 kod numaralı "Erimiş karbonatlı yakıt hücre anot materyallerinden nikel plakaların optimum koşullarda hazırlanması" adlı projeye verdiği destekten dolayı Ankara Üniversitesi Bilimsel Araştırma Projeleri koordinasyon Birimine teşekkür ederiz.

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# TDY-1998 ÖNCESİ TASARLANMIŞ BETONARME BİNALARDAKİ PERDE ORANININ YAPI PERFORMANSINA ETKİSİ

Naci CAGLAR<sup>1</sup>, Hakan OZTURK<sup>2</sup>, Muzaffer ELMAS<sup>1</sup>, Aydın DEMİR<sup>1</sup> ve Abdulhalim AKKAYA<sup>3</sup>

<sup>1</sup>Department of Civil Engineering, University of Sakarya, Sakarya, Turkey

<sup>2</sup>Department of Civil Engineering, University of Kilis 7 Aralık, Kilis, Turkey

<sup>3</sup>Department of Civil Engineering, University of Sakarya, Sakarya, Turkey

**Özet:** Son yıllarda dünyada ve ülkemizde meydana gelen depremlerin yol açtığı büyük can kayıpları ve maddi zararlar, bir çok yapının deprem performansının yetersiz olduğunu göstermiştir. Geçmişte yaşadığımız depremlerin neden olduğu olumsuz sonuçların ardından, ülkemizde mevcut yapı stokunun deprem güvenliğinin belirlenmesi ve gerekli görülen binalarda güçlendirme önlemlerinin alınması zorunlu hale gelmiştir. Yeni yapıların depreme dayanıklı olarak tasarlanabilmesi için mevcut yapı performansının belirlenmesi ve yapı performansına yapı elemanlarının katkısının da belirlenmesi oldukça önemlidir. Yapıların deprem yükleri etkisindeki davranış özelliklerinin ve yapı performanslarının belirlenmesinde artımsal statik itme (pushover) analizleri yaygın olarak kullanılmaktadır.

Bu çalışmada, 1975 Türk Deprem Yönetmeliği'ne (TDY1975) göre tasarlanmış betonarme binalardaki perde oranının yapı performansına olan etkisi araştırılmıştır. TDY2007'e göre tasarlanmış perdesiz yapı referans bina olarak seçilmiştir. Bu amaçla, aynı kat planı ve düşey taşıyıcı boyutlarına sahip TDY1975 ve TDY2007'e göre tasarlanmış olan yapı modelleri oluşturulmuştur. TDY1975'e göre tasarlanmış yapılara farklı oranlarda perde taşıyıcı elemanlar eklenerek 5 farklı yapı modelleri oluşturulmuştur. Tüm yapıların SAP2000 paket programı kullanılarak artımsal statik itme (pushover) analizleri yapılmış ve yapı performansları belirlenmiştir. Referans binaya göre yapı performansları karşılaştırılarak perde oranının yapı performansına etkisi belirlenmiştir.

**Anahtar Kelimeler:** Betonarme yapı, Perde oranı, Artımsal itme analizi, Yapı performansı

**Abstract:** Damage and casualties resulted from the earthquakes occurred both in Turkey and the world have shown that earthquake performance capacity of the most of the buildings are not sufficient. After experiencing these negative results it is highly important to determine safety level of building stocks of our country and then the buildings considered necessary should be retrofitted. In order to construct new earthquake resistant structures, performance levels of them should be determined. It is also important that effect of cross sections to the performance of structure should be known well. Behavior of structures under earthquake loads and structural performance can be generally determined by static pushover analysis.

In this study, contribution of shear-wall ratio to structural behavior of reinforced concrete buildings designed according to Turkish Earthquake Code 1975 (TDY1975) was evaluated. A building designed according to Turkish Earthquake Code 2007 (TDY2007) was selected as a reference building. For that purpose, some structural modals which have same plan and cross section dimensions and designed according to TDY1975 and TDY2007 were prepared. By changing shear wall-ratio of the buildings which were designed according to TDY1975, 5 different structural models were created. Static pushover analysis was performed by using SAP2000 spread sheet program and structural performances were obtained for each building. Contributions of shear-wall ratio to response of RC buildings were determined by comparing results with reference building.

**Key words:** Reinforced concrete structures, Shear-wall ratio, pushover analysis, structural performance

## Giriş

Ülkemizde ve birçok ülkede meydana gelen depremler çok sayıda can kaybı ve çok büyük miktarda maddi hasarlara neden olmuştur. Bu hasar ve can kayıplarının en önemli nedeni bu yapıların deprem performanslarının yetersiz olmasıdır. Yaşadığımız depremler, depreme karşı dayanıklı ve yeterli güvenlikte bina tasarımının önemini bir kez daha ortaya çıkarmaktadır. Geçmişte yaşanan depremlerin neden olduğu bu olumsuz sonuçların ardından, mevcut yapı stokunun deprem güvenliğinin belirlenmesi ve gerekli görülen binalarda güçlendirme önlemlerinin alınması artık zorunlu hale gelmiştir.

Son yıllarda, betonarme perde elemanları, kolonlara göre kesme alanlarının büyüklüğü ve çok daha büyük eğilme rijitliklerine sahip olmaları nedeniyle her yükseklikteki yapılar için bir güvenlik elemanı olarak önerilmektedir. Ayrıca, mevcut betonarme binaların güçlendirilmesinde de betonarme perde elemanların eklenmesi yaygın olarak tercih

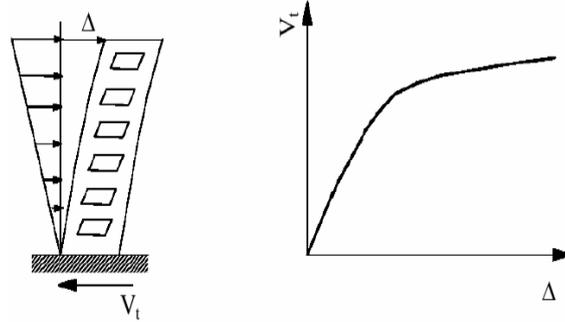
edilmektedir.

Bu çalışmada, deprem etkisindeki betonarme elemanların performansına betonarme perde oranının etkisi araştırılmıştır. Bu amaçla, 2007 Türk Deprem Yönetmeliği'ne (TDY-2007) göre iyi tasarlanmış ve perde elemanı bulunmayan betonarme yapı referans modeli olarak seçilmiştir. Referans modeli ile aynı yapı alanına sahip, 1975 Türk Deprem Yönetmeliği'ne (TDY-1975) göre tasarlanmış ve farklı oranlardaki perde elemanlara sahip betonarme yapı modelleri oluşturulmuştur. Oluşturulan yapı modellerinin tamamının, SAP2000 paket programı kullanılarak artımsal statik itme (pushover) analizleri yapılmış ve yapı performansları ile deprem enerjisi sönmüleme kapasiteleri belirlenmiştir.

## Statik İtme (Pushover) Analizi

Statik itme analizi, yapıları deprem davranışlarının belirlenmesinde kullanılan ve doğrusal olmayan statik analiz prosedürüdür. Statik itme analizi, bilimsel altyapısı oturmuş ve kullanılabilir derecede pratik bir metottur (Lawson vd., 1994). Bu metot ile yapı elemanlarının hasarları sonrası yapı içindeki kuvvet dağılımı ve yapının davranışının nasıl değiştiği gibi birçok bilgi elde edilebilmektedir (Krawinkler ve Seneviratna, 1998).

Artımsal statik itme (pushover) analizi, önceden belirlenmiş bir dağılıma göre yatay yüklerin sisteme etki ettirilmesi ve bu yüklerin belirli bir eşik değerine kadar adım adım artırılması prensibine dayanmaktadır. Bu eşik değeri, ya yapısal stabilitenin bozulması veya önceden belirlenmiş olan bir yatay yer değiştirme limitidir. Artımsal statik itme analizinin her adımında, iç kuvvetler, yer değiştirmeler ve plastik şekil değiştirmeler hesaplanır ve yapının global itme eğrisi yani kapasite eğrisi (pushover curve) belirlenir (Şekil 1). Kapasite eğrisi, statik itme analizinin her adımında belirlenen taban kesme kuvveti ile tepe noktası yatay yer değiştirmesinin doğrusal ötesi değişimini göstermektedir (Koçak, 2007).

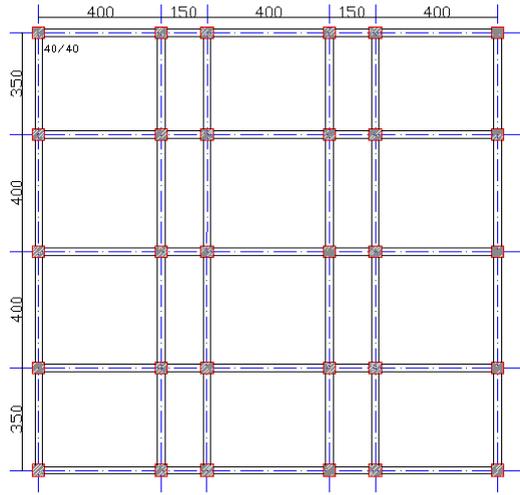


Şekil 1: İtme şekli ve kapasite eğrisi

Yapının yatay olarak itilmesi için değişik yük desenleri kullanılabilir. Yöntemin tanımlandığı ATC-40'da, Statik İtme Analizinde kullanılmak üzere, yapı davranışına bağlı olarak önerilen itme şekilleri tanımlanmıştır (ATC-40, 1996). Yapıya etkiyen yatay yükün tamamının en üst kat seviyesinden etki ettirilmesi de bu itme şekillerinden biridir. Bir başka itme şeklinde ise çatıya ilave yük koyulmadan, her kat seviyesine eşdeğer deprem yükü yönteminden hesaplanan deprem yükleri etki ettirilir. Ayrıca, birinci modun baskın olduğu binalarda, hâkim mod şekli ile kat kütlelerinin çarpımının oranları olan yatay yüklerin kat seviyelerine etki ettirilmesi diğer bir itme şeklidir (Koçak, 2007).

## Sayısal Çalışma

Bu çalışmada, deprem etkisindeki betonarme yapıların davranışına betonarme perde oranının katkısı araştırılmıştır. Perde oranı, bir katta bulunan perde kesit alanının ilgili katın alanına oranı olarak tanımlanmıştır. Referans bina ve farklı perde oranlarına sahip 4 farklı betonarme yapı modeli oluşturulmuş ve yapıların tamamında kat taban alanları ve kat sayıları sabit tutulmuştur. Referans bina, TDY-2007'de verilen tasarım ilkeleri dikkate alınarak perdesiz olarak modellenmiştir (Şekil 2).



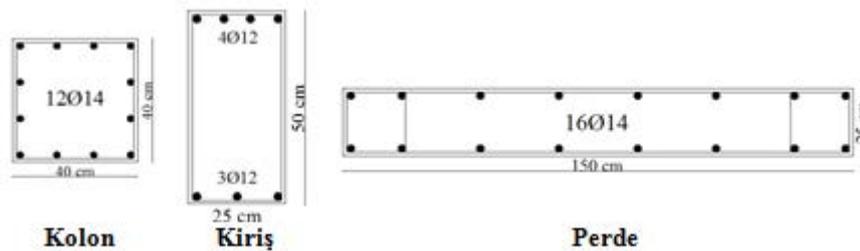
Şekil 2. Referans Model (Plan A)

Yapı modellerinin performanslarını karşılaştırabilmek amacıyla referans modeli TDY-2007 ve farklı oranlarda perde oranına sahip binalar ise TDY-1975'e göre modellenmiştir. Yapı modelleri oluşturulurken TS 498 ve TS 500 şartnameleri göz önünde bulundurulmuştur (TS 498, TS 500). Perde oranının katkısını belirleyebilmek amacıyla, perde oranları Referans ve Model A'da %0.0, Model B'de %0.50, Model C'de %1.00 ve Model D'de %1.50 olarak belirlenmiştir (Tablo 1).

Tablo 1. Yapı Modelleri ve Perde Oranları

| Modeller         | Plan   | Perde Oranı | Çelik Dayanımı (MPa) | Beton Basma Dayanımı (MPa) | Yönetmelik |
|------------------|--------|-------------|----------------------|----------------------------|------------|
| Referans Model A | Plan A | 0.00        | 420                  | 20                         | TDY-2007   |
| Model B          | Plan B | 0.50        | 220                  | 14                         | TDY-1975   |
| Model C          | Plan C | 1.00        |                      |                            |            |
| Model D          | Plan D | 1.50        |                      |                            |            |

Yapı modellerinin tamamı 4 katlı ve yapı modellerinin tamamında zemin kat yüksekliği 4,50m, normal kat yüksekliği 3,00m, kolon boyutları 40cmx40cm, kiriş boyutları 25cmx50cm, döşeme kalınlığı 12cm, perde boyutları 25cmx150cm olarak seçilmiştir (Şekil 3). Kolonların tamamında boyuna donatı oranı minimum 0.01 ve maksimum 0.04 olacak şekilde (12Ø14) ve perdelerde minimum donatı alanı perde brüt enkesit alanının, yatay donatı için 0.0025, düşey donatı için 0.0020'sinden az olmayacak şekilde (16Ø14) ve enine donatılar ise, referans modelde Ø8/150 mm, diğer modellerde Ø8/250 mm olarak seçilmiştir.

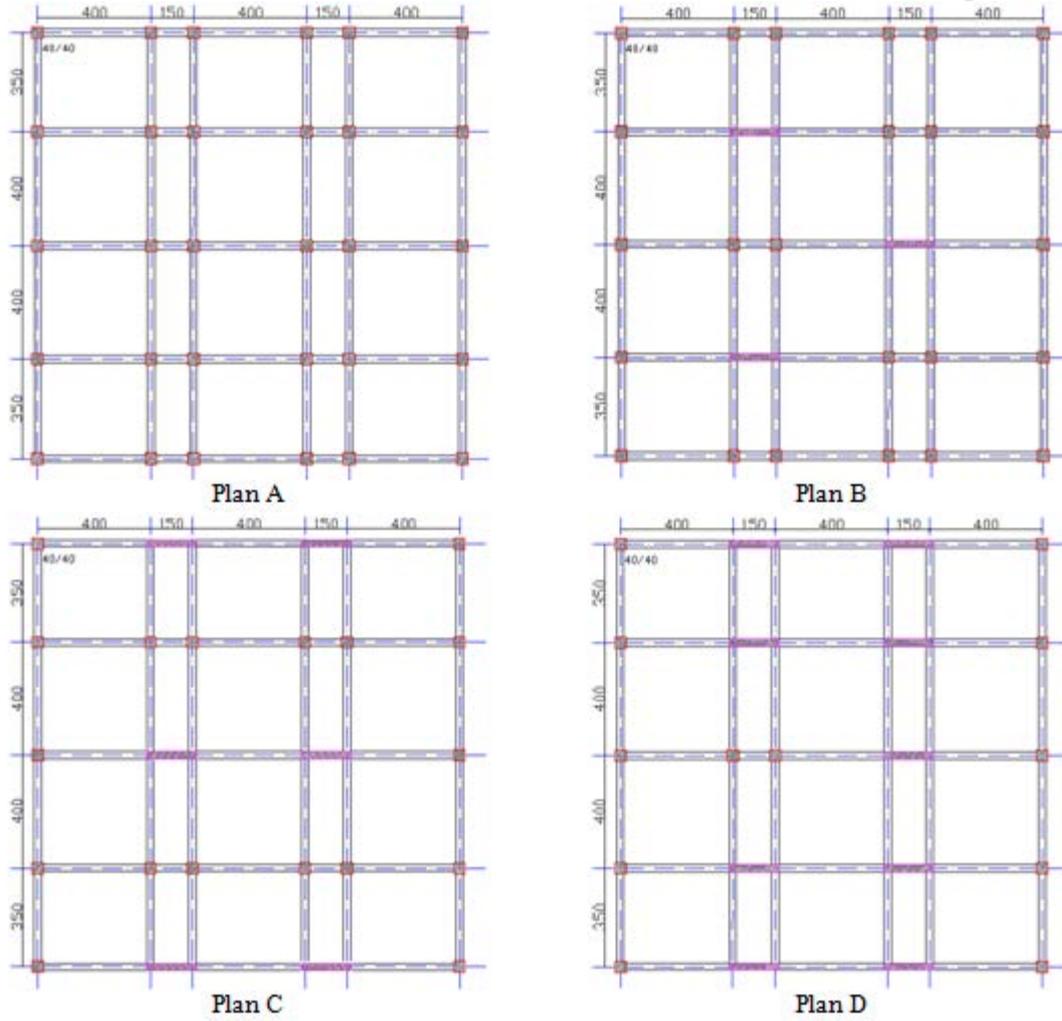


Şekil 3. Taşıyıcı eleman kesitleri ve donatı özellikleri

Yapı planları perde oranına göre isimlendirilmiş ve perde oranı %0.0 Plan A, %0.50 Plan B, %1.00 Plan C ve %1.50 Plan D olarak tanımlanmıştır (Tablo 1). Referans Model ve Model A yapısı Plan A, Model B yapısı Plan B, Model C yapısı Plan C ve Model D yapısı Plan D kullanılarak modellenmiştir (Tablo 1, Şekil 4). Referans modeli ile diğer yapı modellerinin malzeme özellikleri, deprem yönetmelikleri dikkate alınarak farklı olarak modellenmiştir (Tablo 1).

Referans modeli ile aynı boyutlardaki yapı modellerine farklı oranlarda perde elemanlar eklenerek 4 farklı yapı modeli oluşturulmuştur (Şekil 4). Analizleri yapılan yapı modellerinin tamamında taşıyıcı eleman boyutları ve donatı oranları aynıdır (Şekil 3). Fakat referans model ile diğer yapı modellerinin malzeme özellikleri farklı seçilmiştir (Tablo 1).

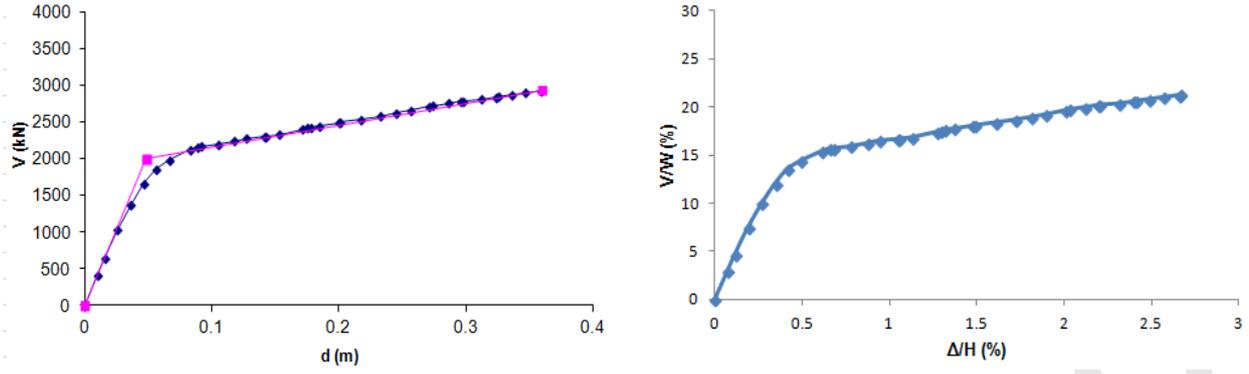
Oluşturulan yapı modellerinin tamamının, SAP2000 paket programı kullanılarak artımsal statik itme (pushover) analizleri yapılmış ve yapı performansları ile deprem enerjisi sönümlenme kapasiteleri belirlenmiş ve karşılaştırılarak sonuçlar grafikler halinde sunulmuştur. Model oluşturulurken kat planları, taşıyıcı sistem eleman boyutları, kesit özellikleri, donatı durum ve düzenleri ile taşıyıcı sistem elemanlarına etkiyen yük durumları dikkate alınmıştır (SAP2000 V.15, 2012). Taşıyıcı sistem üzerinde plastik mafsall oluşması beklenen özellikle kolon-kiriş birleşim bölgeleri için kesit özellikleri (beton ve donatı sınıfı, donatı dizaynı) dikkate alınmıştır. XTRACT programı yardımı ile kolon kabuk betonu için Mander sargısız beton modeli, etriyelerle çevrili çekirdek betonunda ise Mander sargılı beton modeli dikkate alınarak eksenel kuvvet moment etkileşim diyagramları elde edilmiş ve bu diyagramlar SAP2000 programına girilerek ilgili kesitlerin plastik mafsalları oluşturulmuştur. Oluşturulan bu plastik mafsallar, taşıyıcı sistem üzerinde ilgili kesitlere atanmıştır (Xtract V.3.0). Donatı çeliği için literatürde genel kabul görmüş deney sonuçlarından elde edilen gerilme-birim şekil değiştirme eğrilerinden faydalanılmıştır.



Şekil 4. Yapı Modellerinin Planları

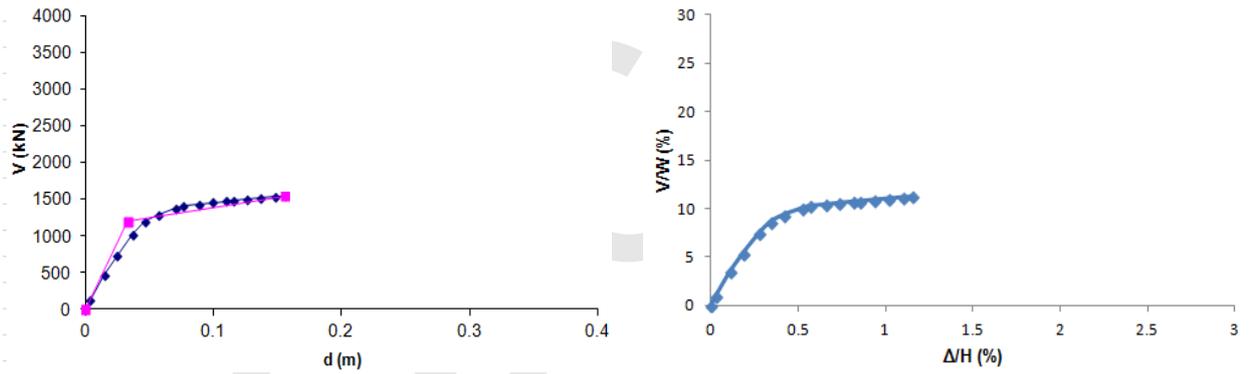
## Sonuçlar ve Tartışma

Referans yapı modeli ve farklı oranlardaki perde oranına sahip yapı modellerinin statik itme analizleri yapılmış ve tüm yapı modellerinin kapasite eğrileri belirlenmiştir. Ayrıca, kapasite eğrilerinden yararlanılarak yapılara etkiyen yatay kuvvetin toplam bina ağırlığına oranı ( $V/W$ ) ve yapı tepe noktası yatay deplasmanın toplam bina yüksekliğine oranı ( $\Delta/H$ ) belirlenerek tekrar grafikler halinde sunulmuş ve tüm yapı modellerinin performansı Referans Model performansı ile karşılaştırılarak değerlendirilmiştir.



Şekil 5. Referans Model İçin a) İdeal Kapasite Eğrisi b) Kapasite Eğrisi

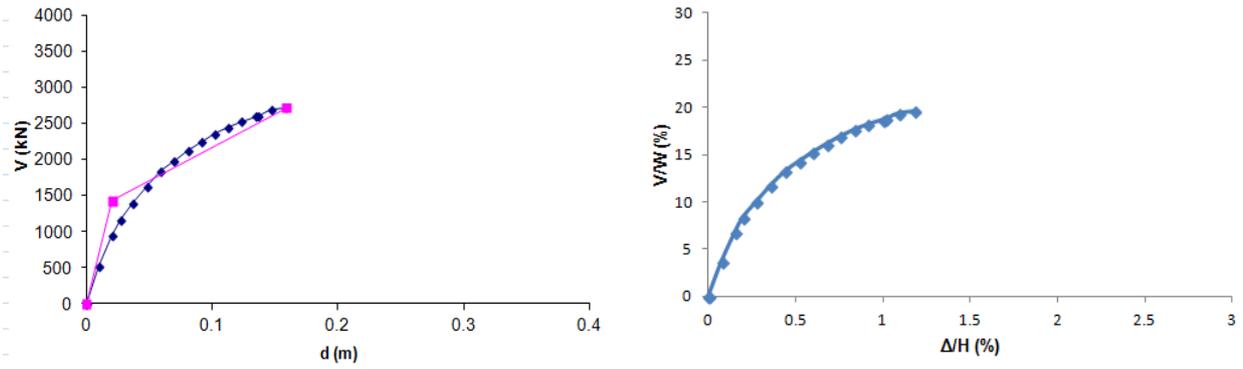
Model A yapısı, perde oranı %0.00 olan yapı modeline karşılık gelmektedir. Model A yapısının kapasite eğrileri Şekil 6'de sunulmuştur. Bu yapının dayanımı ve yer değiştirme kapasitesi beklenildiği gibi, Referans Modelden oldukça düşüktür ve dayanımında %47 ve yer değiştirme kapasitesinde %57 oranında azalış olmuştur. Her iki yapı modelinin yapı alanı, eleman boyutları ve yapı boyutları aynı olduğundan beton ve donatı sınıfındaki dayanım azalması, etriye aralıklarının değişimi gibi parametrelerin yapı dayanımını ve yer değiştirme kapasitesini ve sünekliliğini önemli oranlarda azalttığı görülmektedir. Ayrıca, Model A yapısı, Referans modelin yaklaşık % 23'ü seviyesinde deprem enerjisi tüketme kapasitesine ulaşabilmiştir (Tablo 3).



Şekil 6. Model A İçin a) İdeal Kapasite Eğrisi b) Kapasite Eğrisi

Model B yapısı, perde oranı %0.50 olan yapı modeline karşılık gelmektedir. Model B yapısının kapasite eğrileri Şekil 7'de sunulmuştur. Bu yapının yatay yük taşıma kapasitesinde Model A yapısına göre önemli artmalar olmakla birlikte yer değiştirme kapasitesinde çok büyük değişimler olmadığı görülmektedir.

Model B yapısının yatay yük taşıma kapasitesi Referans Modele göre %8 azalırken Model A yapısına göre ise % 43 artmaktadır. Perde oranı arttıkça yapının yatay yük taşıma kapasitesi artmakla birlikte yer değiştirme kapasitesinde önemli artışlar olmamaktadır. Model B yapısının deprem enerjisi tüketme kapasitesi yaklaşık olarak, referans modele göre %63 oranında azalırken Model A yapısına göre ise % 60 oranında artmıştır (Tablo 3).

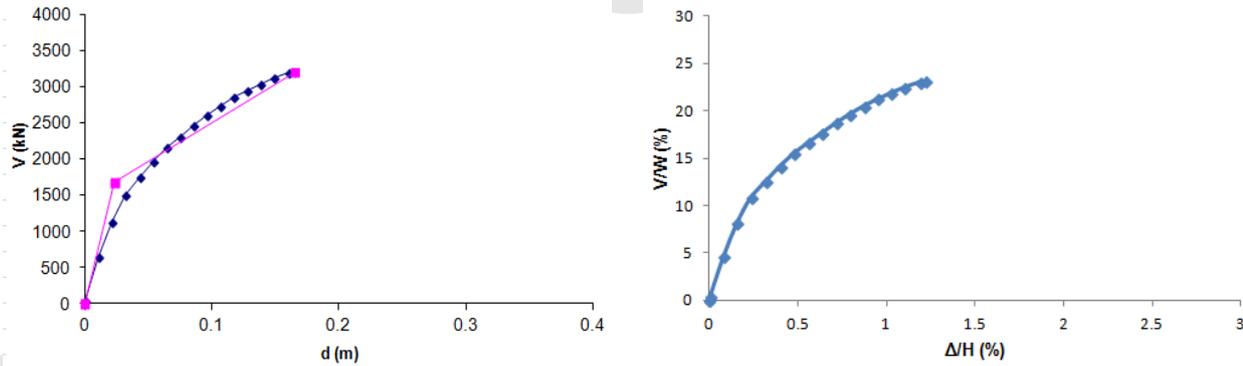


Şekil 7. Model B İçin a) İdeal Kapasite Eğrisi b) Kapasite Eğrisi

Model C yapısı, perde oranı %1.00 olan yapı modeline karşılık gelmektedir. Model C yapısının kapasite eğrileri Şekil 8’de sunulmuştur. Bu yapının yatay yük taşıma kapasitesinde Model A ve B yapılarına göre önemli artmalar olmakla birlikte yer değiştirme kapasitesinde çok büyük değişimler olmadığı görülmektedir.

Model C yapısının yatay yük taşıma kapasitesi yaklaşık olarak Referans Model ile aynı olmakla birlikte yer değiştirme kapasiteleri arasında önemli farklar bulunmaktadır. Yatay yük taşıma kapasitesi açısından, Model C yapısındaki %1.00 lik perde oranı ile TDY-1975 deprem yönetmeliğine göre tasarlanmış olan bu yapı TDY-2007 göre tasarlanmış olan perdesiz bir yapı davranışını yakalamaktadır. Buradan yapılara en az taban alanının %1.0’i kadar perde yerleştirilmesi ile yatay yük taşıma kapasitesinde ciddi artışlar elde edileceği anlaşılmaktadır. Bununla birlikte, yer değiştirme kapasiteleri arasında önemli farklar bulunduğundan deprem enerjisini tüketme açısından değerlendirildiğinde ise referans modele göre %55 civarında daha düşüktür.

Model C yapısı, Model B ile karşılaştırıldığında ise perde oranındaki artışla birlikte dayanımında yaklaşık olarak %15 ve enerji tüketme açısından ise %20 artış oluşmaktadır. Model C yapısının deprem enerjisi tüketme kapasitesi yaklaşık olarak, referans modele göre %55 oranında azalırken Model A yapısına göre ise % 94 ve Model B yapısına göre ise %20 oranında artmıştır (Tablo 3).

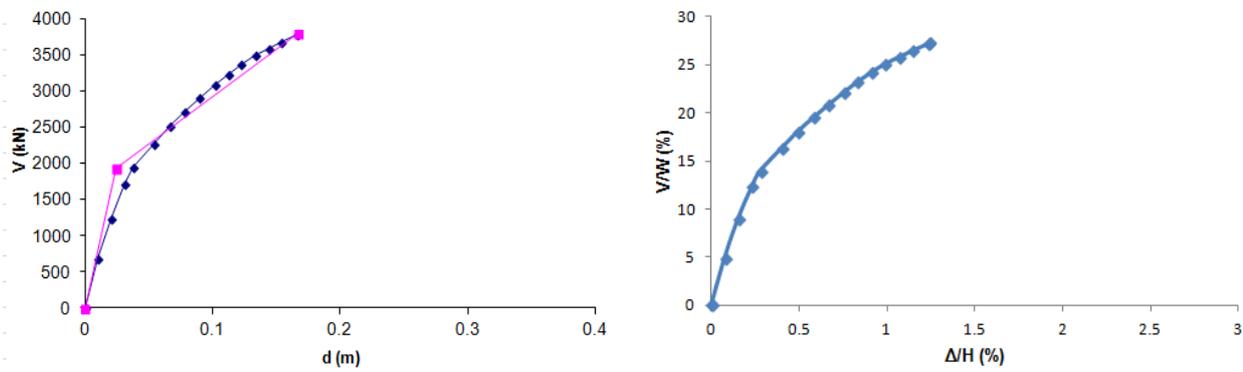


Şekil 8. Model C İçin a) İdeal Kapasite Eğrisi b) Kapasite Eğrisi

Model D yapısı, perde oranı %1.50 olan yapı modeline karşılık gelmektedir. Model D yapısının kapasite eğrileri Şekil 9’da sunulmuştur. Bu yapının yatay yük taşıma kapasitesinde Model A, B ve C yapılarına göre önemli artmalar olmakla birlikte yer değiştirme kapasitesinde çok büyük değişimler olmadığı görülmektedir.

Model D yapısındaki perde oranının artması ile birlikte, yatay yük taşıma kapasitesi Referans Modele göre yaklaşık olarak %25 oranında artmaktadır. Bununla birlikte, yer değiştirme kapasiteleri arasında önemli farklar bulunduğundan deprem enerjisini tüketme açısından değerlendirildiğinde ise referans modele göre %48 civarında daha düşüktür. Her ne kadar önemli bir oranda perde eklenmiş olsa da TDY-1975 deprem yönetmeliğine göre tasarlanmış olan bu yapı TDY-2007 göre tasarlanmış olan perdesiz bir yapı davranışını yatay yük taşıma açısından geçse bile deprem enerjisini tüketme açısından oldukça düşük seviyelerde kalmaktadır.

Model D yapısı, Model A, Model B ve Model C ile karşılaştırıldığında perde oranındaki artışla birlikte sırasıyla dayanımında yaklaşık olarak %145, %40, %18 oranında artış olmaktadır. Model D yapısının deprem enerjisi tüketme kapasitesi yaklaşık olarak, referans modele göre %47 oranında azalırken Model A yapısına göre %130, Model B yapısına göre %43 ve Model C yapısına göre ise %18 oranında artmıştır (Tablo 3).

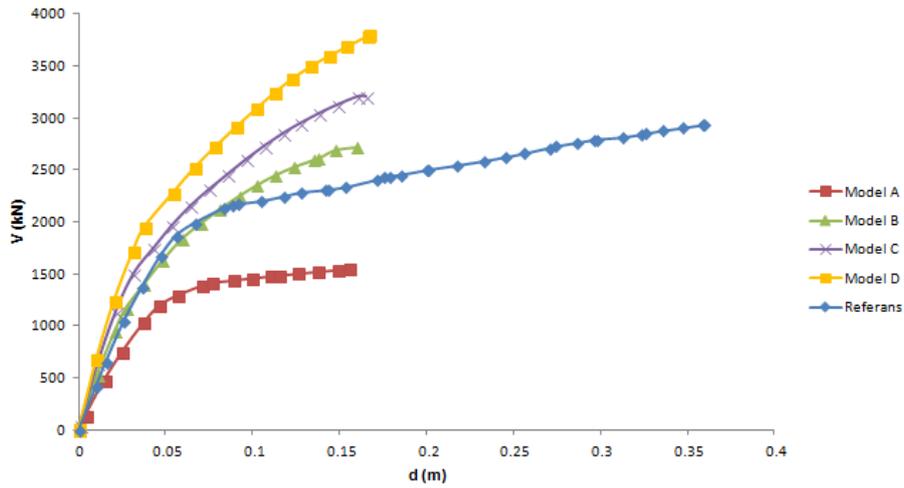


Şekil 9. Model D İçin a) İdeal Kapasite Eğrisi b) Kapasite Eğrisi

Tablo 3. Yapı Modellerinin Enerji Tüketme Kapasiteleri

| Model    | Enerji Tüketme Kapasitesi | Model Referans (%) |
|----------|---------------------------|--------------------|
| Referans | 817.620                   |                    |
| Model A  | 188.148                   | 23.00              |
| Model B  | 302.179                   | 36.95              |
| Model C  | 365.661                   | 44.72              |
| Model D  | 432.091                   | 52.85              |

Tüm grafikler birlikte değerlendirildiğinde, yapılarıdaki perde oranı arttıkça, yapı dayanım kapasitelerinde önemli artmalar olduğu, bununla birlikte yatay yer değiştirme kapasitelerinde ise çok küçük değişimler olduğu ve azaldığı anlaşılmaktadır. Yatay yer değiştirme kapasitelerindeki değişimin az olması ve yatay yük taşıma (dayanım) kapasitelerindeki önemli artışlar nedeni ile perde oranı arttıkça deprem enerjisi tüketim oranlarında artışlar olduğu belirlenmiştir (Şekil 10).



Şekil 10. Yapı Modellerinin Kapasite Eğrileri

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# THE ARTEMISIN POTENTIAL OF LEAVES FROM CULTIVARS AND WILDLINGS OF *ARTEMISIA ANNUA* L. GROWN IN WESTERN KENYA

<sup>1a</sup> Odundo, J. O., <sup>1b</sup> Oyoo, D. and <sup>1c\*</sup> Nawiri, M. P.

**Abstract** Half of the world's population and especially those in Africa are most vulnerable to malaria. In Western region of Kenya, malaria prevalence levels are above 40%. The disease is preventable and treatable with currently recommended interventions one being the use of Artemisinin-based combination therapy. A hybrid plant *Artemisia annua* named ('A3'), a clone of artemisinin annua is being embraced in western Kenya. We report the levels of artemisinin in leaves of 'A3' grown in regions of Western Kenya and of soil nutrients Zinc (Zn), Boron (B), Nitrate (NO<sub>3</sub><sup>-</sup>) and Ammonium (NH<sub>4</sub><sup>+</sup>). High performance Liquid Chromatography, Atomic Absorption Spectrometry and Ion Selective Electrodes were employed. In comparison to the expected levels in soils for artemisinin accumulation; Zn was above the minimum tolerable levels; B was very low in the top-soil but high at in-depth; nitrogen NH<sub>4</sub><sup>+</sup> and NO<sub>3</sub><sup>-</sup> ions were found sufficient and the ratio of NO<sub>3</sub><sup>-</sup> : NH<sub>4</sub><sup>+</sup> was high. Artemisinin in leaves of cultivars ranged between 0.04-0.88% dry matter. The levels of artemisinin in 'A3' grown in Western region of Kenya can be improved if nutrient levels are well managed. These findings showcase the need to expand cultivation of *A. annua* in Western Kenya and consequently produce artemisinin that would be useful in addressing malaria.

**Key Words** *Artemisia annua* leaves; artemisinin; cultivars and wildlings, Western Kenya

## INTRODUCTION

Half of the world's population is at risk of malaria with people living in the poorest countries being the most vulnerable. In 2010, 90% of all malaria deaths occurred in the WHO African Region, mostly among children under five years of age. Increased prevention and control measures however have led to its reduction in mortality rates by more than 25% globally and by 33% in the WHO African Region (WHO, 2012). In Kenya, malaria is the leading cause of morbidity and mortality, with 25 million out of a population of 34 million Kenyans at risk (Ministry of Health, 2009). Other associated effects of the disease include; loss of productivity and income associated with illness and death; loss of working day and/or absenteeism from school and formal employment; and in case of death of a family member, the loss of future lifetime earnings. Malaria is an entirely preventable and treatable disease, provided that currently recommended interventions are properly implemented.

The WHO recommends the use of Artemisinin-based combination therapy (ACT), an effective drug based on artemisinin, a sesquiterpene lactone peroxide found in the plant *Artemisia annua* L (*A. annua*) (Graham *et al.*, 2010). The Kenya government allocates about KShs. 69.5 billion annually in acquiring ACTs since chemical synthesis of artemisinin is complex and uneconomical (Health Sector Strategic Plan HSSP, 2005-2015). These figures are projected to increase for expenditure on malaria treatment, prevention and administration. Malaria has significant measurable direct and indirect costs that place major constraints in economic development in Kenya thus retarding efforts on wealth creation and poverty eradication. These costs could however be reduced by more production of artemisinin from *A. annua*.

Among the species of *Artemisia*; *Artemisia absinthium*, *Artemisia tridentata*, *Artemisia vulgaris* and *Artemisia abrotanum*, only *A. annua* has been shown to produce artemisinin (Duke *et al.*, 2005). Additionally, the species is widely studied for its numerous purposes including being used as artemisia tea, anti-cancer, mosquito repellent, a source of essential oils, crafting of aromatic wreaths and as a natural herbicide with its flowers having antiperiodic, antiseptic, digestive, antiprotozoal, antibacterial and supposedly anti-yeast properties (Efferth *et al.*, 2001; Singh and Lai, 2001; Li *et al.*, 2005; Sen *et al.*, 2007). *A. annua* has been undergoing genetic improvement to develop high yielding strains. Its hybrid plant named *A. annua* named or 'A3' is now widely available for cultivation in Central and East Africa (Yeung *et al.*, 2004). Latitudes closer to the equator such as the Western region of Kenya have ecological features that favor stable malaria parasite transmission and as well would benefit the A3 crop establishment. In Kenya, A3, was introduced in early 1990's and is cultivated in large acreage in parts of Central and Rift valley provinces. There is current effort to embrace its cultivation in the Western region (Western and Nyanza provinces) where malaria prevalence levels are above 40%. The plant is grown in small plots by community based organizations in Kajulu, Nyakach, Asembo in Kisumu county, Maseno, Rang'ala in Siaya county and Ingidi in Vihiga county. In the region, it is majorly used as artemisia tea and as mosquito repellent.

The viable levels of artemisinin in *A. annua* are usually above 0.6% although most collections of artemisia derive from natural stands have highly variable content, some as low of 0.01% while others have ranged between 0.3 to 1.5% dry weight (Mueller *et al.*, 2000; Delabays *et al.*, 2001; Abdin *et al.*, 2003; EABL, 2005). Factors that will determine these levels include variation in soil nutrient (Zinc (Z), Boron (B), Nitrate ion (NO<sub>3</sub><sup>-</sup>), Ammonium ion (NH<sub>4</sub><sup>+</sup>)), plant part

(leaves, flowers, stem and roots), climatic conditions (temperature, water and light), age of growth, species and method of cultivation (Dhingra *et al.*, 2000; Laughlin *et al.*, 2002; Liu *et al.*, 2003; Zhang *et al.*, 2004; Khudsar *et al.*, 2004; Kumar *et al.*, 2004; Covello, 2008). Zn is needed by plants to activate several important enzymes while its deficiency has several negative effects (Khudsar *et al.*, 2004). At extremely low levels of 0.05mg/L (50µg/g) in soil, zinc apparently increased the artemisinin yield while levels higher than this are considered toxic for *A. annua* (Yekuan *et al.*, 2010). The role of B in plant nutrition is still not very well known but some postulations have been made (Tanaka and Fujiwara 2007). Levels of 0.05 mg/L and 2.50 mg/L are considered very low and very high respectively and there is evidence of a linear relationship between B and artemisinin content (Zhang *et al.*, 2004; Yekuan *et al.*, 2010).  $\text{NH}_4^+$  is tolerated by plants in small amounts, and can be toxic at higher levels while increased  $\text{NO}_3^-$  is not toxic and has been associated with increased artemisinin production (Liu *et al.*, 2003). A ratio of higher  $\text{NO}_3^-$  :  $\text{NH}_4^+$  has been found to increase artemisinin content while increases in  $\text{NH}_4^+$  resulted in decreased artemisinin content (Wang and Tan, 2002; Liu *et al.*, 2003).

Artemisinin compounds have been predominately found in the upper parts (flowers and leaves) of the *A. annua* plant, with higher concentrations found just before or during full flowering (Laughlin, 1995; Delabays *et al.*, 2001). Glandular trichomes are more abundant in the flowers and there is strong evidence that artemisinin is produced in them (Mehrotra *et al.*, 1990; Duke *et al.* 1994). Duke and co-workers, (1994) showed neither artemisinin nor its derivatives were detected from a glandless plant and that artemisinin content was shown to be 4 to 11% times higher in the flowers as compared to leaves. With the assumption that flowers of A3 grown in Western region of Kenya will have viable levels of Artemisin, we report the levels and correlate them with levels of Zn, B,  $\text{NO}_3^-$  and  $\text{NH}_4^+$  soils growing them.

## MATERIALS AND METHODS

### Chemicals

Acetonitrile (ACN) and petroleum ether were of HPLC grade and were sourced from Sciencescope Ltd, Nairobi, Kenya. All the other reagents and solvents used including pure zinc metal granules (Zn), 99.8% Hydrochloric acid (HCl), Boric acid ( $\text{H}_3\text{BO}_3$ ), Ammonium chloride ( $\text{NH}_4\text{Cl}$ ), Hydrated Aluminum sulphate ( $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ ), Silver sulphate ( $\text{Ag}_2\text{SO}_4$ ), Sulphamic acid ( $\text{H}_2\text{NSO}_3$ ) and Sodium hydroxide pellets (NaOH) were of analar grade sourced from Merck. Artemisinin (98.9% pure) standard was sourced from Sigma-Aldrich Chemical Company, St. Louis, U.S.A. Buffer solution for the analysis of nitrate ions was prepared by dissolving  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Ag}_2\text{SO}_4$ ,  $\text{H}_3\text{BO}_4$  and  $\text{H}_2\text{NSO}_4$  in about 400ml distilled water, adjusting pH to 3.0 by slowly adding 0.1N NaOH and the solution made to 1 liter using distilled water.

### Soil sampling and analysis of nutrients

Sampling and analysis of soil was done according to the procedure described in Alloway, (2008). Soil was sampled before transplanting of seeds from the nurseries (described under section flower samples). About 200g of soil was randomly obtained from different spots within the plot using a 1" diameter stainless steel metallic hollow pipe at two depths; 10-15cm (top soil) and 30-45cm (in-depth). The soil samples were then transported to the laboratory in labeled bags and stored at low temperatures to minimize microbial activity. Before digestion, soil was dried at 105°C, stone particles and plant debris were removed and the soil pulverized to a fine powder (pulverizer- Siebtechnik Model TS 250 made in Hague, Switzerland). The pulverized fine powder was apportioned into four for analysis of Zn, B,  $\text{NH}_4^+$  and  $\text{NO}_3^-$ .

Analysis of Zn and B was done according to Alloway, (2008). Briefly, the pulverized soil sample (2.5g and 10 g for Zn and for B measurement respectively) was accurately weighed into a 250ml glass flask. 10ml distilled water was added and left to stand for about an hour. 25ml aqua regia (1:3  $\text{HNO}_3$  and HCl) was added and the mixture heated at 450°C for approximately 2-3 hours. A few drops of the aqua regia were added continuously into the flasks in order to avoid dryness. The contents were then filtered using a filter paper No. 541 into a 50 mL volumetric flask and the residue washed before topping up with warm distilled water. Calibration curves were obtained by calibration the instrument using five standard solutions. Measurement of Zn and B was done using computerized Varian Atomic Absorption Spectrometer (Model: AA-10). The operating parameters were set according to the specification given by the manufacturer including lamp current of 1.2 amperes, fuel system of  $\text{N}_2\text{O}$ -Acetylene and oxidant flow rate of 4.5 L/min. The equation of each generated calibration curve was used in calculating Zn and B in the soil sample.

Soil samples were analyzed for  $\text{NH}_4^+$  and  $\text{NO}_3^-$  according to Lachat instruments (1995). Briefly, the pulverized soil sample (1.0g and 0.5g for  $\text{NH}_4^+$  and  $\text{NO}_3^-$  analysis respectively) was accurately weighed into a 100ml glass beaker. 50ml of distilled water was added and thoroughly stirred using a magnetic stirrer for 2 minutes. To 25 ml of the solution was added 25 ml of buffer and the solution was stirred before taking millivolts readings on an Ion Selective Meter (ISE-Model 290A, made in U.S.A) that was connected to either  $\text{NH}_4^+$  or  $\text{NO}_3^-$  ISE.

### Leaf samples

*A. annua* anamed (A3) seeds were sourced from the International Center for Research in Agroforestry (ICRAF-Nairobi, Kenya) and grown in five nurseries (cultivars) one each at the study areas; Kajulu, Nyakach, Asembo, Maseno and

Ingidi in Western region, Kenya. Seeds were also broadcasted on soils with minimal tillage to serve as control. After germination and growth in a period of 3 months, the seedlings from the nurseries were transplanted into to 50 m<sup>2</sup> plots and allowed to grow for six months a period when flowering began. While no manure or fertilizer was used on either the cultivars or controls, the former were watered and weeded regularly during their growth. Approximately 250g of the leaves from each of the five plots were randomly picked at onset of flowering (6 months old). These were immediately transported to the laboratory in aerated bags, weighed and dried in an oven (40°C) for about 72 hours to achieve moisture content of less than 10%.

### Artemisinin extraction and HPLC analysis

The procedure of extraction was adapted from Aditi and Sarin (2010). Dry leave samples were ground to powder using a pestle and mortar and sieved through 0.5 mm pore size sieve. 2.0 g of the powder was soaked in 25 ml of petroleum ether for 48hrs to extract artemisinin. The extract was filtered, solvent evaporated by a rotatory evaporator and the residue re-dissolved in 25 ml acetonitrile for injection into an HPLC (Model Agilent 1100 Shimadzu LC-20AT). A calibration curve within the range of 500-2500 ppm was prepared. 20 µL sample extract was injected onto the column head (Hyper Clone BDS C<sub>18</sub> column; 5 µm, 250 mm x 4.6 mm) that was maintained at 30 °C for separation of artemisinin for a 12 minutes elution time. A mobile phase consisting of water: acetonitrile (25:75 v/v) was isocratically eluted at a flow rate of 1.0 mL/min and detection was achieved at 260 nm using a photodiode array detector. Artemisinin was identified by comparing the retention times with that of standard solutions while peak areas were used for quantification.

### Data analysis

Data was analyzed with SPSS 17.0 for windows. The mean and standard deviation of means were calculated and one-way analysis of variance (ANOVA) was used for statistical differences with Duncan's multiple range tests used to separate means (P < 0.05).

## RESULTS AND DISCUSSIONS

### Nutrient levels in soil growing cultivars of A3

The concentrations of Zn and B in soil at depths of 10-15cm and 40-50 cm from Kajulu, Maseno, Ingidi, Nyakach and Asembo are presented in table 1. Those of NH<sub>4</sub><sup>+</sup> and NO<sub>3</sub><sup>-</sup> are given in table 2.

**Table 1:** Levels of Zn and B (µg/g) at two depths of soils growing A3 cultivars in five regions of Western Kenya

| Area     | Zn Mean±SD (n=3)         |                         |          | Boron Mean±SD (n=3) |                         |          |
|----------|--------------------------|-------------------------|----------|---------------------|-------------------------|----------|
|          | 10-15cm depth            | 40-50cm depth           | p-values | 10-15cm depth       | 40-50cm depth           | p-values |
| Kajulu   | 49.13±0.42 <sup>a</sup>  | 77.07±1.15 <sup>b</sup> | 0.414    | 347.3±23.4          | 135.0±30.4 <sup>a</sup> | 0.201    |
| Maseno   | 108.80±0.69 <sup>c</sup> | 94.73±0.6 <sup>e</sup>  | <0.001   | ND                  | 187.3±41.0 <sup>c</sup> | -        |
| Ingidi   | 116.40±0.69 <sup>d</sup> | 79.53±1.01 <sup>c</sup> | <0.001   | ND                  | 192.7±24.4 <sup>d</sup> | -        |
| Nyakach  | 79.60±0.72 <sup>b</sup>  | 91.60±0.69 <sup>d</sup> | 0.641    | ND                  | 163.2±12.4 <sup>b</sup> | -        |
| Asembo   | 110.00±0.80 <sup>c</sup> | 72.47±0.42 <sup>a</sup> | <0.001   | ND                  | 196.5±72.8 <sup>e</sup> | -        |
| p-values | <0.001                   | <0.001                  |          |                     |                         |          |

Same small letters within the same column are not significantly different (p>0.05, SNK test).

**Table 2:** Levels of NH<sub>4</sub><sup>+</sup> and NO<sub>3</sub><sup>-</sup> (µg/ml) at two depths of soils growing A3 cultivars in five regions of Western Kenya

| Area     | NH <sub>4</sub> <sup>+</sup> ion Mean±SD (n=3) |                        |          | NO <sub>3</sub> <sup>-</sup> ion Mean±SD (n=3) |                        |          |
|----------|--|------------------------|----------|--|------------------------|----------|
|          | 10-15cm depth                                  | 40-50cm depth          | p-values | 10-15cm depth                                  | 40-50cm depth          | p-values |
| Kajulu   | 0.13±0.00 <sup>b</sup>                         | 0.09±0.01 <sup>c</sup> | <0.001   | 0.34±0.01 <sup>b</sup>                         | 0.34±0.09 <sup>a</sup> | 0.243    |
| Maseno   | 0.11±0.00 <sup>a</sup>                         | 0.07±0.00 <sup>b</sup> | 0.005    | 1.37±0.02 <sup>d</sup>                         | 0.28±0.01 <sup>a</sup> | <0.001   |
| Ingidi   | 0.18±0.01 <sup>d</sup>                         | 0.23±0.00 <sup>d</sup> | 0.876    | 0.42±0.02 <sup>c</sup>                         | 0.37±0.02 <sup>a</sup> | 0.665    |
| Nyakach  | 0.19±0.00 <sup>d</sup>                         | 0.01±0.00 <sup>a</sup> | <0.001   | 0.31±0.02 <sup>a</sup>                         | 0.36±0.02 <sup>a</sup> | 0.731    |
| Asembo   | 0.16±0.01 <sup>c</sup>                         | 0.10±0.00 <sup>c</sup> | <0.001   | 1.45±0.01 <sup>e</sup>                         | 1.15±0.02 <sup>b</sup> | 0.002    |
| p-values | <0.001   | <0.001                 |          | <0.001   | <0.001                 |          |

Same small letters within the same column are not significantly different (p>0.05, SNK test).

There was no specific trend in levels of Zn observed for the top (10-15cm depth) and in- depth (40-50cm depth) soils (table 1). However, the levels were all above 50 µg/g, the minimum tolerable levels of Zn in the soil for maximum artemisinin accumulation in *A. annua* (Zhang *et al.*, 2004; Yekuan *et al.*, 2010). As well, significant differences were generally noted between the regions as well as between depths (p<0.05). While the importance of Zn is known and

increased artemisinin yield have been reported for extremely low levels, the concentration of Zn reported in this study could pose potential toxicity for the plant (Hopkins and Hüner, 2004; Khudsar *et al.*, 2004; Zhang *et al.*, 2004; Yekuan *et al.*, 2010).

Boron in the topsoil (10-15 cm depth) was detected only at Kajulu while in the in-depth soils the range was 135-196 µg/g (table 1). However, in all the five regions of study B increased with depth and was found to be above 2.5 µg/g, the minimum for plant requirement. Although its role in plant nutrition is still not very well known evidence of a linear relationship between B and artemisinin content has been reported (Zhang *et al.*, 2004; Yekuan *et al.*, 2010). Contrary to the levels being very low in the top-soil, those in the in-depth soil are described as being very high. The explanation may not be deduced from this study but could be attributed to leaching (Khudsar *et al.*, 2004; Zhang *et al.*, 2004; Yekuan *et al.*, 2010; Aftab *et al.*, 2010).

The concentration of NH<sub>4</sub><sup>+</sup> ions in the top and in-depth soil was found to range between 0.11-0.19 µg/ml and 0.01-0.23 µg/ml respectively (table 2). Generally, the concentration of NH<sub>4</sub><sup>+</sup> ions in the top soil was higher than that in soils at in-depth. There were significance differences in the levels of NH<sub>4</sub><sup>+</sup> ions in the soil across the regions and also between depths for soils in Kajulu, Nyakach and Asembo (p<0.05). The levels found in both top-soil and in-depth are described as sufficient since NH<sub>4</sub><sup>+</sup> is tolerated by plants in small amounts, and can be toxic at higher levels (Liu *et al.*, 2003).

There was no specific pattern on the concentrations of NO<sub>3</sub><sup>-</sup> ions in the soils. A range of 0.31-1.45 µg/g and 0.28-1.15 µg/g was found for top and in-depth soils respectively. These were found to differ significant across the regions although between depths only soils from Maseno showed significant differences (p<0.05). NO<sub>3</sub><sup>-</sup> ions however are not toxic and they have been associated with increased artemisinin production (Liu *et al.*, 2003). The ratio of NO<sub>3</sub><sup>-</sup> : NH<sub>4</sub><sup>+</sup> was high and would therefore lead to an increase in artemisinin content (Liu *et al.*, 2003; Wang and Tan, 2002).

### Artemisinin in leaves of *A. annua* cultivars

The mean content of artemisinin in leaves of *A. annua* from Kajulu, Maseno, Ingidi, Nyakach and Asembo are given in table 3.

Table 3: Mean percent content (DM) of artemisinin in leaves of A3 cultivars in five regions of Western Kenya

| Region   | Cultivar<br>%DW (Mean±SD, n=3) | Wildings<br>%DW (Mean±SD, n=3) | p-values |
|----------|--------------------------------|--------------------------------|----------|
| Kajulu   | 0.27±0.01 <sup>b</sup>         | 0.25±0.00 <sup>b</sup>         | 0.116    |
| Maseno   | 0.04±0.00 <sup>a</sup>         | 0.25±0.00 <sup>b</sup>         | <0.001   |
| Ingidi   | 0.46±0.02 <sup>c</sup>         | 0.08±0.01 <sup>a</sup>         | <0.001   |
| Nyakach  | 0.88±0.02 <sup>d</sup>         | 0.90±0.03 <sup>c</sup>         | 0.370    |
| Asembo   | 0.04±0.00 <sup>a</sup>         | 0.12±0.02 <sup>d</sup>         | 0.003    |
| p-values | <0.001                         | <0.001                         |          |

Same small letters within the same column are not significantly different (p>0.05, SNK test).

Artemisinin in leaves of the A3 clone cultivars ranged between 0.04-0.88% DM. There were significant differences between the levels of artemisinin between the cultivars and the wildings at maseno and Ingidi (p<0.05). However, between the regions, the leaves differed significantly in their artemisinin levels (p<0.05). This can be attributed to differences in soil nutrient composition of Zn, B, NH<sub>4</sub><sup>+</sup> and NO<sub>3</sub><sup>-</sup> (Wang and Tan, 2002). Except in Nyakach, the leaves from the other four regions studied contained levels that were lower than the commercially viable levels of artemisinin, being above 0.6% DW (EABL, 2005; Abdin *et al.*, 2003). In our unpublished work, flowers had abundant artemisinin as would be expected since there is strong evidence that artemisinin is produced in the glandular trichomes which are found in flowers (Covello, 2008).

Artemisinin levels had negative correlation with the levels of nutrients in the soils (r>-0.800). While these findings agree with some previous studies, others have reported positive correlation of artemisinin with soil nutrients (Khudsar *et al.*, 2004; Zhang *et al.*, 2004; Yekuan *et al.* 2010; Aftab *et al.*, 2010). For NH<sub>4</sub><sup>+</sup> and NO<sub>3</sub><sup>-</sup>, the correlation was found to be positive with artemisinin levels (r>0.800) in the top-soil.

### CONCLUSIONS

The levels of artemisinin in leaves of *A. annua* grown in Western region of Kenya can be improved if nutrient levels are well managed. These findings showcase the need to expand cultivation of *A. annua* in Western Kenya and consequently production of artemisinin from flowers of *A. annua* in this region.

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# THE DIDACTIC ENGINEERING OF THE FOREIGN LANGUAGES FOR THE NON LINGUISTIC DISCIPLINES - NLD- AT THE UNIVERSITY.

CHIKHI Nadjet  
University of M'sila, Algeria

**Abstract:** In the era of spectacular development of the internationalization and the globalization, the mobility of individuals and the requirements of the employment's market have given rise to specific and pressing needs of formation in foreign languages. This need for training is widely felt at the university level: a meeting place for all linguistic disciplines and non linguistic disciplines. In such situation, a foreign language teaching, which is concretized into a functional design to develop a training system that would allow cross between different specific disciplines and teaching of foreign languages, is the best device which can answer the pressing needs of training with objectives modelled according to the diversity of the specific public who have precise needs, and also according to a pattern and a precise calendar of training. Furthermore, at the level of the NLD at the university, it is not question of having an absolute competence, a total control or a perfect literary culture of the foreign language but to have communicative skills to meet the needs of one's activity sector either academic professional or social. Such a conception of foreign languages teaching which means the conception of a training system which takes into account several factors such as: the demand / offer of the formation, the trainees / trainers (language needs, discourse analysis, teachers of foreign languages, designers of the Language curriculum for Special Purpose) and specifications. Therefore, a didactic engineering for teaching foreign languages is required in order to articulate all the parameters necessary for teaching foreign languages for special purposes. The present article attempts to highlight the synergy between all the elements which are implemented in a didactic engineering design to achieve a language teaching for special purpose.

**Keywords:** didactic engineering, language for Special purpose, language needs, discourse analysis, curriculum, NLD.

## Introduction:

Throughout the time and the multiple didactic and pedagogical works, the general orientation of the teaching / learning of the foreign languages have passed from teaching a foreign language as *the object of study* aiming to developing the general culture competencies as well as the literary competencies or skills to the teaching of the language as *a system of communication and an instrument of learning* aiming at developing the learner's communicative skills.

Indeed, in foreign languages, due to the sociolinguistic, didactic, pedagogical, political, economic reality, etc. which the field of education actually imposes, it is a question of having an absolute competence, a total control or a perfect literary culture of the foreign language but to have a variety of communicative competencies: just what it is necessary of the linguistic tool in order to meet the needs of its activity sector either it is academic (for the learners in a school or university system), professional (for the linguistic requirements of the activity sector) or social (for the insertion).

Besides, owing to the didactic orientations which recommend the communicative approach in teaching foreign languages, the general objectives of such a teaching are actually directed towards *the communicative* approach rather to the linguistic or *the literary approaches*. Moreover, "*nobody today aims at having a global capacity to communicate in foreign language or to master the language as a 'native person'*", (*a fantasy which was never true but still exists in the minds of many of teachers and authors of textbooks (manuals)*). " (DROUERE & PORCHER, on 2002, p. 7). The language doesn't become an end no more, but a means to operate in a specific activity sector.

Let us say that in the era of vertiginous development of the internationalization, the globalization of the rapid consumption, the mobility of the individuals and the requirements of the employment markets made special needs of

training appear in foreign languages. This teaching of foreign languages for specific public and precise objectives, according to fields of activity, can't be realized only within the framework of an engineering didactic which has as a final objective or purpose to elaborate a system of training which would allow the transversality between the different disciplines of speciality and teaching the foreign languages.

This prospect would really be the best device which can answer the urgent needs of training with objectives modeled according to the diversity of the specific public which has precise needs, and also according to a pattern and a precise calendar. Consequently, the engineering didactic of the foreign languages became the major component of a synergy between the demand of training and the offer of training too. This demand of training is widely felt at the university level: a meeting place of all the linguistic and non linguistic disciplines.

So providing the diversity of disciplines and the specificity of the needs training in the university environment, the elaboration of a Curriculum which takes into account all the parameters necessary in such a didactic engineering, becomes primordial.

The present article tries to clarify the synergy that exists between all the elements which are implemented in a didactic engineering in order to conceive a language teaching on specific objectives for the Non Linguistic Disciplines (DNL) at the university.

At this level, it would be interesting to bend over the ins and outs of such a device of a didactic engineering by considering, notions such as: the demand / offer of training, the trainees and trainers (language needs, discourse analysis, the teachers of foreign languages, the designers of curricula in languages on special objectives) and specifications; so as to put into account their degree of complexity and functional teaching of foreign languages, some of these notions overlap, are linked or articulate with the others.

### **The protagonists of training in language for special purpose**

Besides the political, institutional, economic implications even ideological which underlie any foreign languages teaching and which are felt much more in such a functional teaching of the foreign languages; we shall interfere only at the level of the methodological implications which govern the didactic engineering of the foreign languages.

The didactic device in language for special purpose corresponds globally to any device of teaching / learning. So, we can trace the situation of training in language for special purpose on a simple didactic situation which implies various agents whom we shall call in our article "protagonists" who are dependent some of the others on each others.

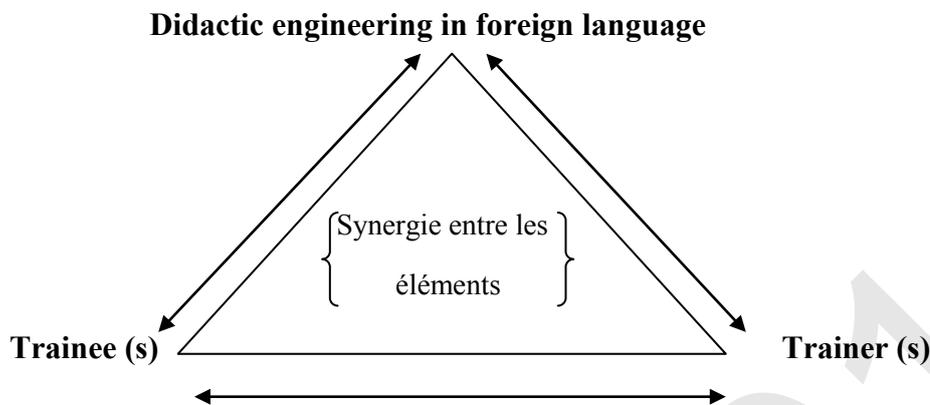
Any didactic situation puts in relation:

- **a learner (s):** we opt for the name " **the trainees**", given that the didactic device in language on specific objectives can come true in an institution or outside, with professionals or students, etc.

- **a teacher (s):** we opt in this article for the naming " **the trainers** ", due to the capacity of conception and adaptation of the syllabus which the teacher of the languages should have on specific objectives.

- **And knowledge:** we represent it under the title of "**didactic engineering in foreign language**". It is especially about syllabus or curricula conceived à la carte to answer precise demands according to specific public.

We present this triangular relation so:



*Plan of the didactic engineering of the languages for special purpose*

The didactic triangle above represents by no means the subdivision between the various protagonists of the training but reflects or shows much more the complex, complementary and synergic relation between these elements.

We suggest bending over these relations which govern any device of languages teaching on specific objectives to lighten the interdependence between the elementary components in a functional dimension of the foreign languages teaching in the Non Linguistic Disciplines.

To try to clarify the notion about the didactic engineering of the foreign languages for the NLD, it is advisable to approach, first of all, the imperatives of the design of curricula in languages for special purpose and what they imply, the parameters which determine the situation of the trainees in the second place, and lastly the trainers and their profile (s).

We shall expose at first the notion of language for special purpose; then, the device of languages teaching on specific objectives according to the various naming in the didactic field (the elaboration of syllabus, the engineering of the training, the curricula); we shall make, besides, a survey of the notions of "trainees" and of "trainer" in an optics of foreign languages teaching for the NLD.

### **The notion of language for special purpose:**

To approach the foreign languages teaching to specific public on Non Linguistic Disciplines, brings us to evoke many expressions met in the didactic field such as, among others: scientific language and technique, language for speciality, instrumental language or functional language, language for special purpose, language for specialized public, professional language, language for the Non Linguistic Disciplines (NLD) and at present language for University purpose.

Nevertheless, all these names reflect the orientation towards the functional character of the foreign languages teaching. This teaching is diversified due to the diversity and the multitude of the specific languages according to domains, due to the diversity of the concerned public and also due to the diversity of the used methods.

Denis LEHMAN asserts that these expressions differed according to their angles of perception of the foreign languages teaching: as they describe this domain by means of the public of learners or by that of the programs to be taught.

Besides, it is certain that all these expressions have the same principle which is: the consideration of the learner with all that he conveys; and all on the same end (purpose) converge which is: teach the foreign languages to specific public to provide them with a language which could be of use to them in their fields of activity or their activity sector.

To conclude, this foreign languages teaching enters within the framework of the didactic engineering of the foreign languages where all the process of teaching is conveys with reality.

In this optics, given that this conception has for objective a functional teaching of the foreign languages, it is thus advisable to hear (introduce) the term "function" in a double meaning. In the "utilitarian" meaning: this teaching has as a purpose of increasing the linguistic skills of the trainees so that they can assume the linguistic requirements of their fields of activity according to their speciality; then in the "mathematical" meaning: where the foreign languages teaching is dependent of specialized public, Of the demand for training, the trainers and the pattern of training.

### **Syllabus, Curriculum and Engineering of the training**

At the university, the difference between the mother tongue, that vehicular of the knowledge and that specific in the domain of study and activity generates a problematic situation which is felt at various levels:

- At the level of the student (learner) who sees itself put, by the requirements of his(her) university or long-term education by the professional requirements, in the necessity of learning a language of speciality which was never a part of his previous training or to learn in a Non Linguistic Disciplines in foreign language.
- At the level of the teachers of the NLD.
- And at the level of the methodological choices in a process of a foreign languages teaching of speciality to make acquire to the learners of the interdisciplinary skills which would allow them to answer the linguistic needs of their university training.

It is essential in that case, to think of successful didactic strategies which would allow a better acquisition of the linguistic requirement of the students, the requirements of the university education and the imperatives of the market of the employment.

Therefore, all the researches in didactics agree that the didactic engineering of the foreign languages should be based on an approach essentially on the analysis of needs and analysis of the university discourse. Several didacticiens bent over the elaboration of these achievements as they base themselves on the art to conceive such devices by speaking about engineering of the training (ROLLE-BOUMLIC, on 2006) either on bases in didactics of the foreign languages by speaking about elaboration of courses (MANGIANTE and PARPETTE, on 2004), or still on the program itself by speaking about Curriculum (LEHMAN, on 1993).

We suggest exposing two examples of conception of the trainings foreign language for the NLD:

### 1- **The approach of the engineering of the training (ROLLE-BOUMLIC, on 2006)**

This approach articulates in a system of training which should result in the conception of a program of teaching concerning every domain. This program consists in building a successful device which would accelerate the acquisition of the language by university students and the linguistic needs of speciality in which it is committed. This approach suggests being a bridge between the acquisition and linguistic needs or requirements of the university students. It can be realized in there mains stages:

A) - the first one is a stage of **Audit**. It consists in including the situation, in establishing the deficit of the skills and in determining the objectives of training. At this stage, it is a question, on one hand of studding the public-targets to define "*their acquired profile (s) of skill* "; and on the other hand of analyzing the linguistic requirements of the university education, to establish "*the required profile (s) of skill*". This allows to determine "*the need (s) of training*" which express the distance which exists between the acquired profile (s) of skills and the required profile (s) of skill. Indeed, the **Audit** is a type of investigation consisting in comparing, thanks to relevant indicators, a real situation with an unreal situation (**the reference table**) and in highlighting distances (**the deficit of the skills**). It has for objective to make an operating decision as for the priorities of the training (**the objectives of training**).

B-) The second is a stage of **pedagogical Engineering of the training**. It consists in building a successful device (training plan, educational objectives, modulate) and to implement training initiatives. At this stage are established, on the basis of the needs of training, "*the objectives of training (s)*" (which are only the deficits of the skills previously determined) which will be translated "*an specific pedagogical objectives*" relative to every sector and to every group of students.

C) - the third and last stage is the one of a modality of **triple Evaluation** (formative, summative and functional) which consists in following, in checking and in analyzing the educational action throughout the training and after the training. Indeed, given that this training is in a frame of the engineering which underlies an incidental adaptation of curricula, the evaluation should be true certainly realized at the level of the leanings (formative assessment during the training, summative at the end and functional after) but also at the level of Curricula (their relevance, their efficiency, their coherence, etc.)

### 2- **Elaboration of foreign language syllabus for special purpose** Chantal PARPETTE

The constitution of a language of speciality is a process articulated in 5 stages which leads to an application for training, generally institutional, from which is elaborated an analysis of needs. This analysis was made; the designer begins a collection of data from which he will build his linguistic training program. These authentic data must be then analyzed and treated to become supports of teaching which will give birth to the class activities.

In summary, all the steps in the conception of the programs of language for special purpose base themselves on the knowledge of the linguistic needs and the training of public-target as beginnings of any educational approach. The question which arises would be in what perception would it be necessary to take analyses of the linguistic needs and are they enough as the only criterion of elaboration of curricula?

### **The profile and the place of the trainer in foreign languages for the NLD**

One of the main actors of the training in language for special purpose is the teacher. Nevertheless, in this perspective, the role of the teacher is widely modified: of a teacher of language who acts didactically according to a program and curricula pre-established by the systems of teaching, he becomes a content creator by training in an unknown domain (NLD), according to objectives of training that he should determine on the basis of the linguistic needs that he should be able to analyze. This trainer should enjoy not only the capacity of conception of curricula in language for special purpose but also that of their adaptation according to the diversity of the public and the variety of needs within the same public.

*" The notion of adaptation is at the heart of the problem of French on specific objective. And this adaptation is two orders. It is at first structural, essential programs of FOS as far as these define themselves by the answer to a precise and short-term need, of linguistic training. It is on the other hand cyclical because of the diversity of the contexts of implementation, as long on the institutional plan, that geographical, human or material. And, however paradoxical it could appear, that's because the approach is very precise that the adaptation is permanent. "*

In this optics, would not it too much be asked to a teacher who was upstream formed to realize operational objectives of language skill prescribed beforehand by the educational institution?

For F MOURLHON DALLIES, " the skill which the teacher of foreign language has to develop is above all of methodological and didactic order, because it is a question of producing exercises and activities varied, articulated in sharp training programs, to prepare for the practice - in foreign language of the considered occupations. ". However, such a skill should be acquired by the teacher of language within a special training and scheduled upstream without which no teacher of French language could claim to be able to adapt his knowledge in language and his educational skills to a non linguistic discipline.

## Conclusion

By way of conclusion, due to the various elements which interfere in the languages teaching on specific objectives, due to the complexity of the relations which they maintain and also due to the reality of the teaching which is imperative, we present three axes of reflection as for the opérationalisation of the didactic engineering of the foreign languages for the NLD. These reflections articulate around challenges to operate between the components of such a design of the training in foreign languages.

- Training and institution: problem of the application for training and problem of the mobilized means.
- At the level of the trainees :
  - The relevance of the choice of the bars of analysis and evaluation.
  - Needs in usual language and needs in special language.
  - The cultural component.
- At the level of the trainers:
  - The passage of a teacher of foreign language to a designer of curriculum.

- The intervention of the specialists of the disciplines in the conception of curricula.
  - The collaboration with these specialists.
- The notion of time and responsibilities: the training in Language for Special Purpose suggests being fast and successful.

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# THE EFFECT OF ANTIOXIDANT PROTEINS DUE TO SALT STRESS AND WOUNDING IN *VICIA FABA* AGAINST BEAN YELLOW MOSAIC VIRUS

Zenab Aly Torky, PhD

Assistant Professor, Department of Microbiology,  
Faculty of Science, Ain Shams University, Cairo, Egypt

[ZenabAly72@Yahoo.com](mailto:ZenabAly72@Yahoo.com)

**Abstract:** Environmental stresses like salinity and wounding are very harmful to plants and cause major economical losses especially if the plant is a major crop like bean. Exposure of plants to those types of stresses cause the production of reactive oxygen species which in turn damage the plant cellular system. To reverse this lethal effect, plants have developed a counter attack mechanism to adjust the oxygen level in the cells through anti-oxidant enzymes, a process known as oxygen scavenging. In this research, experiments have been conducted to investigate the relation between the type and magnitude of the stress, together with the timeline of bean yellow mosaic virus (BYMV) inoculation and the level of anti-oxidant enzymes if any, and the resistance to the virus infection. Salinity and mechanical wounding were used on the bean plants as types of the stress, three types of salinity concentrations and two types of mechanical wounding were used, and then the leaves of the stressed plants were inoculated with the virus immediately, after 6 hours, 1 and 3 days to study the systemic effect of the stress on signaling any antioxidant enzymes on those time intervals, and in one and two weeks as well to determine the state of the enzyme in the plant. The enzymes assayed were catalase (CAT), glutathione reductase (GR), superoxide dismutase (SOD), and guaiacol-specific peroxidase (POX). Results revealed that there is a correlation between the stress and the level of the enzymes in the plant. These enzymes seem to trigger the induced resistance in the bean plants to the BYMV.

**Keywords:** Abiotic stress, antioxidant, ROS, oxygen scavenging, antiviral

## Introduction

Due to its low cost, and being a very rich source of protein, *V.faba* or broad beans is a very important crop for humans and animals as well. It was also reported that *V.faba* has a big role in biological fixation of aerial nitrogen (Jelenic et al, 2000).

BYMV, on the other hand, is a wide host range virus that infects *V.faba* systemically, and although the virus does not really kill the plant it can spread very fast in the crop leading to a great economical loss (Checng et al, 2002).

Stresses are the negative impacts of pathogens, environment, and other species on plants and they represent major restrictions in crop agriculture. Flowers and Yeo stated that 50% of the crop land in the world is salt stressed (Flowers and Yeo, 1995). A stress can be biotic where fungi, bacteria, virus or an insect can harm a plant in some way. It can also be abiotic, where the harm can be caused by unavoidable factors like salinity, heat, mechanical wounding, intense sunlight, heavy rain, drought, and wind. Abiotic stresses can be even more harmful when combined together (Mittler, 2006).

Environmental stresses can however, induce plant resistance against pathogens (Babosha, 2008). Barley has been reported to have an induced resistance against pathogens when stressed abiotically (Wiese et al., 2004). It had been reported as well that heat shock could help induce cross adaptation to many environmental challenges in maize (Ming et al., 2004).

The Prime\_A\_Plant Group et al., studied the state of plant priming, which is a state induced in the plant when it gets attacked by insects, pathogens or when it gets subjected to abiotic stress. The group reported that this primed state of the plant activates the defense responses of the plant more quickly and strongly than the usual (Prime-A-Plant Group et al., 2006).

To better understand how stress can induce resistance in the plant against pathogens attacks, the metabolism inside the stressed plant should be understood. Consider salinity as an example of a stress, as the salt increases in the soil the level of water decreases and consequently the ion uptake increases and reactive oxygen species increase. This abnormal generation of reactive oxygen species is the main reason of oxidative damage to the lipids, proteins and nucleic acids of the plant cells (Noctor and Foyer, 1998, and Mittler, 2002). There are however, a series of enzymatic systems that developed in plants to revert the effect of the reactive oxygen species and conduct an oxygen scavenging process (Sairam and Tyagi, 2004). On the other hand, when a localized injury happens to a plant leaf by a herbivore, an insect or a mechanical wounding, the injury activates local and systemic responses include metabolic changes and a disorder in the damaged tissues cell structure associated with the drastic loss of water, and consequently increasing the level of the ROS in the plant, which activates the defense mechanisms systemically in the whole plant via complex wound signals (Pearce et al., 1991).

The way this oxygen scavenging works is like this: the plant gets exposed to a stress, at some point stress result in an increased level of ROS. The successive reduction of molecular oxygen to H<sub>2</sub>O yields the intermediate

radicals  $O_2^{\cdot-}$ ,  $HO^{\cdot}$  and  $H_2O_2$  which are toxic. Now the elevation in the level of ROS triggers the production of antioxidant enzymes that naturalize the reactive bad radicals to produce more stable harmless compounds. This process is using multiple enzymes including GR, CAT, POX, and SOD.

Now, the question is, “can those detoxification enzymes used in the process of oxygen scavenging, be the reason of enhancing the plant induced resistance against pathogens?”. It was reported that doubling the glutathione in transgenic tobacco plants caused the seedlings to grow faster than the ordinary plants (Roxas et al., 1995), and that mechanical wounding of sunflower plants triggered the accumulation of the S-nitrosothiols which constitutes a signal of the detoxification process in the plant (Mounira et al., 2011). SOD was also names as the first line of antioxidant defense because it can remove the superoxide anion produced during the bio-oxidation process (Bowler et al., 1992).

In this paper, the *vicia faba* plants will be subjected to either salinity or mechanical wounding stress and then the stressed plant will be examined using the bioassay against the BYMV. For those plants showing resistance against the virus further experiments will take place to determine the level of detoxification enzymes developed in those plants and compare it with the corresponding levels in non stressed plants to determine the protective role of antioxidants expressed due to stress and the acquired resistance of the plant against the BYMV.

## Materials and Methods

### Plant Material

Seeds of *V.faba* (L) were surface disinfected with solution of mercuric chloride (0.1%) for 30 sec, and were washed immediately and germinated in pots containing vermiculite. Plants grown for 30 days under constant environmental conditions (23°C day : 18°C night) and were watered twice a week.

### Virus inoculum

BYMV inoculum was obtained from infected *Vicia faba* leaves ground using a pestle and mortar with a little acid washed sand and distilled water (1:2 w/v). The bulk of the leaf debris and sand was removed by squeezing the pulp through three layers of muslin. The extract was centrifuged at 4,000 xg for 15 min, and the supernatant decanted and kept at room temperature over night to precipitate any proteinaceous virus inhibitor presented in the leaf sap. The supernatant was clarified by further centrifugation at 3,000 xg for 15 min. For each one of the abiotic stress treatments an exact replica of the plant was prepared for the viral bioassay after the treatment.

### Abiotic stress

Different treatments according to the type of abiotic stress were applied on the bean plants. After each treatment and according to the corresponding time course the control leaves as well as the treated leaves were inoculated with BYMV according to the method below.

### Salt stress

Bean plants were subjected to salinity stress by watering the base by 100, 200, and 300 mM NaCl.

### Mechanical wounding

Leaves were wounded using a plastic brush having two rows. Some leaves were punctured with around 200 punctures and some were punctured with around 600 punctures.

### Plant viral bioassay

Designated primary leaves of fourteen days old bean plants were inoculated with BYMV. Inoculation was done under green house conditions at  $25 \pm 5$  °C, by dusting virus inoculum with Carborandum (600 mesh). Ten replicates were made for each virus inoculation.

The antiviral bioassay was done on the test plants with same height, and age. For each treatment, ten replicates of equal size were used. For controls, test plant leaves were treated directly with the virus inoculum without prior treatment of salinity or mechanical wounding of the adjacent leaves. After 0, 6 hours, 1 and 3 days of the stress, the designated leaves were sprinkled very lightly with 600mesh carborandum powder and inoculated gently and uniformly with virus inoculum. After inoculation, leaves were washed with distilled water. Plants were observed for the development of mosaic symptoms after 15 days. The inhibitory activity of the BYMV symptoms on bean plants due to stress was calculated according to the ratio between obviously infected plants (showing systemic symptoms) to the total inoculated plants.

### SDS-polyacrylamide gel electrophoresis

Discontinuous SDS-PAGE was carried out in 12% separating gel with a 5% stacking gel according to Laemmli (1970). The proteins were visualized by staining with 0.1% Coomassie brilliant blue R-250.

## Chemicals

All chemicals used in the assay of enzymes were purchased from Sigma Aldrich.

## Extraction of enzymes and antioxidants

Bean leaves were homogenized with 100 mM sodium phosphate buffer (pH 7.5) containing 1 mM EDTA, and 5 mM -mercaptoethanol. The homogenate was filtered through four layers of cheese cloth, centrifuged at 45,000Xg for 20 min. The supernatant was used as source of enzymes, antioxidants, and other components. All the steps in the preparation of the enzyme extract were carried out between 0 to 4°C.

## Assay of enzymes

CAT activity was determined by measuring the rate of disappearance of H<sub>2</sub>O<sub>2</sub> following the procedure of Dhindsa et al, (1981). 0.5g of leaf sample was homogenized in 5mL of 50mM potassium phosphate buffer pH=7 and 1% PVP. Homogenized samples were centrifuged at 4°C for 10mins at 15000g. An aliquot of 1mL of the supernatant of the enzyme extract was added to the reaction mixture containing 1 mL of 1.5 M H<sub>2</sub>O<sub>2</sub> and 3mL of 50 mM potassium phosphate buffer pH=7. Decrease in H<sub>2</sub>O<sub>2</sub> is followed as decline 240 nm during 30 sec.

The activity of GR, on the other hand was assayed in 2 mL of 100 mM TRIS-HCl buffer (pH=7.2) containing 0.2 mM NADPH, 5mM glutathione disulphide (GSSG) and 100 µL of plant extract (Anderson, 1996). The change in absorbance at 340 nm was recorded at 25°C in a spectrophotometer. Enzyme activity was based on the oxidation rate of NADPH using an extinction coefficient of 6.2 mM<sup>-1</sup>cm<sup>-1</sup>.

POX activity was measured by monitoring the formation of tetra guaiacol at 470 nm, using H<sub>2</sub>O<sub>2</sub> as substrate (Chance and Machly, 1955). One unit of peroxidase is defined as the amount of enzyme that caused the formation of 1 mM of tetra-guaiacol per minute.

Finally, SOD was extracted in 50 mM potassium phosphate buffer (pH 7.8), 0.1 mM EDTA, 0.1% Triton X-100 and 1% (w/v) soluble polyvinylpyrrolidone (PVP-10), and its activity was determined by the ferric cytochrome c method.

## Statistical analysis

All data in the tables below are the means of at least ten values. Minitab statistics software was used to compare the mean values together. Analysis of variance (ANOVA) was used and the mean values were compared using lowest standard deviation test with P<0.05 for significant difference.

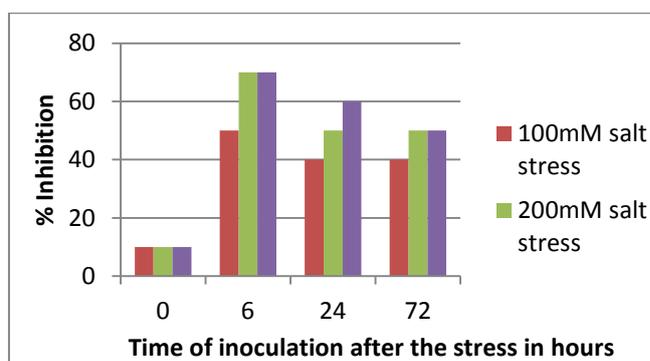
## Results and Discussion

### Induction of resistance as a result of salt stress

The roots of *Vicia faba* plants of about 14 days of age were watered with 100, 200, and 300 mM NaCl and the primary leaves of each of the stressed plants were inoculated with BYMV after 0, 6, 24, and 72 hours of the watering. Results in table 1 and figure 1 below, show that exposing the roots of the Bean plants to the different salt concentrations did not affect the response of the plant to the virus inoculation or induce any kind of resistance when it is conducted immediately after salinity stress. After six hours though, the plant started to show up a peak of resistance to the virus for all concentrations. This resistance increased with the increase of concentration. This induced resistance decreased from six hours to a day and sort of stabilized afterwards till three days. These results come in accordance with those reported by Lu et al., (2003), stating that salinity treatment increased the resistance of *Suaeda salsa* against heat stress, and that this resistance increases with the salinity concentration up to 400mM NaCl.

**Table 1:** Percent inhibition of salt stressed *Vicia faba* plants to BYMV varying by time of inoculation after the salinity stress, and concentration of the salt stress

| Time of inoculation after the stress in hours | 0    | 6      | 24     | 72     |
|---|------|--------|--------|--------|
| % Inhibition at 100mM salt stress             | 10±0 | 60±1.1 | 50±2   | 50±0.1 |
| % Inhibition at 200mM salt stress             | 10±0 | 80±0.7 | 60±0.7 | 60±1.3 |
| % Inhibition at 300mM salt stress             | 10±0 | 80±0.9 | 70±0.8 | 60±0.9 |



**Figure 1:** Percent inhibition of salt stressed *Vicia faba* plants to BYMV varying by concentration of the salt stress and timeline of virus inoculation after the stress.

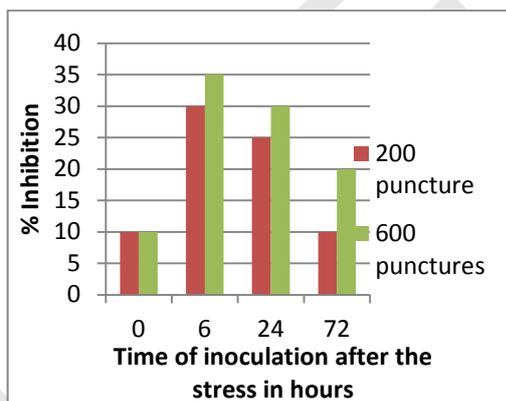
### Induction of resistance as a result of leaves mechanical wounding

The designated leaves of bean plants of about 14 days of age were wounded using a plastic brush having two rows. Leaves were punctured with 200, and 600 punctures. After 0, 6, 24, and 72 hours of leaves damage the adjacent leaves were inoculated with BYMV. Results in table 2 and figure 2 below, show that damaging the leaves and inoculating the adjacent ones immediately did not induce any resistance in the plant at all. Some resistance though, started to show up systemically, after 6 hours of leaves damage. This induced resistance persisted after one day of inoculation and started to decay on three days. Those results suggest that, damaging the leaves of the *Vicia faba* plants did not induce the resistance until after 6 hours and showing a peak of resistance induction between 6 and 24 hours.

These results agree with those of Francia et al., (2007) who reported that wounding can induce resistance to pathogens with different lifestyles in tomato. Also, Li et al., (2009) discovered a novel Wall-associated protein kinas (WAK) gene induced in rice after mechanical wounding; this gene was proven to play an important role in plant defense. It was also reported by Ito et al., (2002), that cell death and wounding in tobacco plant induced a receptor-like protein kinase gene, which agrees with the results shown here.

**Table 2:** Percent inhibition of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants to BYMV varying by time of inoculation after the damage, and the magnitude of the damage

| Time of inoculation after the stress in hours | 0      | 6        | 24       | 72       |
|---|--------|----------|----------|----------|
| % Inhibition at 200 punctures                 | 10 ± 0 | 30 ± 0.3 | 25 ± 1.1 | 10 ± 0.6 |
| % Inhibition at 600 punctures                 | 10 ± 0 | 35 ± 0.6 | 30 ± 0.3 | 20 ± 1.5 |

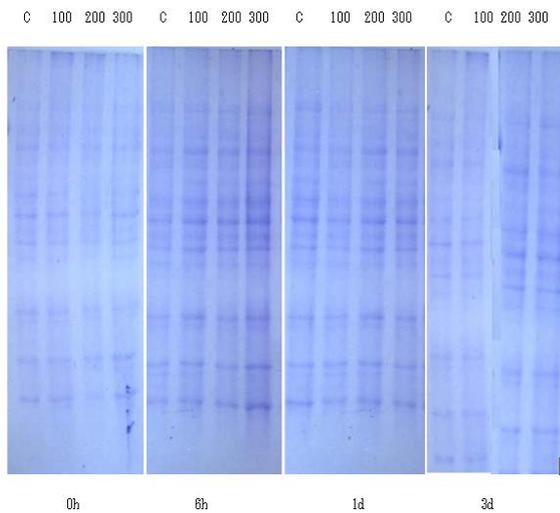


**Figure 2:** Percent inhibition of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants to BYMV varying by hours of inoculation after the damage, and the magnitude of the damage

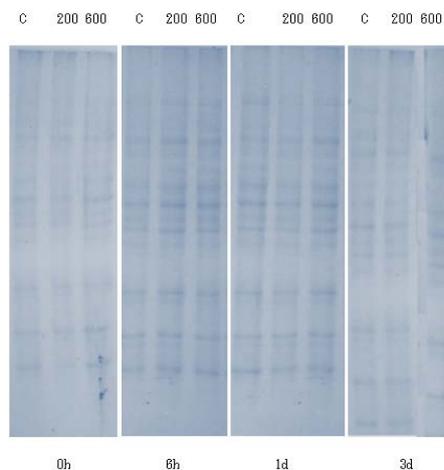
### Effect of stress on the total protein in the *V.faba* plants

In order to gain more understanding on what happened inside the *V.faba* plants to induce the resistance to the BYMV as noticed above, SDS-PAGE was carried over to get an insight on the proteins inside the plant and to see if there undergo any change with the different timeline and magnitude of the stress.

Results in figure 3, and figure 4 below and based on the densitometric scanning of protein patterns for the different stress magnitude and timeline (data now shown), show that there was some variation in the number of separated bands and the concentration of protein in each particular band. This variation depends on the type, magnitude of the stress and the timeline.



**Figure 3:** The SDS-PAGE of salt stressed *V.faba* plants varying by concentration of salt and time after the stress



**Figure 4:** The SDS-PAGE of wounding stressed *V.faba* plants varying by magnitude of the wounding and time after the stress

#### Assay of antioxidant enzymes

GR, CAT, POX, and SOD were assayed in the leaves of the stressed, non-infected bean plants, at 0h, 6h, 1d, 3d, 1w, and 2w, where h stands for hour, d stands for day, and w stands for week. The reason the assay of the enzymes was conducted on non-infected plants is that the virus itself is a biotic stress to the plant and might as well increase the level of antioxidant enzymes and in this case the assay conducted will not be objective and cannot judge for sure if the environmental stresses used generated any enzymes or not. For every assay in the stressed plant another assay has been done for the same enzyme in the non-stressed plant having exactly the same conditions to serve as a control. Results are shown in tables 3 to 10 and figures 5 to 12 below. Results in tables and figures 5 to 8 show that there is almost no change in the enzymes level when measured at the time of the stress, and that there is a very noticeable elevation in the level of the four enzymes for all concentrations, comparing to the control started after six hours of the salt stress, that is in case of 100mM salt stress, 1800 for GR, 1100 for CAT, 1700 for POX, and 530 for SOD (all in IU/g tissue). This elevation was stable till after one day of stress, showing 1650 for GR, 820 for CAT, 1550 for POX, and 500 for SOD, and started to decay suddenly starting at the third day of the stress in case of GR showing 850, and POX showing 800. In case of CAT, and SOD, on the other hand, enzymes levels were 700 for CAT, and 320 for SOD, and there was a steady decay till the second week after the salt stress. Results for the 200mM, and 300mM, were similar to that of 100mM with the exception of the enzyme levels were higher in higher stress concentrations. Comparing with the result of the viral bioassay of the salt stressed plants in table 1, it can be concluded that the enzymes level elevation in the salt stressed plants implied the induced resistance inside the plant till the first day after the stress. At the third day however, the levels of the enzymes showed dramatic decay and this decay was not accompanied with a similar decay in the resistance induced in the plant against the BYMV, which implies that maybe those enzymes elevation in the plant triggered the systemic acquired resistance (SAR) of the plant against the virus and then enzymes started to decay to the normal level, but the resistance persisted in the plant. Those results come in accordance with those reported by Lu et al., (2003)

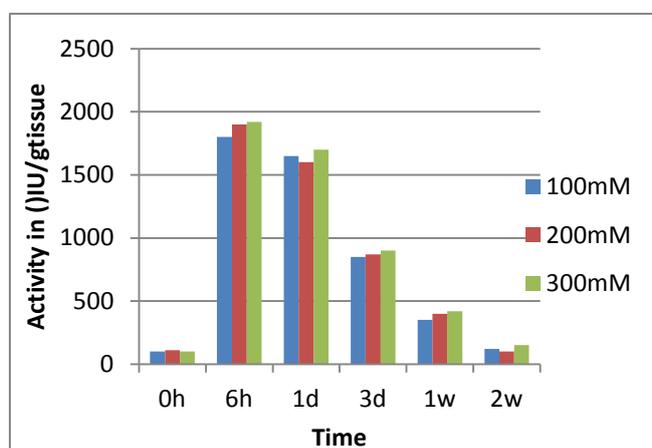
For mechanical wounding on the other hand, for 200 punctures stress, GR gave a measurement of 900 IU/g tissue after six hours of wounding, while CAT gave 930, 900 for POX, and finally 500 for SOD, showing an elevation in the level of the all enzymes but much less than their corresponding value in the salt stress. These values persisted till

the first day after the stress showing 950 for GR, 750 for CAT, 950 for POX and finally 410 for SOD. Those values started to drop after he first day dramatically to almost back to normal level after two weeks of stress.

Results showed that the elevation of the enzymes in the mechanical wounding stress were much smaller than those in the case of salt stressed plants which can be perfectly correlated to the results of the virus resistance which gave better inhibition of the virus in case of salt stress than in the case of mechanical wounding. Results also showed that as the magnitude of the stress increases the enzymes levels increase and the SAR increases. Results agree with those reported by Prime-A-Plant\_Group et al., (2006), and Francia et al., (2007). So, it can be concluded from these results that when the *V.faba* plants suffer salt and wounding stress and consequently suffer from an elevation in the level of ROS, the level of antioxidant enzymes increase. This increase triggers the systemic acquired resistance in the plant to fight pathogenic attacks like BYMV.

**Table 3:** GR enzymatic activity of the leaves of salt stressed *Vicia faba* plants, varying by time after the stress, and the concentrations of the stress

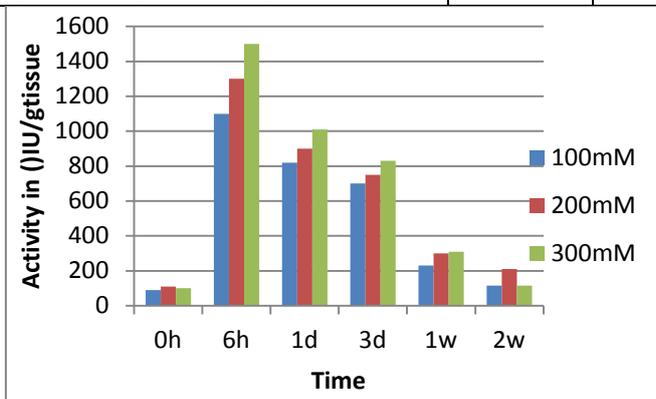
| Time   | 0h      | 6h       | 1d       | 3d      | 1w      | 2w      |
|--|---------|----------|----------|---------|---------|---------|
| Enzyme activity in 100mM salt stressed plant | 100±0.3 | 1800±2.0 | 1650±0.4 | 850±1.5 | 350±0.3 | 120±0.5 |
| Enzyme activity in 200mM salt stressed plant | 110±0.3 | 1900±1.4 | 1600±0.6 | 870±1.1 | 400±0.2 | 100±2   |
| Enzyme activity in 300mM salt stressed plant | 100±0.2 | 1920±0.7 | 1700±1.5 | 900±1.2 | 420±0.2 | 150±0.5 |
| Enzyme activity in control plant             | 90±0    | 90±0     | 90±0     | 90±0    | 90±0    | 90±0    |



**Figure 5:** GR enzymatic activity of the leaves of salt stressed *Vicia faba* plants, varying by time after the stress, and the concentrations of the stress

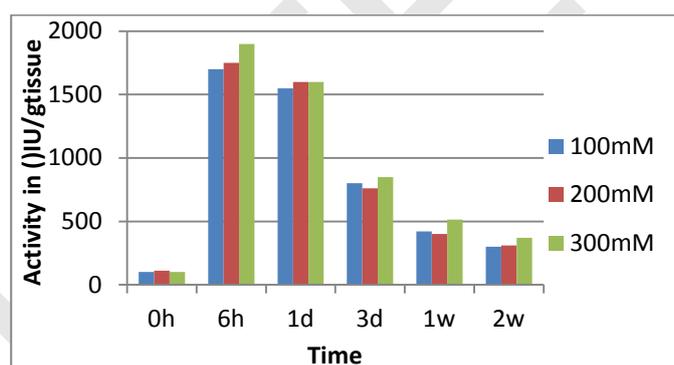
**Table 4:** CAT enzymatic activity of the leaves of salt stressed *Vicia faba* plants, varying by time after the stress, and the concentrations of the salt stress

| Time   | 0h      | 6h       | 1d       | 3d      | 1w      | 2w      |
|--|---------|----------|----------|---------|---------|---------|
| Enzyme activity in 100mM salt stressed plant | 90±0.1  | 1100±1.3 | 820±0.6  | 700±0.4 | 230±0.7 | 115±0.1 |
| Enzyme activity in 200mM salt stressed plant | 110±1.1 | 1300±0.9 | 900±0.7  | 750±0.6 | 300±1.5 | 210±0.3 |
| Enzyme activity in 300mM salt stressed plant | 100±0.3 | 1500±0.4 | 1010±0.3 | 830±0.4 | 310±0.3 | 115±0.2 |
| Enzyme activity in control plant             | 80±0    | 80±0     | 80±0     | 80±0    | 80±0    | 80±0    |


**Figure 6:** CAT enzymatic activity of the leaves of salt stressed *Vicia faba* plants, varying by time after the stress, and the concentrations of the salt stress

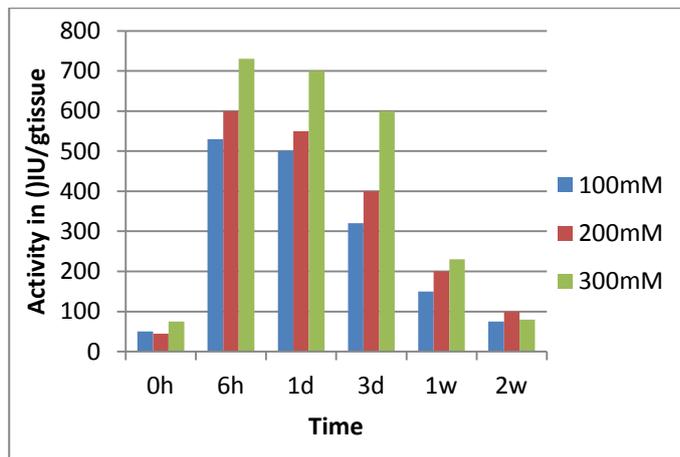
**Table 5:** POX enzymatic activity of the leaves of salt stressed *Vicia faba* plants, varying by time after the stress, and the concentrations of the stress

| Time   | 0h      | 6h       | 1d       | 3d      | 1w      | 2w      |
|--|---------|----------|----------|---------|---------|---------|
| Enzyme activity in 100mM salt stressed plant | 100±0.1 | 1700±1.2 | 1550±0.2 | 800±0.2 | 420±0.1 | 300±0.1 |
| Enzyme activity in 200mM salt stressed plant | 110±0.5 | 1750±0.3 | 1600±0.5 | 760±0.4 | 400±0.3 | 310±0.3 |
| Enzyme activity in 300mM salt stressed plant | 100±0.3 | 1900±0.3 | 1600±0.3 | 850±0.3 | 515±0.4 | 370±1.2 |
| Enzyme activity in control plant             | 95±0    | 95±0     | 95±0     | 95±0    | 95±0    | 95±0    |


**Figure 7:** POX enzymatic activity of the leaves of salt stressed *Vicia faba* plants, varying by time after the stress, and the concentrations of the stress

**Table 6:** SOD enzymatic activity of the leaves of salt stressed *Vicia faba* plants, varying by time after the stress, and the concentrations of the salt stress

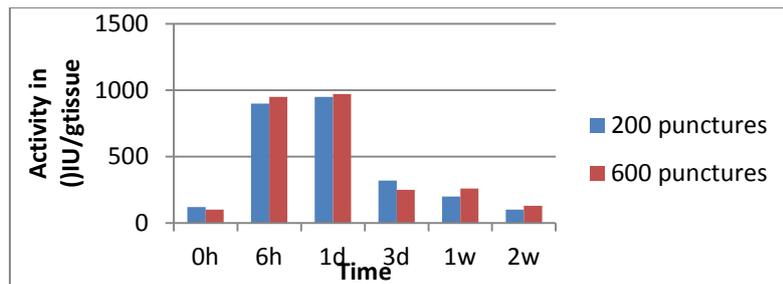
| Time   | 0h     | 6h      | 1d      | 3d      | 1w      | 2w      |
|--|--------|---------|---------|---------|---------|---------|
| Enzyme activity in 100mM salt stressed plant | 50±0.1 | 530±0.1 | 500±1.2 | 320±0.1 | 150±0.1 | 75±0.1  |
| Enzyme activity in 200mM salt stressed plant | 45±0.4 | 600±0.2 | 550±0.2 | 400±1.9 | 200±0.2 | 100±0.3 |
| Enzyme activity in 300mM salt stressed plant | 75±1.2 | 730±0.1 | 700±0.4 | 600±0.3 | 230±0.4 | 80±0.1  |
| Enzyme activity in control plant             | 30±0   | 30±0    | 30±0    | 30±0    | 30±0    | 30±0    |



**Figure 8:** SOD enzymatic activity of the leaves of salt stressed *Vicia faba* plants, varying by time after the stress, and the concentrations of the salt stress

**Table 7:** GR enzymatic activity of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants, varying by time after the stress, and the magnitude of mechanical wounding

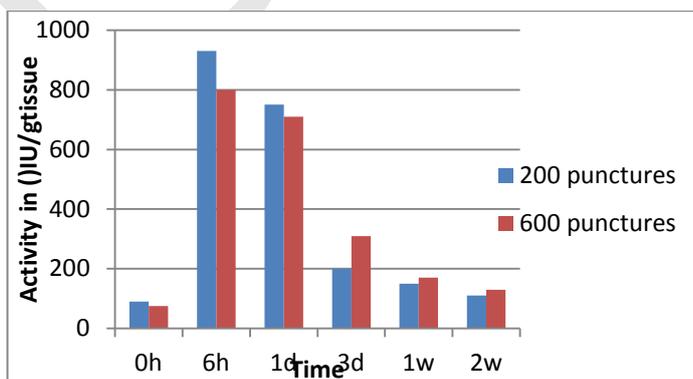
| Time  | 0h      | 6h      | 1d      | 3d      | 1w      | 2w      |
|---|---------|---------|---------|---------|---------|---------|
| Enzyme activity in 200 punctured stressed plant | 120±0.1 | 900±0.2 | 950±0.3 | 320±0.2 | 200±0.1 | 100±0.2 |
| Enzyme activity in 600 punctured stressed plant | 100±0.2 | 950±0.3 | 970±1.2 | 250±0.3 | 260±0.6 | 130±0.4 |
| Enzyme activity in control plant                | 90±0    | 90±0    | 90±0    | 90±0    | 90±0    | 90±0    |



**Figure 9:** GR enzymatic activity of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants, varying by time after the stress, and the magnitude of mechanical wounding

**Table 8:** CAT enzymatic activity of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants, varying by time after the stress, and the magnitude of mechanical wounding

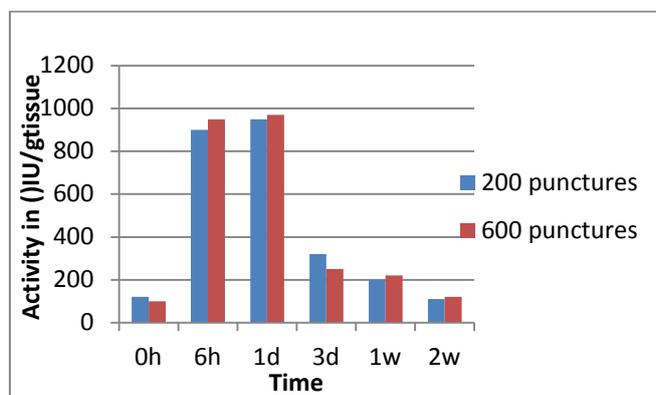
| Time  | 0h     | 6h      | 1d      | 3d      | 1w      | 2w      |
|---|--------|---------|---------|---------|---------|---------|
| Enzyme activity in 200 punctured stressed plant | 90±0.1 | 930±0.1 | 750±0.3 | 200±0.7 | 150±0.7 | 110±0.3 |
| Enzyme activity in 600 punctured stressed plant | 75±1.2 | 800±0.2 | 710±0.5 | 310±0.3 | 170±0.5 | 130±1.2 |
| Enzyme activity in control plant                | 80±0   | 80±0    | 80±0    | 80±0    | 80±0    | 80±0    |



**Figure 10:** CAT enzymatic activity of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants, varying by time after the stress, and the magnitude of mechanical wounding

**Table 9:** POX enzymatic activity of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants, varying by time after the stress, and the magnitude of mechanical wounding

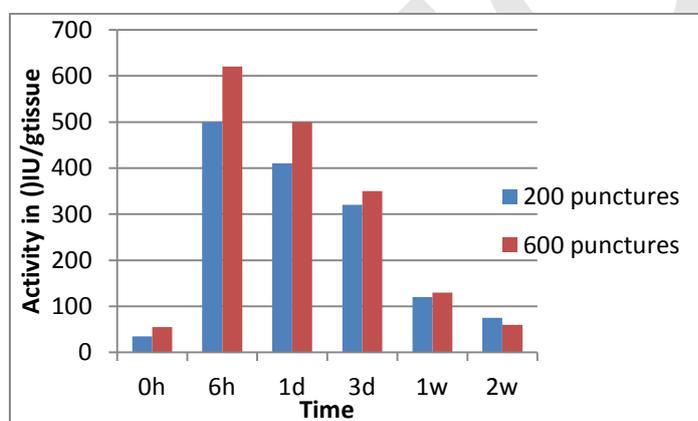
| Time  | 0h      | 6h      | 1d      | 3d      | 1w      | 2w      |
|---|---------|---------|---------|---------|---------|---------|
| Enzyme activity in 200 punctured stressed plant | 120±0.1 | 900±0.3 | 950±0.6 | 320±0.3 | 200±0.3 | 110±0.3 |
| Enzyme activity in 600 punctured stressed plant | 100±0.3 | 950±0.2 | 970±0.5 | 250±0.7 | 220±1.1 | 120±0.2 |
| Enzyme activity in control plant                | 95±0    | 95±0    | 95±0    | 95±0    | 95±0    | 95±0    |



**Figure 11:** POX enzymatic activity of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants, varying by time after the stress, and the magnitude of mechanical wounding

**Table 10:** SOD enzymatic activity of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants, varying by time after the stress, and the magnitude of mechanical wounding

| Time  | 0h     | 6h      | 1d      | 3d      | 1w      | 2w     |
|---|--------|---------|---------|---------|---------|--------|
| Enzyme activity in 200 punctured stressed plant | 35±0.1 | 500±0.4 | 410±0.2 | 320±0.3 | 120±0.5 | 75±0.6 |
| Enzyme activity in 600 punctured stressed plant | 55±0.2 | 620±0.3 | 500±1.5 | 350±0.9 | 130±0.3 | 60±0.3 |
| Enzyme activity in control plant                | 30±0   | 30±0    | 30±0    | 30±0    | 30±0    | 30±0   |



**Figure 12:** SOD enzymatic activity of the leaves adjacent to mechanically wounded leaves of *Vicia faba* plants, varying by time after the stress, and the magnitude of mechanical wounding

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# THE EFFECTIVENESS OF DISTANCE LEARNING AS PROMOTIVE IN ENGLISH TEACHING

<sup>1</sup>Ümit Ferit ALDIM

<sup>2</sup>Sebahattin ARIBAŞ

School of Foreign Languages

Firat University

[silentoption12@gmail.com](mailto:silentoption12@gmail.com)

Department of Primary Education

İnönü University

[sebahattin.aribas@inonu.edu.tr](mailto:sebahattin.aribas@inonu.edu.tr)

**ABSTRACT:** Not long ago, distance learning was considered to be irrelevant in English teaching due to some challenges and obstacles. But in the past few decades, thanks to rapid innovations in education technology, much has been changed. Distance learning has become one of the most important and inevitable touchstones of education, particularly of English teaching. Growing interest in distance learning presents new opportunities to both learners and teachers of English. That's because English is the common interest of all cultures around the globe. In this study, the effectiveness of distance learning as supplement in English teaching was studied to find out its expected benefits in English teaching. During a given period of a time, students were tutored by the teacher and oriented from a web based interface for additional tasks. The aim here is both to provide a continuous progress and to move lesson from a closed area to an open environment where students can learn more effectively. In the end, it has been observed that distance learning environment has provided students not only a long term practicable knowledge but also a more comprehensive English acquisition.

**Key Words:** Distance Learning, English, Language Acquisition, Practicable Knowledge, Promotive

## 1. Introduction

Distance learning, as a definition, is a need or a necessity for both teachers and learners apart from each other because of geographical, personal, sociological and economical reasons (Moore, 1973). The need for distance learning was first appeared due to distances between students and the schools, that is, teachers (Gore, 2000). Education through distance learning, like its counterpart – in class traditional education - has some specifications which differentiate it from other types of learning. To start with, there are three sub-categories that can be defined under distance learning are; the learner, the teacher and the communication method (Moore, 1973). Secondly, Web and internet based communication methods are used in order to provide both teachers and learners with an environment that is not limited with time, learning environment etc. Furthermore, when compared to classroom learning environment, distance learning tools are versatile, flexible and easy accessible environments through which every learner, including breastfeeding mothers, handicapped, disabled, housebound and imprisoned, can reach whenever and wherever they want. The distance learner, in contrast to any other student, can reach to his learning environment; get in touch with his classmates and teacher synchronous or asynchronous. So, the Internet has caused the biggest change in education ever since the advent of the first printed books roughly 500 hundreds years ago (Draves, 2000). Today, in over 90 countries, distance learning methods are being used in universities effectively (Gürüz, 2001).

But; at this point, some problems reveal the necessity of traditional communication for the learners in terms of the supplementary details of the education (Boyacı and Akbal, 2012). This phenomenon is particularly important in English learning. Since English is situational, and its skills (speaking, listening, reading, and writing) are collaborated with each other, the teaching method should include face to face communication in order to enhance the learning, provide a continuous and constant language acquisition. For example, the learner can learn the rules of grammar, can

memorize the vocabulary but he may not use them appropriately together. On the other hand, especially for foreign learners who learn English as a second language, phonetics of the vocabulary may be another problem. It may not be taught without real-time teaching profoundly.

The challenge to all universities in 21<sup>st</sup> century is not to decide why they should have an online distance learning program, but to decide how to design, embed and adapt it into traditional education program. Since distance learning environments may not be adequate, when they are used alone; without traditional education programs. Because of these situations mentioned above, this study is aimed to explore the embedded use of distance learning as a promotive tool in traditional language education. Preparation for distance learning usually focuses on budget, prestige and personnel planning, not on cognitive and critical pedagogic issues (Bates, 2000; Berge & Smith, 2000). Distance learning is more than a learning or teaching method; it is a distinct and coherent field of education (Keegan, 1986), focused on new delivery methods and pedagogical philosophy. Administrators have tended to put narrow limits on ways to make technology effective while expecting broad outcomes (Hawkes & Cambre, 2000). Yet, the technological infrastructure should not be built without considering the academic and educational requirements of a distance learning program (Bates, 2000; Bunn, 2001; Gibbons & Wentworth, 2001). Many instructors do not want to change their style of instruction (Anderson & Middleton, 2002). Some teachers feel that interactive lectures, small group activities, or closed labs are the only way that a subject can be taught. Others have not yet adapted their lectures to the advances provided by technology such as PowerPoint presentations and multimedia demonstrations and do not want to change their teaching style. These beliefs and long-established practices will be changed as courses are moved online, requiring new ways of thinking about teaching and learning (Bates, 2000; Burgess, 1994). This rapid evolution of knowledge requires innovative development in curriculum. (Trindade, Carmo, & Bidarra, 2000). Effective distance learning environment requires the instructor to not only have knowledge of the content area, but also to have interpersonal skills to communicate with their students online (White & Weight, 2000). Instructors will be assuming a broader role as planners, designers, guides, mentors, and facilitators and will no longer be seen as leaders and lecturers (Gillespie, 1998; Young, 2002).

## 2. Method

The research is based on the type of qualitative research patterns, in accordance with the nature of the research, case study design was used. "One or more states in their territory (environment, time, etc.) analyzing as a whole" (Yıldırım ve Şimşek, 2008: 79) is expressed as a state.

This study has been carried out in a college class. The learners have attended to The Department of Computer Programming (Distance Learning). The total number of the students was 22. The learners took part in the program during one year. The whole process of the education was completed over LMS, but the first week and final exams. 6 weeks after the registration, the students had their first visa exams. And 13 weeks after the registration the final exam was applied. At regular intervals, the learners were given homework and assignments. The visa exam was done over the internet and the final exam was carried out at the faculty.

## 3. Findings

The findings obtained from the study are given below in accordance with the purpose of the study.

### 3.1. Syllabus

**Table 1.** The syllabus used in this program is given below:

| Week | Functions                       | Grammar                              | Topics               |
|------|---------------------------------|--------------------------------------|----------------------|
| 1    | Directions                      | Adjectives: common and demonstrative | Family life          |
| 2    | Describing habits and routines  | Adverbs of frequency                 | Hobbies and pastimes |
| 3    | Giving personal information     | Comparatives and superlatives        | Holidays             |
| 4    | Greetings                       | Going to                             | Leisure activities   |
| 5    | Telling the time                | How much/how many and very           | Shopping             |
| 6    | Understanding and using numbers | common uncountable nouns             | Work and Jobs        |
| 7    | VISA EXAM                       | VISA EXAM                            | VISA EXAM            |
| 8    | Describing habits and routines  | Imperatives (+/-)                    | Education            |
| 9    | Describing past experiences     | Intensifiers - very basic            | Hobbies and pastimes |
| 10   | Describing people               | Modals:<br>can/can't/could/couldn't  | Holidays             |
| 11   | Describing places               | Past simple of "to be"               | Leisure activities   |

|    |                          |                       |               |
|----|--------------------------|-----------------------|---------------|
| 12 | Describing things        | Past Simple           | Shopping      |
| 13 | Obligation and necessity | Possessive adjectives | Work and jobs |
| 14 | FINAL EXAM               | FINAL EXAM            | FINAL EXAM    |

The program given here involves in one semester only (Fall Term). The syllabus was developed according to Common European Framework in English Language Teaching. Applying the CEFR to the teaching approach is an important competence for teachers, and for many teachers extra training, resources and support are needed to make this successful. The embedding of the CEFR in English Language Teaching has been a long process, so the adaptation to the curriculum is getting harder.

### 3.1.1. Gender Status

**Table 2.** The gender of the learners is given below:

|        |    |
|--------|----|
| Male   | 13 |
| Female | 9  |
| Total  | 22 |

13 of the learners are male and 9 of them are female. The total number of the learners in this class is 22.

### 3.1.2. Marital Status

**Table 3.** Marital status of the learners is given below:

|         |    |
|---------|----|
| Single  | 17 |
| Married | 5  |
| Total   | 22 |

17 of the learners are single, 5 of the learners are married.

### 3.1.3. Social Status

**Table 4.** The social status of the learners is given below

|                        |    |
|------------------------|----|
| Employed               | 8  |
| Unemployed             | 11 |
| Imprisoned             | 2  |
| Disabled / Handicapped | 1  |
| Total                  | 22 |

As understood from the table, the most differential specification of distance learning classes is the social status variation. Since this is an open program, the learners can attend the classes wherever they can. In this table it is shown that 8 of the learners are employed. Some of them work for private sector and the others work for the public sector. 11 of the learners are haven't been working anywhere, say, they are typical students. Unemployed haven't specified how they make a living. 2 of the learners are imprisoned. One of them is jailed in Tekirdağ and the other is jailed in Elazığ. They couldn't manage to reach LMS program punctually due to the conditions of the jails. This situation has affected their acquisition. Surprisingly, the latter imprisoned has finished three higher education program before attending this program. One of the learners is physically handicapped to wheelchair and depends on her parents for her some needs.

### 3.1.4. Age Interval

**Table 5.** Age intervals of the learners are given below

|                    |    |
|--------------------|----|
| Ages between 15-20 | 1  |
| Ages between 21-25 | 3  |
| Ages between 26-30 | 16 |
| Ages between 31-35 | 1  |
| Ages between 35-40 | 1  |

19 of the learners are at their 20s, which means they attend the program in their more productive age interval. One of the learners is at his teens. The rest two are at their 30s. This table also shows that for distance learning, age

limitation is not a problem for the education. This can be classified as an outstanding difference of distance learning from traditional learning.

### 3.1.5. Attendance to the program and final exam marks

**Table 6.** The attendance of the students to the program, submitting assignments and final exam marks are given below

| Learners   | Assignment / Homework submission | Attendance to program | Final exam mark |
|------------|----------------------------------|-----------------------|-----------------|
| Student 1  | 8/8                              | 14 weeks              | 95              |
| Student 2  | 8/8                              | 14 weeks              | 90              |
| Student 3  | 3/8                              | 14 weeks              | 90              |
| Student 4  | 5/8                              | 8 weeks               | 90              |
| Student 5  | 8/8                              | 14 weeks              | 85              |
| Student 6  | 3/8                              | 9 weeks               | 85              |
| Student 7  | 1/8                              | 14 weeks              | 70              |
| Student 8  | 6/8                              | 9 weeks               | 70              |
| Student 9  | 8/8                              | 14 weeks              | 60              |
| Student 10 | None                             | 14 weeks              | 60              |
| Student 11 | 4/8                              | 5 weeks               | 60              |
| Student 12 | 7/8                              | 14 weeks              | 55              |
| Student 13 | 8/8                              | 14 weeks              | 55              |
| Student 14 | 5/8                              | 9 weeks               | 55              |
| Student 15 | 4/8                              | 7 weeks               | 50              |
| Student 16 | None                             | 8 weeks               | 50              |
| Student 17 | 7/8                              | 9 weeks               | 45              |
| Student 18 | 5/8                              | 7 weeks               | 45              |
| Student 19 | 2/8                              | 5 weeks               | 40              |
| Student 20 | None                             | 4 weeks               | 35              |
| Student 21 | None                             | 2 weeks               | 30              |
| Student 22 | None                             | 5 weeks               | 15              |

As can be understood from the table, final marks have a direct correlation with attendance to the program. From the first week of the education, students have been given weekly classes. Most of them have included video presentations, worksheets and grammar sheets. The students have been expected to follow the instructions, watch the presentations, study the sheets and submit the assignments. Moreover they have had a chance every week to communicate with the teacher interactively through the LMS and e-mails. The learners, who have attended the program fully, have submitted assignments properly have had the highest marks. The irrelevant students to the program and assignments have had the lowest marks.

## 4. Result

Distance learning has made the process of gaining the education regardless of time or location easier for the learner. At the same time, it has provided more challenges for the colleges providing this education. In distance learning, not only does the instruction occur via a computer system, usually over the Internet, but also other educational processes occur via the computer. It is obvious that no matter how well the program is designed. It is obvious that the distance learning courses should be carried out in correlation with traditional education. The findings of this study show us some facts as follows;

- The gender of the learners can be different from each other, as the acquisition level may be varied, so the expectations from the program may not be achieved completely.
- Age interval is another problem. Because of age, the needs, priorities requirements may vary, and this variation directly affects the success of the course.
- The social status of the learners is a big dilemma. Since the teacher can't predict who can use the LMS system punctually due to personal situations, he can't know what the outcomes of the course will be and how many of the learners will be successful through the course. This situation is also valid for learners who aren't able to reach internet for LMS easily when needed.
- Unlike other classes English classes are build up of several skills; reading, listening, speaking, writing. Apart from the grammar which can be taught through rules, these skills are hard to acquire when studied alone. They frequently require face to face communication for a complete, comprehensive and collaborated learning.

- In contrast to traditional education, distance education take out the limits such as exact lesson duration, repetition, written books etc. This brings some new perspectives for language learning. If the teacher can't control the whole class at once, it will be difficult for him to deliver the lesson to all participants as scheduled.

## 5. Conclusions

Delivering English classes online through distance learning needs a reorganization of the ways through which supportive services are provided. This is necessary to ensure the highest standard of support. Distance learning programs and embedded technology should be widened and become comprehensive in order to meet the demands. Not everybody has the chance to receive a proper language education and complete acquisition through the traditional learning methods (Rogers, 2001). That's why distance learning should be available to all public. At the same time the content of the LMS programs should be appropriate for all participants, due to the situational properties of language learning. Schools which urge to have and establish effective distance learning need to reconsider all aspects of providing online language education. Since English is English everywhere, the methods used, the technology presented and the environment provided should be common for all participants around the globe. The information age that we struggle to keep up with, is rapidly moving online, especially in terms of the education this velocity is very fast. While distance language learning creates an array of new advantages, it also places new demands on participants: to acquire new roles, and develop new skills. In spite of the growing presence of distance learning opportunities, and the eagerness to participate in these opportunities, the field of distance language learning remains little known and little understood. It is often narrowly conceptualized as the development of technology-mediated language learning opportunities. Many of the key issues for distance language learning, however, relate to human factors which are common to both hi-tech and low-tech environments – factors that arise as learners attempt to establish and maintain an effective means of working within a distance learning context (White, 2003). Distance learning refers to a learning model in which learners and teachers, apart from each other, put into practice their learning-teaching activities, communication abilities (İşman, 1998). The most distinctive feature of distance learning systems is the ability to adapt technology to education in order to provide students with continuous, broad, valid and reliable learning opportunities. For further studies to be done, it is advisable to say there should be more studies to enhance the extent of language learning and teaching through distance learning environments. Since the learner profiles can be surprisingly variable, the methods to be applied into the field should be compatible with the requirements.

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# THE EFFECTS OF NATURE EDUCATION PROJECT ON THE ENVIRONMENTAL SENSITIVITY

Naim Uzun, Özgül Keleş, Funda Varnacı Uzun  
Aksaray University, Faculty of Education  
Turkey

naimuzun@yahoo.com, ozgulkeles@gmail.com, fundavarnaci@hotmail.com

**Abstract:** The purpose of this study is to investigate the effects of the project “Nature Education in Ihlara Valley (Aksaray) and Its Surrounding Area III” supported by The Scientific and Technological Research Council of Turkey (TUBITAK) on environmental sensitivity. “Environmental Sensitivity Scale” were used to collect data in the present study. The study was carried out in line with the pre-test-post-test design. The difference between the environmental sensitivity pre-test and post-test scores of the participants was found to be statistically significant as a result of the t-test analysis ( $t_{(29)} = -3,518, p < 0.01$ ). In light of this result, it can be argued that nature education raised the environmental sensitivity of the participants.

**Key words:** environmental sensitivity, nature education, pre-service teachers

## Introduction

In today’s world where global environmental problems are growing rapidly, the carbon emission has already reached the possible highest level and ecologic foot traces have climbed to the top of the loading capacity of the earth environmental education has gained greater importance.

In the analysis of the environment, perceiving the unity of nature and our planet, and raising our environmental awareness and sensitivity, environmental education is of vital importance (Schmidt, 1996; Erten, 2005). Training of teachers with ecological knowledge and experience sufficient enough to carry out theoretical and applied environmental works efficiently can make the biggest contribution to the development of environmental education and achieving its goals (Kahyaoğlu et al., 2008). Environmental education should not only provide information but also lead to changes in human behaviors. The main objective of environmental education should be permanent and positive changes of behaviors and active participation of individuals in efforts made to find solutions to problems (Özgen, 2012). In order to train environmentally-sensitive individuals, education systems promoting the active participation of individuals should be adopted (Çabuk & Karacaoğlu, 2003). Environmental sensitivity is 'an empathetic or understanding view of the environment', and is characterized by the individual who 'refuses to litter highways and natural areas... conserves natural resources... works to preserve ecologically important natural areas... strives for a stable and appropriate human population level... respects hunting and fishing laws... insists on rational zoning requirements... etc.' (Hungerford, Peyton & Yolk, 1992; Sivek, 2002).

When environmental education is given in the natural environment, it may increase the interest in nature and enable the participants to look at the life by creating empathy with nature; hence, it is very important (Atasoy, 2006; Ozaner, 2004; Palmberg & Kuru, 2001). Many authors have emphasized that nature education informs individuals about natural processes, makes them more sensitive and conscious, when it is accompanied by field trips, the information gained can be turned into behavior more easily and becomes more permanent and makes contribution to the creation of more independently thinking individuals (Shepard & Speelman, 1985; Dresner & Gill, 1994; Erten, 2004; Farmer et al., 2007). The purpose of this study is to investigate the effects of the project “Nature Education in Ihlara Valley (Aksaray) and Its Surrounding Area III” supported by The Scientific and Technological Research Council of Turkey (TUBITAK) on environmental sensitivity.

## Materials and Method

### *Study group*

The study group consists of 30 pre-service teachers studying in 4 different departments (preschool education, primary education, social studies, science and physics) of the education faculties of 17 universities who participated in nature education program carried out on 27 August-02 September 2012 with the support of TUBITAK. 18 (54%) of the participants are girls and 12 (46%) are boys.

#### *Activities carried out within the framework of the nature education*

With this project, where active learning methods were used, the pre-service teachers were introduced to geological, geomorphologic, floral, faunal and cultural features of the natural environment and to the problems stemming from the mass tourism activities taking place in the region. In this respect, some field studies were carried out on the volcanic structure around Ihlara Valley and Hasan Mountain. Besides field studies, some activities in a classroom setting were also carried out. In the classroom setting, creative drama activities were performed for the pre-service teachers to get to know each other and take individual responsibilities.

#### *Data collection instruments*

“Environmental Sensivity Scale” developed by Çabuk and Karacaoğlu (2003) was used to evaluate the changes in the pre-service teachers’ environmental sensivity as a result of the nature education they participated in. The scale consists of 24 items designed in the form of 3-Point Likert type (always, sometimes, never). The Cronbach Alpha reliability coefficient was found to be .72. This scale was administered as pre-test on the first day of the program and post-test on the last day of the program.

#### *Data analysis*

SPSS program package was employed to analyze the data, and after presenting the descriptive statistics related to the scores, paired t-test was used to find out whether there are significant differences between the pre-test scores for environmental sensitivity and those of the post-test.

## Results

In this section of the study, the data obtained through “Environmental Sensivity Scale” designed to elicit the environmental sensitivity of the pre-service teachers are discussed. In the evaluation, first the means of the pre-service teachers’ scores concerning their opinions about air pollution, water pollution, soil pollution, ecologic balance, participation in environmental works and training taken in their formal education institutions were descriptively evaluated in the form of pre-test and post-test. Then, t-test was conducted to test whether the pre-service teachers’ environmental sensitivity scores significantly changed as a result of education given. Mean values of the pre-service teachers’ scores taken for their sensitivity towards air pollution (pretest-posttest) are presented in Table 1.

**Table 1:** Pretest-posttest mean values for the pre-service teachers’ sensitivity towards air pollution

| No           | Items (Air pollution)  | N  | Mean (pre-test) | Mean (post-test) | t             | p           |
|--------------|--|----|-----------------|------------------|---------------|-------------|
| 1            | Do you pay any attention not to use consumption goods (deodorants etc.) including substances harmful to Ozone Layer? | 30 | 2,20            | 2,33             |               |             |
| 2            | Even if you had your own vehicle, would you use public transportation not to pollute the earth?                      | 30 | 2,23            | 2,43             |               |             |
| 3            | Do you pay attention not to disturb other people while you are talking or using some tools?                          | 30 | 2,90            | 2,93             |               |             |
| 4            | Do you warn people to be sensitive towards air pollution?  | 30 | 2,50            | 2,66             |               |             |
| <b>Total</b> |  | 30 | <b>9,83</b>     | <b>10,35</b>     | <b>-1,606</b> | <b>,119</b> |

As can be seen in Table 1, the mean values obtained for the responses given by the pre-service teachers to the items concerning their sensitivity towards air pollution have increased as a result of the application for the four items. On the other hand, the participants’ posttest mean score concerning air pollution ( $\bar{X} = 10,35$ ) was found to be higher than their pre-test mean score ( $\bar{X} = 9,83$ ), yet, this difference is not statistically significant ( $t = -1.606$ ;  $p > .05$ ).

Mean values of the pre-service teachers’ scores taken for their sensitivity towards water pollution (pretest-posttest) are presented in Table 2.

**Table 1:** Pretest-posttest mean values for the pre-service teachers’ sensitivity towards water pollution

| No | Items (Water pollution)  | N  | Mean (pre-test) | Mean (post-test) | t | p |
|----|--|----|-----------------|------------------|---|---|
| 5  | While purchasing cleaners, do you pay attention to whether they include harmful chemicals or not?      | 30 | 2,23            | 2,26             |   |   |
| 6  | Are you thrifty in any circumstances in water use?   | 30 | 2,80            | 2,86             |   |   |
| 7  | Do you pay any attention to prevent harmful chemical substances such as engine oils, paints from being | 30 | 2,46            | 2,50             |   |   |

|              |   |    |              |              |              |             |
|--------------|---|----|--------------|--------------|--------------|-------------|
|              | dumped into sewer system?                                   |    |              |              |              |             |
| 8            | Do you warn people to be sensitive towards water pollution? | 30 | 2,63         | 2,76         |              |             |
| <b>Total</b> |   | 30 | <b>10,12</b> | <b>10,38</b> | <b>-,830</b> | <b>,413</b> |

The score obtained for the responses of the pre-service teachers to the items concerning water pollution is higher for one item favoring the posttest score. In general, the mean score of the pre-service teachers taken from the posttest ( $\bar{X} = 10.38$ ) is higher than that of the pretest ( $\bar{X} = 10.12$ ). The difference found between these two scores (0.26) is not significant ( $t = -.830$ ;  $p > .05$ ) (Table 2).

Mean values of the pre-service teachers' scores taken for their sensitivity towards soil pollution (pretest-posttest) are presented in Table 2.

**Table 2:** Pretest-posttest mean values for the pre-service teachers' sensitivity towards soil pollution

| No           | Items (Soil pollution)  | N  | Mean (pre-test) | Mean (post-test) | t             | p           |
|--------------|---|----|-----------------|------------------|---------------|-------------|
| 9            | Do you pay attention to using the both sides of a paper you are writing on?                 | 30 | 2,66            | 2,83             |               |             |
| 10           | Are you thrifty in any case in terms of using paper tissues?                                | 30 | 2,46            | 2,50             |               |             |
| 11           | Do you plant trees by looking for suitable environments for them to grow?                   | 30 | 2,26            | 2,36             |               |             |
| 12           | Do you pay attention for wastes to end up in garbage?                                       | 30 | 2,80            | 2,90             |               |             |
| 13           | Do you sort out the wastes by using suitable boxes to achieve the most effective recycling? | 30 | 2,70            | 2,76             |               |             |
| 14           | While leaving your garbage out, do you sort out it?   | 30 | 2,36            | 2,46             |               |             |
| 15           | Do you warn people around you to be sensitive towards soil pollution?                       | 30 | 2,36            | 2,56             |               |             |
| <b>Total</b> |   | 30 | <b>17,60</b>    | <b>18,37</b>     | <b>-2,292</b> | <b>,029</b> |

As can be seen in Table 3, it is clear that the pre-service teachers' sensitivity towards soil pollution changed significantly for 7 of the items as a result of the application. In general, the posttest mean score of the pre-service teachers ( $\bar{X} = 18.37$ ) was found to be higher than their pretest mean score ( $\bar{X} = 17.60$ ) and this difference is statistically significant ( $t = -2.292$ ;  $p < .05$ ). Hence, the application can be claimed to have made important contributions to the sensitivity towards environment.

Mean values of the pre-service teachers' scores taken for their sensitivity towards ecological balance (pretest-posttest) are presented in Table 4.

**Table 3:** Pretest-posttest mean values for the pre-service teachers' sensitivity towards the concept of ecological balance

| No           | Items (The concept of ecological balance)   | N  | Mean (pre-test) | Mean (post-test) | t            | p           |
|--------------|---|----|-----------------|------------------|--------------|-------------|
| 16           | I you were/are married, would/do you pay attention to family planning considering ecological balance? | 30 | 2,83            | 2,90             |              |             |
| 17           | Do you support experiments carried out on animals for the benefit of humanity?                        | 30 | 1,53            | 1,40             |              |             |
| 18           | Do you warn people around you to be sensitive towards the protection of ecological balance?           | 30 | 2,63            | 2,73             |              |             |
| <b>Total</b> |   | 30 | <b>6,99</b>     | <b>7,03</b>      | <b>-,128</b> | <b>,899</b> |

Posttest mean score obtained from the pre-service teachers' responses to the items aiming to elicit their sensitivities towards the concept of ecological balance ( $\bar{X} = 7.03$ ) is higher than their pretest mean score ( $\bar{X} = 6.99$ ). However, this difference is not statistically significant ( $t = -.128$ ;  $p > .05$ ) (Table 4).

Mean values of the pre-service teachers' scores taken for their sensitivity towards participation in environmental works (pretest-posttest) are presented in Table 5

**Table 4:** Pretest-posttest mean values for the pre-service teachers' sensitivity towards participation in environmental works

| No | Items (Participation in environmental works) | N | Mean | Mean | t | P |
|----|--|---|------|------|---|---|
|----|--|---|------|------|---|---|

|              |   |    | (pre-test)  | (post-test) |               |             |
|--------------|---|----|-------------|-------------|---------------|-------------|
| 19           | Do you participate in scientific activities on environment such as seminar, panel, conference etc.? | 30 | 2,40        | 2,60        |               |             |
| 20           | Do you take part in the activities of voluntary organizations working on environment?               | 30 | 2,26        | 2,43        |               |             |
| <b>Total</b> |   | 30 | <b>4,66</b> | <b>5,03</b> | <b>-1,779</b> | <b>,086</b> |

As can be seen in Table 5, the posttest mean score obtained for the pre-service teachers sensitivity towards participation in environmental works ( $\bar{X} = 5.03$ ) is higher than their pretest mean score ( $\bar{X} = 4.66$ ), yet, this difference is not statistically significant ( $t = -1.779$ ;  $p > .05$ ).

The mean values of the pre-service teachers' scores taken from their opinions about the education they were given in formal education institutions are presented in Table 6.

**Table 5:** The mean values of the pre-service teachers' scores taken from their opinions about the education they were given in formal education institutions

| No           | Items (Environmental education in formal education institutions)                               | N  | Mean (pre-test) | Mean (post-test) | t             | p           |
|--------------|--|----|-----------------|------------------|---------------|-------------|
| 21           | Do you think that you have had enough instruction to raise your awareness of air pollution?    | 30 | 1,93            | 2,26             |               |             |
| 22           | Do you think that you have had enough instruction to raise your awareness of water pollution?  | 30 | 1,96            | 2,33             |               |             |
| 23           | Do you think that you have had enough instruction to raise your awareness of soil pollution?   | 30 | 1,93            | 2,36             |               |             |
| 24           | Do you think that you have had enough instruction to raise your awareness of ecologic balance? | 30 | 1,86            | 2,56             |               |             |
| <b>Total</b> |  | 30 | <b>7,68</b>     | <b>9,51</b>      | <b>-3,596</b> | <b>,001</b> |

As can be seen in Table 6, for all the items, posttest scores taken by the pre-service teachers from the items concerning their sensitivity towards the environmental education taken at formal education institutions are higher than those of pre-test scores. The mean score taken from the posttest ( $\bar{X} = 9.51$ ) is higher than that of the pretest ( $\bar{X} = 7.68$ ) and this difference is statistically significant ( $t = -3.596$ ;  $p < .01$ ). This shows that the pre-service teachers included the training they took during the application in their general formal environmental education and think that the application enhanced their sensitivity.

In order to test whether there is a significant difference between the pre-service teachers' environmental sensitivity before and after the application, their general scores were evaluated.

**Table 7:** T-test results concerning environmental sensitivity pretest and posttest scores

| Environmental sensitivity scale | N  | $\bar{X}$ | S    | Sd | t      | p    |
|---------------------------------|----|-----------|------|----|--------|------|
| Pretest                         | 30 | 56,96     | 4,76 | 29 | -3,518 | ,001 |
| Posttest                        | 30 | 60,66     | 4,63 |    |        |      |

$p < .01$

The results of the analysis revealed that before participating in nature education project, the mean pretest environmental sensitivity score of the pre-service teachers is  $\bar{X} = 56.96$ , and after participating in the nature education project, it became  $\bar{X} = 60.66$ . The difference found between environmental sensitivity pretest and posttest mean scores is statistically significant ( $t = -3.518$ ,  $p < 0.01$ ) (Table 7). Hence, it can be argued that seven-day nature education project significantly improved the participants' environmental sensitivity.

## Discussion, conclusions and suggestions

In light of the findings of the study, it is seen that prior to nature education, the participants' environmental

sensitivity was high. Moreover, at the end of education, their environmental sensitivity significantly improved. In a study looking at the environmental sensitivity of the social sciences high school students, the environmental sensitivity of the students was found to be medium (Aydın & Kaya, 2011). In another study a profile of environmentally sensitive high school students was developed (Sivek, 2002).

In another study employing the same scale used in the present study, it was found that the environmental sensitivity of university students varied significantly depending on gender and education level. In addition to this, the same study also revealed the students have poor attitudes towards participating in activities of environmental organizations. However, the present study showed that the participants have positive attitudes towards participating in environmental activities. Again, in the same study, while the students have positive attitudes towards using animals and humans in medical experiments, the participants of the present study have negative attitudes (Çabuk & Karacaoğlu, 2003).

The effectiveness of nature education in improving the students' environmental sensitivity shows the importance of environmental education programs integrating active teaching techniques used in nature. Therefore, such programs should be promoted and made widespread. To be able to carry out such programs, first thing to be done should be to train pre-service teachers.

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# THE EVALUATION OF THE IMPLEMENTATION PROCESS OF SCIENCE AND TECHNOLOGY COURSE CURRICULUM IN ELEMENTARY EDUCATION ACCORDING TO TEACHERS' OPINIONS\*

Prof.Dr. Süleyman ÇELENK

The Department of Educational Science in Faculty of Education  
Abant İzzet Baysal University, Turkey  
celenk\_s@ibu.edu.tr

Dr. Zeynep DEMİRTAŞ

The Department of Educational Science in Faculty of Education  
Sakarya University, Turkey  
zeynept@sakarya.edu.tr

**Abstract:** The aim of the current study is to evaluate the implementation process of the Science and Technology course curriculum based on teachers' opinions in schools with different socioeconomic status (SES). The sample of the current study includes Science and Technology teachers in elementary schools; two of them have high SES, two have middle SES, and two have low SES. These elementary schools were chosen from low- to middle and high SES elementary schools in central district of Sakarya via stratified sampling. The teachers' opinions about the competence of the implementation of the program were obtained by semi- structured interview. The obtained qualitative data was analyzed via content analysis. It was founded that the current program is superior to the old one according to teachers' opinions. However, several factors prevent the implementations of the program, such as insufficient time, insufficiency of materials, individual differences, the population density in some units, class crowding, unprepared students to lessons, placement test (special name is SBS in Turkey), and the process of preparation to exams city- wide, the inappropriateness of the activities to students' level, the unawareness of parents, the difficulty in the access to the sources for students who are not capable of.

**Keywords:** Science and technology course, curriculum, program evaluation, teachers' opinions.

## Introduction

The programs that are used in Teaching- learning process are evaluated to understand the effectiveness of them; if they are not effective, to understand where the problem is derived from. The results of this evaluation serve as a resource to the process of later program development.

With the evaluation of the programs, several factors are supplied, such as making better decisions about the programs, developing better programs, the better use of curriculum (Stake, 1967). Especially, the analysis, and continuous evaluation of "the learning activities that are conducted in classes" elicit the rise of more realistic approaches in the evaluation of the system of education, and the curriculum (Fidan, 1997: 3).

The implementation of the curriculum of any lesson means the development of a teaching and learning process based on the rudiments of that program, and making use of this (Özçelik, 1987:4). The implementation of the curriculum is in the case of linear and straight stages, and occurs radially (Shawer, 2010). In addition, several factors can affect the implementation of the curriculum both positively, and negatively.

In the process of the implementation of the curriculum, important variables that give rise to the actualization of all learning processes take place in all components of the system of education. When the teaching and learning environment is arranged, those variables should be used in a way that fit for purpose because each variable can affect the outcomes of the system. In an education system, which brings students in pre- determined goals of the program, cues, corrections, feedback, and reinforcements should be used in the right place at the right time. Moreover, the equipments, time, and the organization of the classrooms should be arranged in a way that fits to the goals of the learning. Furthermore, the participation of the students to the learning process, the arrangement of the activities that improve the critical, and creative thinking of the students should be supplied with the help of appropriate teaching- learning strategies, methods, and techniques. All of those aforementioned suggestions should intertwine to each other (Sönmez, 2007). Those teaching- learning activities are actualized in stages as preparation (attention getting, motivation, revision), presentation ( passing to the lesson, and development), application (individual and group learning activities), and with the implementation of curriculum in stages of application, summation- evaluation, that is in the course of teaching lesson (Akbaşlı, 2011).

Teacher factor comes first among possible factors that affect the implementation of the curriculum because the meaning that teachers give to new curriculum functions as a map in the implementation process of the curriculum, and this situation indicates the success of the curriculum. Teachers are key factors in the success of new curriculum. The

knowledge, beliefs, and understandings of the teachers play a crucial role in understanding new curriculum. Teachers use their daily knowledge and experiences to make sense of new curriculum process, and this affect and shape the meaning that is given by teachers to new curriculum. The understanding and the acceptance of teachers about the new curriculum process have an impact on the implementation of the curriculum (Bantwini, 2010). Spears (1950) stated that to an effective curriculum it should not be forgotten that the curriculum lies in the heart and mind of the teacher (Varış, 1988: 17). Those are teachers, who transform the curriculum from institutional to educational (Shawer, 2010).

In today's world, curriculums are based on constructivist approach, which provide more roles to teachers. It is expected that teachers should be in the center of teaching- learning process, encourage, and guide students. Teaching-learning process should be undergone with activities, experiments, projects, which are conducted with students, because Science and Technology course is learned with doing and experiencing. That is the purpose of the curriculum. Therefore, teachers should apply stuffs that are foreseen in the curriculum in classroom settings.

According to researches, the approach of teachers to the curriculum has significant effects on both their occupational development, students' learning, and in encouraging them to learning (Shawer, 2010).

Depending on aforementioned factors, the purpose of the current study is to determine how teachers implement the curriculum of Science and Technology course, and what they encounter with while implementing it.

## Method

### Research Method

In the current study, qualitative research method was used.

### Population and Sample

The sample of the current study includes Science and Technology teachers in elementary schools; two of them have high SES, two have middle SES, and two have low SES. These elementary schools were chosen from low- to middle and high SES elementary schools in central district of Sakarya via stratified sampling.

### Data Collection

In the current study, the interview form that was designed to measure the general views of Science and Technology teachers about the applicability of the foreseen factors in the curriculum of 6<sup>th</sup> grade Science and Technology course was used. This interview measures not only the opinions of the teachers but also do measure the attitudes and judgments of them toward the curriculum.

Before the preparation of the interview form, the literature was reviewed, and open-ended questions that best describe the sub-problems were written. For the Content validity of the interview, it was consulted to the opinions of the Science and Technology field experts (n=3), teachers (n=5), and program development experts (n=7). The form of the questions was revised based on the feedbacks of experts. Revised version was broached to same experts again. After taking the expert approval, the interview form was filled out by Science and Technology teachers other than research sample (n=3) to test the functionality and the clarity of the questions. Then structured interview was applied to sample.

Interviews were carried out at times that were suitable for the teachers' schedule. In order to prevent data loss, recorder was used during interviews with taking the permission of the teachers, and the interviews lasted approximately 25-35 minutes.

### Analysis of Data

Data that was obtained by interview form was analyzed with content analysis. For the content analysis, firstly, data was recorded to a recorder, and then was transformed into a written material. The written materials were examined repeatedly, and data that was appropriate for the purpose of the study were codified. Then categories (themes) that described codified data generally were determined. Those findings were organized as tables. Teachers, participating in interview, were coded as G1, G2, G3, G4, G5, and G6. In the evaluation process of the findings, direct quotations about opinions of teachers were used.

## Result and Discussion

Data that was obtained through interviews with teachers was coded in accordance with determined categories, and was presented as tables.

- Teachers' Opinions About Preparation Of The Learning Environment That Fits the Gains  
Themes that are effective in the preparation of the learning environment, which fits to the gains, according to teachers' opinions, and the codes are represented in Table 1.

**Table 1.** Teachers' opinions about preparation of the learning environment that fits the gains

| Teacher | School<br>SES | Themes (categories)         |                    |                             |
|---------|---------------|-----------------------------|--------------------|-----------------------------|
|         |               | Preparation Situation       | Positive Effect    | Negative Effect             |
| G1      | High          | I try to prepare a suitable | Utilization of the | Unprepared students come to |

|    |        |  |  |  |
|----|--------|--|--|--|
|    |        | learning environment with respect to the potential of the school                             | guidance book  | classes<br>Insufficiency of materials<br>Insufficiency in the technological condition of the school    |
| G2 | High   | I prepare learning environment that fits most of the gains                                   | Utilization of the guidance book<br>Utilization of the computer and the projector                        | Insufficiency of materials<br>Students' levels are low   |
| G3 | Middle | I try to prepare a suitable learning environment with respect to the potential of the school | -  | Unprepared students come to classes  |
| G4 | Low    | I cannot prepare a learning environment that fits to every gain                              | Utilization of the guidance book   | Insufficiency of materials<br>Crowded classes<br>Insufficiency in time<br>Density in the program       |
| G5 | High   | I prepare learning environment that fits most of the gains                                   | Utilization of the guidance book<br>Having a laboratory<br>Utilization of the computer and the projector | Crowded classes<br>Insufficiency in time<br>Density in the program<br>The early application of the SBS |
| G6 | Middle | I cannot prepare a learning environment that fits to every gain                              | -  | Unprepared students come to classes<br>Insufficiency in materials                                      |

As represented in Table 1, opinions of teachers were gathered into three categories, namely "Preparation Situation," "Positive Effect," and "Negative Effect." When teachers' situations about preparing a learning environment that fits to gains were investigated, it was founded that two teachers prepare learning environment that fits to most of the gains, two of them try to prepare learning environment according to the potential of the school, and two of them cannot prepare learning environment that fits to every gains. Direct quotations that were gotten from teachers' opinions are as follows:

*"It differs according to the situation of the school... gains are useful but it is not possible to apply all of them."* (G1)

*"I have the edge on this situation because there is a laboratory, computer, and projector in the school. I can provide visibility to students by using them. I think that I cannot provide all the gains but I can do most of them..."* (G5)

When teachers' opinions about the negative effect of preparing a learning environment were investigated, it was founded that four of them mentioned the insufficiency of the materials; three of them mentioned students' unpreparedness; two of them mentioned the crowdedness of the classes, insufficiency in time, density in the program; one of them mentioned the insufficiency in the technological condition of the school; one of them mentioned the low level of students' capacity, and one of them mentioned the early application of SBS exam in Turkey. Direct quotations that were gotten from teachers' opinions are as follows:

*"... because of the crowdedness of the classes, insufficiency in the materials of laboratory, we cannot do experiments, so we cannot give every gain to students. In addition to these, there is a problem in time management; the subjects of 7<sup>th</sup> grade cannot be finished. It is important to learn Science and Technology course with seeing, and doing, but we cannot fulfill it..."* (G4)

- Teachers' Opinions About The Improvement In Students' Learning Desires

What teachers do at the beginning of the classes to increase the desires of students' in terms of learning in the process of teaching- learning was shown in Table 2.

**Table 2.** Teachers' Opinions About The Improvement In Students' Learning Desires

| Teachers | School SES | Themes (categories)   |  |
|----------|------------|---|--|
|          |            | Example   | Question   |
| G1       | Low        | I give examples from daily life<br>I give examples from news in TV programs and news in the media | -  |
| G2       | High       | I give examples from daily life<br>I use pictures at the beginning of the units                   | I test the knowledge of students that they learned at 4 <sup>th</sup> and 5 <sup>th</sup> grades |

|    |        |   |  |
|----|--------|---|--|
| G3 | Middle | I give examples from daily life   | I test the knowledge of students that they learned at 4 <sup>th</sup> and 5 <sup>th</sup> grades |
| G4 | Low    | I give examples from daily life   | I begin classes with asking questions  |
| G5 | High   | I give examples from daily life<br>I begin classes with a suitable object to the subject          | I test the knowledge of students that they learned at 4 <sup>th</sup> and 5 <sup>th</sup> grades |
| G6 | Middle | I give examples from daily life<br>I give examples from news in TV programs and news in the media | I begin classes with asking questions  |

As shown in Table 2, the opinions of teachers were gathered into two categories, namely “example,” and “question.” When opinions of teachers who want to choose giving examples to increase students’ desires were investigated, all of the teachers stated that they give examples from daily life. Direct quotations that were gotten from teachers’ opinions are as follows:

*“By giving examples from daily life, I try to draw students’ attention to the subject...” (G4)*

*“It could be an object that draws attention to the subject... I try to capture their attention by giving examples from daily life because the lesson is about the real life...” (G5)*

When opinions of teachers who want to chose questions to increase students’ desires were investigated, three of the teachers begin classes with testing students’ knowledge that they learned at 4<sup>th</sup> and 5<sup>th</sup> grades, two of them begin classes with asking questions to capture attention. Direct quotations that were gotten from teachers’ opinions are as follows:

*“... I begin classes with question and answer section to draw attention of the students...” (G4)*

*“... The method that I use mostly is asking questions about daily life... for example, in order to explain the movement of the Earth and the Moon, I ask that “did you see the Moon last night?”, “how it looked like?” Thus, I can draw their attention...” (G6)*

- Teachers’ Opinions About The Implementation Of The Activities That Fit To The Gains

Teachers’ opinions about the implementation of the activities that fit to the gains in the teaching- learning process was shown in Table 3.

**Table 3.** Teachers’ opinions about the implementation of the activities that fit to the gains

| Teacher | School SES | Themes (categories)  |  |
|---------|------------|--|--|
|         |            | Planning, presenting, and creating activities  | Application time, place, and opportunities   |
| G1      | Low        | -  | I cannot apply because there is no laboratory and materials  |
| G2      | High       | I try to apply two out of three activities in the guidance book<br>I want students to bring materials for some activities<br>I get students to watch activities that we cannot do in class on the internet | -  |
| G3      | Middle     | We cannot apply all the activities<br>I give homework to students about activities that we cannot do in class.<br>I get students to watch activities that we cannot do in class on the internet            | I have trouble in terms of timing<br>The capacity and the readiness of the students affect the application of the activities |

|    |        |  |  |
|----|--------|--|--|
| G4 | Low    | I sometimes do activities  | I have trouble in terms of timing<br>The crowdedness of the class prevents the application of the activities<br>I do not get students to do activities because it is dangerous |
| G5 | High   | I try to apply two out of three activities in the guidance book<br>I want students to bring materials for some activities<br>I give homework to students about activities that we cannot do in class<br>If I find different activities, I try to do them also.<br>I do some activities myself and students watch me. | I have trouble in terms of timing<br>The crowdedness of the class prevents the application of the activities   |
| G6 | Middle | I want students to bring materials for some activities   | I cannot apply because there is no laboratory and materials  |

As shown in Table 3, teachers' opinions were gathered into two categories, namely "Planning, Presenting, And Creating the Activities," and "Application Time, Place, and Opportunities."

When teachers' opinions about the planning, presenting, and creating the activities category was investigated, it was founded that three of them reflected that they want students to bring materials, two of them stated that they try to do two out of three activities in the guidance book, two of them reflected that they get students to watch the activities that they cannot do in class, on the internet, two of them reflected that they give homework to students about activities that they cannot do in class, one of them pointed out that he does activities sometimes, and one of them declared that he tries to do different activities, and he does some activities himself and gets students to watch him. Direct quotations that were gotten from teachers' opinions are as follows:

*"I cannot do all activities. I give homework to students about activities that we cannot do in class or I get students to watch them on Vitamin program on internet..." (G3)*

*"... I want students to bring some materials from their home and we try to do activities with them as much as possible ..." (G6)*

When teachers' opinions about the application time, place, and opportunities of the activities category was investigated, it was founded that three of them stated that they have troubles in terms of timing, two of them stated that the crowdedness of the classes prevent the application of the activities, two of them stated that they cannot do activities because there is no laboratory and materials, one of them stated that the capacity and the readiness of the students affect the application of the activities, and one of them stated that she does not get students to do activities because it is dangerous. Direct quotations that were gotten from teachers' opinions are as follows:

*"The activities cannot be done because of the school's conditions, like lack of laboratory and insufficiency in materials." (G1)*

*"If we try to do activities, we have trouble in timing. All activities that are mentioned in the program can surpass students' capacity. Students' readiness affects the application of the activities." (G3)*

Researches show that teachers adopt the activities largely, and they try to do them (Doğan, 2009), but the high number of activities (Sert, 2008) and the lack of time make them have trouble in the application process (Wood, 2001; Sert, 2008; Tekbıyık ve Akdeniz, 2008). Moreover, only a few number of teachers do activities about subject in class (Akdeniz, Yiğit ve Kurt, 2002), and the program is not fulfilled as foreseen and enough (Gözütok, Akgün ve Karacaoğlu, 2005; Kurtuluş ve Çavdar, 2011). Besides, teachers have trouble in using local opportunities, organizing excursions, and doing research about immediate surroundings in the application of activities (EARGED, 2006). Similarly, teachers stated that they can do one experiment in a week because of the conditions of classes, they give activities as homework (Kesercioğlu, Türkoğuz, Kılınç ve Toprak, 2006), and the lack of experiments in the application of the curriculum (Wood, 2001).

- Teachers' Opinions About The Methods And Techniques That They Use In The Learning Process

Teachers' opinions about which methods and techniques they use mostly in the teaching- learning process were shown in Table 4.

**Table 4.** Teachers' Opinions About The Methods And Techniques That They Use In The Learning Process

| Teachers | School SES | Themes (categories)              |                   |
|----------|------------|----------------------------------|-------------------|
|          |            | Teacher- centered                | Student- centered |
| G1       | Low        | Question- answer teaching method | Brainstorming     |
| G2       | High       | Formal lecture method            | Discussion        |
|          |            | Question- answer teaching method | Brainstorming     |
|          |            | Demonstration                    | Six thinking hats |

|    |        |  |                             |
|----|--------|--|-----------------------------|
|    |        |  | Drama                       |
| G3 | Middle | Question- answer teaching method<br>Demonstration                    | Discussion<br>Group work    |
| G4 | Low    | Question- answer teaching method                                     | Discussion<br>Brainstorming |
| G5 | High   | Formal lectures<br>Question- answer teaching method<br>Demonstration | Observation                 |
| G6 | Middle | Question- answer teaching method                                     | Drama                       |

As demonstrated in Table 4, teachers' opinions were gathered into two categories, namely "Teacher- centered," and "Student- centered."

When the opinions of teachers that use the teacher- centered approach were investigated, it was founded that all of them use mostly question- answer method, three of them use demonstration method, and two of them use formal lectures. Direct quotations that were gotten from teachers' opinions are as follows:

*"I use firstly the formal lectures, I use mostly the question- answer, I give examples from daily life, and I use visual materials..." (G2)*

*"The method that I use mostly is question- answer ... " (G6)*

When the opinions of teachers that use the student- centered approach were investigated, it was founded that three of them use discussion method, three of them use brainstorming, two of them use drama, one of them uses six thinking hats, one of them uses observation, and one of them uses group work technique. Direct quotations that were gotten from teachers' opinions are as follows:

*"... I sometimes use brainstorming and discussion. This change depends on the subject." (G4)*

*"... I use drama to show the atom models, the movement of the gases, liquids, and solids..." (G6)*

Studies indicate that in the teaching process, the applicability of methods and techniques that foreseen in the curriculum in the class settings is not sufficient. Besides, the student- centered method is not common (Bayrak ve Erden, 2007), and it is not possible to use different teaching methods because of the crowdedness of classes (Erdoğan, 2007). Most of the teachers teach according to teacher- centered approach (Akdeniz, Yiğit ve Kurt, 2002; Yıldırım, 2011), and they use mostly the brainstorming, discussion, question- answer, group work, expression, and examples. On the contrary, they occasionally use problem solving, role playing, drama, demonstration, game method (Şahin, Turan ve Apak, 2005). Moreover, they focus on cooperative teaching (Özdemir, 2006), question- answer formal lectures (Özdemir, 2006; Güneş, Şener-Dilek, Hoplan ve Güneş, 2012). On the other hand, they seldom use laboratory, demonstration, experiment, travel- observation, analogy, projects (İzci, Özden ve Tekin, 2006).

- Teachers' Opinions About The Creation Of Democratic Learning Environment

When teachers' opinions about what they do for the creation of democratic learning environment was investigated, G6 teacher that work at a school with middle SES, stated that it is hard to create a democratic learning environment in class. G4 teacher, who work in a school with low SES indicated that the intergroup communication of students is low because of the lack of group works. Direct quotations that were gotten from teachers' opinions are as follows:

*"It is difficult to create a democratic learning environment in classes because there are active students as well as passive ones..." (G6)*

*"... I cannot get students do group work, so that the interaction within students is not well enough..." (G4)*

Factors that are important in terms of the creation of democratic learning environment according to teachers' opinions were demonstrated in Table 5.

**Table 5.** Teachers' opinions about the creation of democratic learning environment

| Teachers | School SES | Themes (categories)                   |  |  |  |
|----------|------------|---------------------------------------|--|--|--|
|          |            | Encouragement                         | Respect  | Giving opportunity to speak                              | Trust  |
| G1       | Low        | -                                     | I give importance to students' respect to each other | I try to give equal opportunity to speak to each student | -  |
| G2       | High       | -                                     | -  | I try to give opportunity to speak to all students       | I try to call students by their first name to make them trust themselves |
| G3       | Middle     | I encourage students to express their | -  | -  | -  |

|    |        |  |  |  |   |
|----|--------|--|--|--|---|
|    |        | opinions clearly   |  |  |   |
| G4 | Low    | I try to make students, who are passive and timid, involve in discussion by asking questions | -  | -  | - |
| G5 | High   | I tell students that they can ask questions about everything                                 | I give importance to students' respect to each other | -  | - |
| G6 | Middle | -  | -  | I try to give equal opportunity to speak to each student | - |

According to Table 5, teachers' opinions were gathered in four categories, namely "Encouragement," "Respect", "Giving Opportunity to Speak," and "Trust."

When teachers' opinions about the category of encouragement were investigated, it was founded that one of them encourages students to explain their ideas clearly, one of them tells students to ask questions about everything, one of them tries to get passive students participate to lesson with asking questions. Direct quotations that were gotten from teachers' opinions are as follows:

*"... I try to encourage students to participate in class. I try to get them participate in class. When they give wrong answers I say "maybe, we think in detail," instead of "it is wrong" to make them explain their ideas without hesitation. Thus, I try to create a democratic learning environment..." (G3)*

When teachers' opinions in the category of respect were investigated, it was founded that two of them give importance to make students respect for each other. Direct quotations that were gotten from teachers' opinions are as follows:

*"When students share their opinions, I give importance to make others not tease. I try to give awareness to students about this issue..." (G1)*

When teachers' opinions about giving opportunity to speak were investigated, it was founded that two of them try to give equal opportunity to every students, one of them tries to give opportunity to speak to every student. Direct quotations that were gotten from teachers' opinions are as follows:

*"I give opportunity to speak to every student." (G1)*

*"... I try to give equal opportunity to speak to students as far as in me lies..." (G6)*

When teachers' opinions about the category of trust were investigated, it was founded that G2 teacher that work at a school with high SES uses students' first names to make them believe in themselves.

Gözütok, Akgün and Karacaoğlu (2005) stated that teachers do not give importance to students' opinions, and there is no positive democratic learning environment in classes.

- Teachers' Opinions About Alternative Testing And Measurement Methods

Teachers' opinions about alternative testing and measurement methods in teaching- learning process were demonstrated in Table 6.

**Table 6.** Teachers' opinions about alternative testing and measurement methods

| Teachers | School SES | Themes (categories)   |   |
|----------|------------|---|---|
|          |            | Alternative methods and their drawbacks   | Classic methods   |
| G1       | Low        | I do not use alternative testing and measurement methods<br>Scales place a burden because there is too much work related to photocopy   | In exams, I prepare multiple choice, short essays, true false, and fill in the blanks questions.<br>In class, I do verbal exam in question and answer format                              |
| G2       | High       | I do not prefer to use alternative testing and measurement methods that foreseen in the curriculum<br>Volunteer students prepare product file<br>I give performance grade (final grade) according to students' participation in classes<br>Extra time is needed to use scales | In exams, I prepare multiple choice, short essays, true- false, matching fill in the blank questions<br>I prefer mostly multiple choice questions because we prepare students to SBS exam |
| G3       | Middle     |   | In exams, I prepare multiple choice, short  |

|    |        |  |  |
|----|--------|--|--|
|    |        | I do not prefer to use alternative testing and measurement methods that foreseen in the curriculum<br>Volunteer students prepare product file<br>I give performance grade (final grade) according to students' participation in classes<br>Scales place a burden because there is too much work related to photocopy   | essays, true- false, matching fill in the blank questions  |
| G4 | Low    | I give projects to volunteer students<br>I give performance projects to students about subjects that they can do research  | In exams, I prepare multiple choice, short essays, true- false, matching fill in the blank questions |
| G5 | High   | I do not prefer to use alternative testing and measurement methods that foreseen in the curriculum<br>I give projects to volunteer students<br>Extra time is needed to use scales  | In exams, I prepare multiple choice, short essays, true- false, matching fill in the blank questions |
| G6 | Middle | I do not prefer to use alternative testing and measurement methods that foreseen in the curriculum<br>I give projects to volunteer students<br>I give performance grade (final grade) according to students' participation in classes<br>Students determine their project subject<br>Extra time is needed to use scales<br>Scales place a burden because there is too much work related to photocopy | In exams, I prepare multiple choice, short essays, true- false, matching fill in the blank questions |

According to Table 6, teachers' opinions were gathered into two categories namely, "Alternative Methods, and Their Drawbacks," and "Classic Methods."

When teachers' opinion about the category of alternative methods and their drawbacks were investigated, it was founded that four of them do not prefer to use alternative testing and measurement methods that foreseen in curriculum, three of them give performance note (final grade) to students according to their participation in class, there of them give projects to volunteer students, three of them stated that extra time is needed to use scales, three of them indicated that scales place a burden because there is too much work related to photocopy, two of them mentioned that volunteer students prepare product file, one of them does not use alternative testing and measurement methods, one of them gives projects and performance home works seldom, one of them stated that students determine their own project subject, one of them gives performance home works that enable students to do research. Direct quotations that were gotten from teachers' opinions are as follows:

*"Scales that are foreseen in the guidance book do not allow us to teach a lesson. So I do not use that scales."* (G1)

*"... I give projects to volunteer students as term paper. They chose their own subject themselves after I determine possible subjects. I give performance homework that enables them to do research..."* (G4)

When teachers' opinions about classic methods were investigated, it was founded that all teachers prepare multiple choice, short essays, true- false, matching, fill in the blank questions in exams. One of them does verbal exam in class as question- answer format. One of them prefers multiple-choice questions because we prepare students to SBS. Direct quotations that were gotten from teachers' opinions are as follows:

*"I try to prepare exam questions in accordance with curriculum. I use multiple- choice, fill in the blank, short essays questions in exams, but not the scales that are foreseen because there is too much photocopy work there, which brings extra burden. Thus, I evaluate students with my own exams..."* (G3)

*"...My exam questions are multifarious. Indeed, they include true- false, fill in the blank, multiple- choice question..."* (G5)

Researches show that teachers pointed out about the evaluation of the curriculum that evaluation examples foreseen in the curriculum is necessary but they are not sure about the applicability of it (Bayrak ve Erden, 2007), even they do not apply it (Kurtuluş ve Çavdar, 2011). Similarly, they stated that the testing and measurement is not done enough because there is too much evaluation methods (Gündoğar, 2006; Sert, 2008), they are too complicated (Ersoy, 2008; ERAGED, 2006; Selvi, 2006), and they place a burden to teachers (Aydın ve Çakıroğlu, 2010; Özdemir, 2007), and there are some problems related to its implementation (Ayvacı ve Devocioğlu, 2009; Kurtuluş ve Çavdar, 2011; Bantwini, 2010). Moreover, they indicated that they have problems in terms of the implementation of the testing and measurement methods (Ayvacı ve Devocioğlu, 2009), and they consider themselves as inadequate in this issue

(Gözütok, Akgün ve Karacaoğlu, 2005). Doğan (2009) founded that teachers who work in schools with high SES are more likely to use testing and measurement methods.

- Teachers' Opinions About The Implementation Of Science And Technology Curriculum

Teachers' opinions about the implementation of the Science and Technology curriculum in teaching- learning process were shown in Table 7.

**Table 7.** Teachers' opinions about the implementation of the Science and Technology curriculum

| Teachers | School SES | Themes (categories)                        |  |   |
|----------|------------|--|--|---|
|          |            | Application situation                      | Factors making application easier                              | Factors making application difficult  |
| G1       | Low        | I think that I do not apply                | -  | The potentials of the school is not suitable<br>Parents' unconcernedness and their economical problems are disadvantages                |
| G2       | High       | I apply                                    | In the application process, I use teacher guidance book        | The insufficiency in materials is a problem<br>The preparation to SBS exam affects the application of the program                       |
| G3       | Middle     | I think that I apply in terms of approach  | In the application process, I use teacher guidance book        | -   |
| G4       | Low        | I think that I do not apply                | -  | The crowdedness of the classes affect the application<br>The laboratory is not available<br>The potentials of the school are not enough |
| G5       | High       | I think I apply by 80%                     | The student exercise books make it easier to apply the program | The crowdedness of the classes affect the application<br>The preparation to SBS exam affects the application of the program             |
| G6       | Middle     | In think that I apply in terms of approach | -  | The laboratory is not available<br>The insufficiency in materials is a problem  |

According to Table 7, teachers' opinions were gathered into three categories, namely "Application Situation," "Factors Making Application Easier," "Factors Making Application Difficult."

When teachers' opinions in the category of application situation were investigated, it was founded that two of them do not think they apply the program, two of them think they apply in terms of approach, one of them applies, one

of them thinks he applies by 80%. G1 and G4 who think that they do not apply the program work at schools with low SES. Direct quotations that were gotten from teachers' opinions are as follows:

"... There are several factors that affect the application of the curriculum... it is not only about the teacher... I do not think that I apply..." (G1)

"I think I apply by 80%" (G5)

When teachers' opinions about the category of factors making application easier were investigated, it was founded that two of them use teacher guidance book in the application process of the program, one of them considers student exercise books as useful in terms of the application of the program. Direct quotations that were gotten from teachers' opinions are as follows:

"I apply the program on the basis of guidance book ..." (G2)

"I follow the guidance book in the application process..." (G3)

When teachers' opinions about the category of factors making application difficult were investigated, it was founded that two of them stated that the potentials of the school are not enough, two of them consider material insufficiency as a problem, two of them see laboratory as unavailable, two of them consider the crowdedness of the classes as a problem, two of them stated that the preparation process to SBS affects the application, and one of them considers the unconcernedness and economical problems of the parents as problems. Direct quotations that were gotten from teachers' opinions are as follows:

"... This problem is specific to our school, if we had a laboratory, materials, or a Science and Technology class, I would be able to apply the program better ..." (G6)

- Teachers' Opinions About The Positive And Negative Aspects In The Application Process Of The Program

Teachers' opinions about the positive and negative aspects in the application process of the program were shown in Table 8.

**Table 8.** Teachers' opinions about the positive and negative aspects in the application process of the program

| Teachers | School SES | Themes (categories)   |   |
|----------|------------|---|---|
|          |            | Positive  | Negative  |
| G1       | Low        | It is better to be student- centered<br>It is superior to the old curriculum  | The time is not sufficient<br>Exam subjects are not taken place<br>Subjects are very superficial  |
| G2       | High       | I think that positive aspects are more than negative ones<br>In general, the program is better, it can be applied<br>I am satisfied with the program<br>It is better than the old one<br>It is suitable for student level<br>It is suitable for schools | Material insufficiency is a problem<br>Time is not sufficient<br>Some units are very extensive<br>Individual differences create problems  |
| G3       | Middle     | It is better to be student- centered<br>Being superficial of the subjects prevent students to be bored<br>It encourage students to think and research<br>Being spiral of the program is good  | Time is not sufficient<br>Activities foreseen in the program are too much for students' capacity  |
| G4       | Low        | I think that it has positive aspects as compared to the old one   | Material insufficiency is a problem<br>Time is not sufficient<br>Individual differences create problems<br>The crowdedness of the classes is a problem<br>Students' unpreparedness for lessons is a problem<br>SBS and the exams city- wide are problems<br>Parents do not have awareness<br>It is difficult for some students to reach resources |
| G5       | High       | I am satisfied with the program<br>It is better than the old one<br>It is more current than the old one   | Some units are extensive<br>The crowdedness of the classes is a problem<br>SBS exam and other exams city-wide are problems  |

|    |        |   |   |
|----|--------|---|---|
|    |        | I think positive aspects are more than negative ones                                |   |
|    |        | It is better than the old one   | The material insufficiency is a problem           |
|    |        | It is suitable for student level  | Time is insufficient                              |
| G6 | Middle | It is more current than the old one   | Students' unpreparedness for classes is a problem |
|    |        | Being spiral of the program is good   |   |
|    |        | Students are more likely to love Science and Technology lesson compared to the past |   |

As shown in Table 8, teachers' opinions were gathered into two categories, namely "Positive," and "Negative."

When teachers' opinions in the category of positive aspect were investigated, it was founded that four of them consider the curriculum better than the old one, two of them stated that being student-centered is well, two of them pointed out that positive aspects are more than the negative ones, two of them are satisfied with the program, two of them consider the program as appropriate for student level, two of them consider being spiral as a good thing, two of them stated that new program is more current than the old one, one of them stated that the program is better, it can be applied, one of them mentioned that being superficial prevent students to be bored, and make students think and research, and one of them stated that students are more likely to love Science and Technology course compared to the past. Direct quotations that were gotten from teachers' opinions are as follows:

*"... In terms of positive aspects, it is better than the old one by %80-%90. Being student-centered, activities, different teaching methods are good..." (G1)*

*"... The program has positive aspects as compared to the old one but..." (G4)*

*"... Program is better than the old one. I am satisfied with the program. Its intensity is decreased compared to the past. The old program based upon the formulas, problem-solving. Now, it based upon commentary, observation, and it is more current..." (G5)*

Teachers' opinions about positive aspects of the curriculum are supported by researches. Researches indicated that teachers' opinions about the curriculum focus on the easiness of its applicability (Probart, McDonnell, Achterberg ve Anger, 1997), its application in the current circumstances (Dellalbaş, 2010), its being spiral (Ayvaci ve Devecioğlu, 2009; Sert, 2008). The subject intensity decreased (Ercan ve Akbaba-Altun, 2005). Thus, teachers are satisfied with the program. In terms of student perspective, it was founded that program is student-centered (Tüysüz ve Aydın, 2009; Aydın ve Çakiroğlu, 2010), it is appropriate for student level (Dellalbaş, 2010; Ayvaci ve Devecioğlu, 2009; Tüysüz ve Aydın, 2009), it is current and has an interaction to real life (Tekbiyık ve Akdeniz, 2008; Ayvaci ve Devecioğlu, 2009), it allows students to learn with doing, experiencing, thinking (Sert, 2008; Yıldırım ve Dönmez, 2008), it encourages students to do research and think critically (Çınar, Teyfur ve Teyfur, 2006; Selvi, 2006), it is interesting and attention getting (Tekbiyık ve Akdeniz, 2008; Kurtuluş ve Çavdar, 2011). Hence, students are more likely to love Science and Technology course now.

When teachers' opinions about negative aspects of the curriculum were investigated, it was founded that five of them stated that time is insufficient, two of them stated that materials are insufficient, two of them consider individual differences as problem, two of them consider some units as intensive, two of them see crowdedness of the classes as problem, two of them regard student' unpreparedness as problem, two of them consider the preparation process in SBS exam and city-wide exams as problems, one of them stated that in the curriculum exam subjects do not take place, and subjects are very superficial, one of them mentioned that activities in the curriculum surpass students' capacity, one of them stated that parents do not have awareness, and finally it is difficult to reach sources for students who are not capable of. Direct quotations that were gotten from teachers' opinions are as follows:

*"In terms of negative aspects, time is not sufficient for all activities. Formal lecture, answering questions, and experiments cannot be finished in a 4 hour- period. Topics are too much disjointed, and they cannot be put together... in terms of subjects, there is not enough details. Exam subjects do not take place in the course book. There is no summary section in the course book. The important aspects about subjects do not take place in the course book. Subjects are too superficial..." (G1)*

*"...In terms of negative aspects, if we tried to do all activities we would be in trouble in terms of time. In addition, doing all activities in the curriculum surpass students' level..." (G3)*

Teachers' opinions about negative aspects of the curriculum are supported by researches. Studies show that time is not enough in terms of doing activities, and using testing and measurement techniques foreseen in the curriculum (Doğan, 2009; Yıldırım ve Dönmez, 2008; Sert, 2008; Erdoğan, 2007; Bantwini, 2010; Güneş, Şener-Dilek, Hoplan ve Güneş, 2012). The curriculum cannot be implemented because of material, equipment insufficiencies in schools (Tekbiyık ve Akdeniz, 2008; Ayvaci ve Devecioğlu, 2009; Aydın ve Çakiroğlu, 2010; Kurtuluş ve Çavdar, 2011). Moreover, the classes are too crowded (Doğan, 2009; Tüysüz ve Aydın, 2009; Adıgüzel, 2009; Bantwini, 2010; Ersoy, 2008; Dellalbaş, 2010; Okur, 2008), the content is too intensive, the number of activities, and gains are too much (Güneş, Şener-Dilek, Hoplan ve Güneş, 2012; Tekbiyık ve Akdeniz, 2008; Sert, 2008). The content is too superficial (Sert, 2008; Güneş, Şener-Dilek, Hoplan ve Güneş, 2012), the subjects surpass students' level (Ayvaci ve Devecioğlu, 2009, Güneş, Şener-Dilek, Hoplan ve Güneş, 2012), the content is not balanced with the exams in city-wide (Karaer, 2006; Sert, 2008).

If negative aspects in terms of students are considered, students tend to study in accordance with SBS exam (Özden ve Tekin, 2006); they do not do projects and performance home works (Özdemir, 2007; Dellalbaşı, 2010). Furthermore, projects surpass students' levels (Tabak, 2007), and students cannot do activities that aim to process knowledge (Adıgüzel, 2009).

Negative aspects of the curriculum in terms of parents are as follows: parents' teaching perspective focus on SBS, and they cannot change their habits (Aydın ve Çakıroğlu 2010). Parents do not have awareness and attention (Adıgüzel, 2009; Doğan, 2009; Bantwini 2010), their SES are low (Aydın ve Çakıroğlu, 2010; Özdemir, 2007). Thus, they cannot add too much thing to their children.

Besides to aforementioned factors, studies indicated that substructure, equipments, and opportunities in schools are not enough (Erdoğan, 2007; Yıldırım ve Dönmez, 2008; Ercan, 2007). Similarly, the physical conditions of classes are not suitable (Tekbıyık ve Akdeniz, 2008; Doğan, 2009; Güneş, Şener-Dilek, Hoplan ve Güneş, 2012), the school environments are negative (Hardal-Ateş ve Aşçı-Akdağ, 2006; Bağdatlı, 2005). The teaching environment is insufficient for student-centered applications (Bulut, 2008; Erdoğan, 2007); there is insufficiency in laboratories in schools (Tabak, 2007; İzci, Özden ve Tekin, 2006; Kesercioğlu, Türkoğuz, Kılınc ve Toprak, 2006). Moreover, new methods and techniques cannot be used (Gündoğar, 2006; Bantwini, 2010), students' active participation cannot be achieved (Tekbıyık ve Akdeniz, 2008; Tabak, 2007), activities cannot be implemented (Kurtuluş ve Çavdar, 2011; Wood, 2001). Besides, some activities are under the level of students (Aydın ve Çakıroğlu, 2010; Kurtuluş ve Çavdar, 2011).

## Conclusion and Suggestions

In general, it is obvious that teachers cannot implement the curriculum of Science and Technology course in classes. In order to compensate shortcomings in the application process, followings are suggested:

1. There should be some amendment in the physical conditions of schools and classes. By focusing on SES factor, teachers should determine insufficiencies in their own classes, and those should be compensated.

2. Materials that are needed for the application of activities foreseen in the curriculum should be gathered, and should be supplied to each school in the form of boxes. Those boxes should be gathered according to class, units, and subjects and they should be enough for the whole semester.

3. Teaching seminars should be organized during the semester in accordance with teachers' desires, demands, and opinions about the implementation of the curriculum.

4. For the application based Science and Technology course, the elements of the curriculum should be revised and its intensity should be minimized.

5. Duration of lessons should be revised and time management problem should be solved. The duration may be divided into three categories, namely course hour, activity hour, testing and measurement hour, which is similar to reading hour, guidance hour in schools.

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## THE FORMATION OF AUTOMOTIVE CLUSTER IN EAST MARMARA REGION OF TURKEY

Mehmet Bilgehan ERDEM, Harun Taşkın  
Sakarya University  
Department of Industrial Engineering  
Turkey  
{bilgehan,taskin}@sakarya.edu.tr

**Abstract:** Turkey is a rapidly growing country with a tremendous industrial production. Among all others, one of the rising industries, automotive industry has an important role with its mission: Production of Nation Car Project of Turkey. This study investigates an attempt of establishing an industrial cluster which emerged in East Marmara Region of Turkey. The potential of the region was analyzed in the scope of business networks and collaborations. Then, current domestic clusters were examined. Afterwards opportunities, threats and success factors were defined for the automotive cluster. Finally a roadmap was proposed for the defined cluster.

**Key words:** Industrial clusters, cluster formation, automotive cluster, East Marmara region

# THE IMPACT OF THE MECHANICAL BEHAVIOR OF THE STENT DEPLOYMENT DURING THE INSTALLATION. COMPARATIVE STUDY BETWEEN STAINLESS STEEL AND NITINOL BEHAVIOR.

T.Outtas, H.Bouhafs and A.Derardja  
Laboratory of Structural Mechanics and Materials  
faculty of technology - University of Batna  
tf\_outtas@hotmail.com, Tel/fax : 033 81 21 43

**Abstract :** The restoration of the permeability of a vessel to blood flow can be done through the introduction of stents. In this case, it is necessary to have a physical model or a numerical model to study the implementation of such elements. In this work, we approached the incidence of mechanical behavior of stent deployment during the installation.

The model considered in these calculations is a blend of an artery whose inner wall is covered with an uniform distribution of atherosclerotic plaque and a stent with chosen dimensions. The comparative study between the nitinol stent and the stainless steel 316 L shows that nitinol stents have a better behavior than the 316L steel stents when the stress is applied locally or globally. Spring back is defined by the loss of the stent diameter after removal of the balloon. This parameter is very important in clinical practice because the diameter of post-angioplasty is the major predictor of restenosis.

**Keywords :** stents, mechanical behavior, stress field, stenosed vessel, stainless steel, nitinol, alloy with shape memory.

## Introduction

The idea to restore the passage of blood flow in an artery using a permanent device was for the first time applied by the American radiologist Charles Dotter in 1969 in the case of smokers having the arteries of the blocked legs. Thereafter, the technique was improved to become current in the years 1990. Since the stents were introduced commercially in the United States in 1994, the US market followed an exponential growth involving with him the whole of the worldwide market. In 2002, more than 80% of the percutaneous interventions on the coronary arteries were accompanied by the installation of a stent.

A device such as stent which representing a metal tube inserted in the human organism after angioplasty with an aim of providing a structural support to channels reopened, was studied by Julio Palmaz and Richard Shatz in the United States [1].

In 1986, other researchers in Europe developed their clean model. The first stent inserted in a human coronary artery was carried out by Jaques Puel and Ulrich Sigwart [2]. In 1994, the model of stent conceived by palmaz-shatz was approved for the use in the United States. The properties of materials used in the manufacturing of the conventional stents particularly, their metal structure and their hardness make them harmful devices at the walls of the vessels. Consequently the development of new stent becomes a need. The researchers propose to replace metallic materials by polymers. A study of a Japanese group suggests that the conceived biodegradable stents of poly-L-lactic acid can replace the metal version. They noticed that the restenosis among patients with biodegradable stents is of 10.5% whereas it is about 20 to 30% among patients with metal stents [3]. Also, the effect of the metal stents on the coronary arteries in the long run (more than 10 years) remains unknown.

On the other hand the biodegradable stents will disappear gradually in the coronary arteries within the space of two years, which can solve this problem. The first biodegradable stent is the "biodegradable Duke stent", it is a stent ensuring a dropping of drug, it is biocompatible, it does not cause inflammatory reaction and provides a sufficient initial support to react to the force exerted by the vessel reached. Various biodegradable polymers were tested with acids poly-L-lactic (PLLA) showing good performances for thorough experiments. Such stent was used in the department of cardiology of Shiga in Japan. It was noticed that the most important characteristic of this stent is the reduction of the ignition of the vascular walls.

Frantzen [4] conceived, recently, new stent in a titanium and nickel alloy, it is an alloy which is flexible at its ends, thus it delays the formation of new arterial fabrics in these points. The ideal stent must be economic, easy to deploy, sufficiently rigid to resist the radial forces, able to deliver therapeutic agents locally and to disappear after treatment without leaving materials. Among the polymer stents which have these properties, we have the polyesters – polyorthoesters – poly anhydrides which show a potential raised for this kind of application. Several parameters such that the size or the shape of the meshes as well as metal used, characterize the mechanical behavior of stent, and can affect the restenose. When a stent is placed in a sick artery with an aim of supporting it mechanically, it is important that the

section bypass of blood (or light of the artery) on the level of stent is of a dimension close to the initial bypass section of the healthy artery in order to reduce the risks of restenose.

In her study, the team of Dr. Paul Barragan and col. [5] predicts the mechanical behavior of stent after her establishment. The test benches which were developed permit to propose reliable systems of evaluation of the mechanical characteristics of stents such as they are recommended by the European standards (IN 12006 - 3, January 1999). Indeed, the researchers measure radial resistance to the compression of twenty-seven models of stents present on the market. It is a question of measuring the deformations which the stents of small gauge undergo when they are subjected to external pressures similar to that exerted by the arterial wall and to appreciate their resistance to extreme requests. They show that all the studied stents, although presenting each different mechanical characteristic, were sufficiently resistant to present a healthy behavior after establishment [6]. Another problem emerges following this study; intrinsic elastic retreat or "recoil", which is determining as for the final gauge of the artery with stent. Indeed, one stent dilated with a given diameter returns naturally to a lower diameter after deflation under the action of its internal stresses [7]. This retreat is all the more important as external constraints (even weak) are applied by the wall of stent. This problem is the object of current researches.

In this work, we approached the incidence of the mechanical behavior of stent on its deployment at the time of the installation. The model considered in these calculations is an assembly of an artery whose interior wall is covered with an athérome plate uniformly distributed and a selected size stent.

## Modeling and properties

The model considered consists of an assembly of the arterial wall and stent. Boundary conditions specific are established such as stent it is studied in its fixed position. In order to simplify the study, the wall is comparable with a cylinder including a layer, thickness  $E$ , uniformly distributed which represents the atherome plate settling on the interior wall of the artery and leading to a stricture [8]. Calculations are carried out for two types of materials and for the same geometry of stent. The materials are: stainless steel doubles phase and nitinol.

The artery is supposed an elastic tubular structure whose ray is of 5 mm and thickness equal to 0.5 mm [13]. The length of the artery considered is equal to 16 mm. the properties of the arterial walls are mentioned in table 1.

**Table1** : properties of the arterial wall.

|                                     |        |      |
|-------------------------------------|--------|------|
| Elastic limit (N/m <sup>2</sup> )   | 170000 | [13] |
| Elastic Modulus (N/m <sup>2</sup> ) | 106    |      |
| Poisson's ratio                     | 0.35   | [14] |
| Density (kg/m <sup>3</sup> )        | 1200   |      |

The atherome plate constitutes actually an anisotropic and rigid medium. In this simulation we consider that the atherome plate is isotropic and has the properties defined in the table 2.

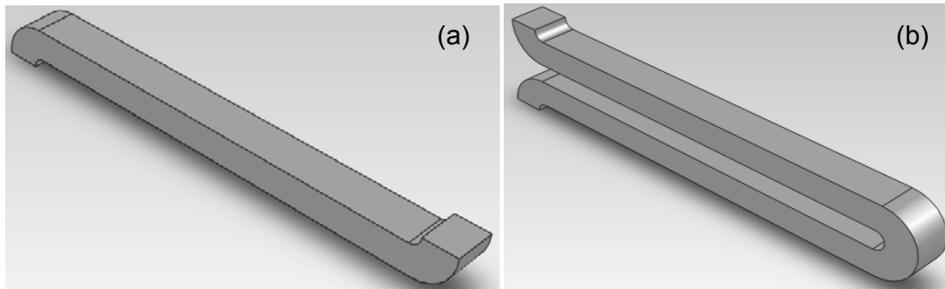
**Table2** : properties of the atherome plate.

|                                     |                |
|-------------------------------------|----------------|
| Elastic limit (N/m <sup>2</sup> )   | 300000         |
| Elastic Modulus (N/m <sup>2</sup> ) | $2 \cdot 10^6$ |
| Poisson's ratio                     | 0.34           |
| Density (kg/m <sup>3</sup> )        | 1200           |



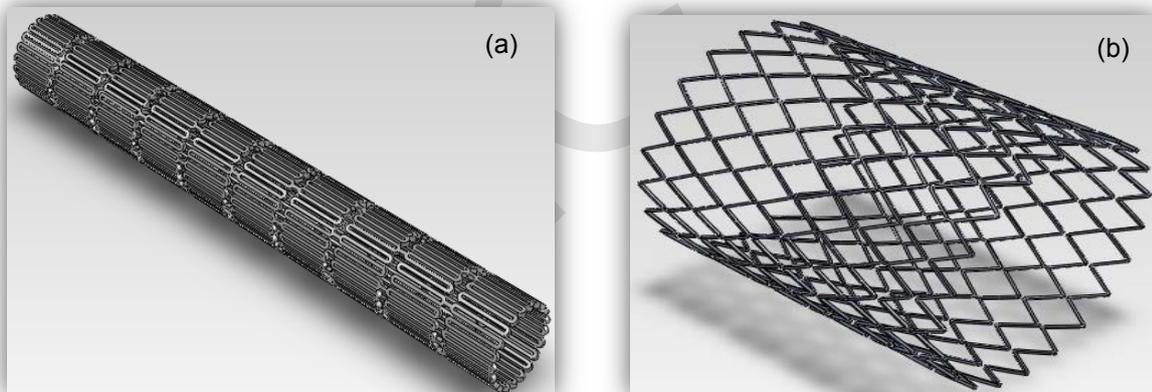
**Figure 1:** assembly of the arterial wall with atherome plate and stent

The geometry of stent considered is based on the assembly of structural units called “struts” schematized in figure 2, [14].



**Figure 2:** (a) structural unit called (strut), (b) assembly of two structural units

The structural units are assembled over a pre-selected length  $L$ . Stent in a not-deployed state is represented on the figure 3.(a) and stent it in a state deployed i.e. in its final form is represented on the figure 4.(b).



**Figure 3:** (a) Stent in a not-deployed state, (b) stent it in a state deployed i.e. in its final form, [14].

#### **Boundary conditions, charges and meshes.**

For the boundary conditions, we consider that the external walls all around stent is blocked (see Fig.4), which will possibly allow us, after application of the loads, to note or not the movement of stent relative to the wall.

##### **a) Force exerted on external surface of stent:**

In this kind of simulation we use a size relating to the force called radial pressure which results from the application of the radial forces on the wall-athérome-stent unit. It is about 129 KPa [14]. To optimize time calculation, only half of the cylinder is taken, so the radial pressure becomes 64.5 KPa.

##### **b) Blood pressure:**

Let us note  $P_2$  the blood pressure, it is a pressure which is exerted on the interior wall of the artery. It is function of the blood flow. We consider in the first calculation the case of a hypertensive person. In this case the systolic pressure is equal to 120 mm Hg and the diastolic pressure is equal to 80 mm Hg.

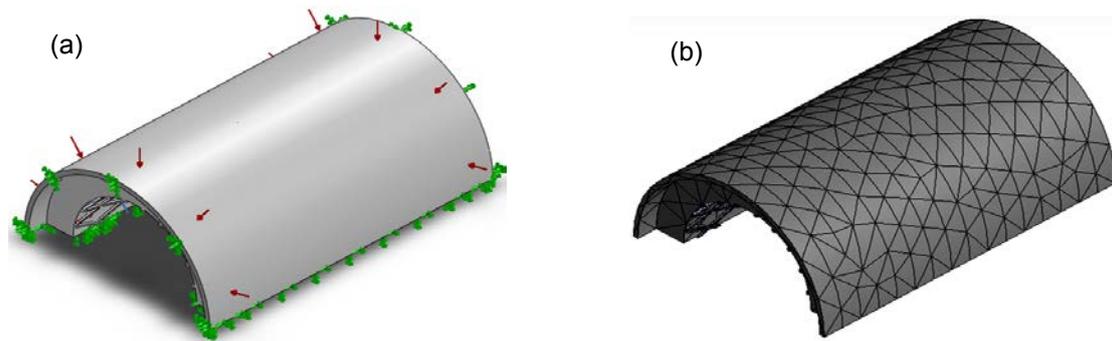


Figure 4: (a) Boundary conditions and charges, (b) global meshes with tetrahedral elements.

### c) Shear stress:

The vessels are permanently subjected to mechanical constraints associated with the blood pressure and blood flow. The blood pressure exerts on the vascular wall of the forces perpendicular to endoluminal surface. Those are compensated by tangential intra-parietal forces in the tangential and longitudinal directions are exerted by the various elements of this wall and being opposed to the effects of distension of the blood pressure. In the tangential direction, the force per unit of length of the vessel, or parietal tension  $T$  is related on the blood pressure  $P$  and the ray  $R$  of the vessel by the law of Laplace:  $T = P.R$ . The relation which exists between the shear stress and the deformation of the vessel depends at the same time on the geometry and the elastic characteristics of its wall. The shear stress is actually supported by all the thickness of the arterial wall. The tension reported to the unit thickness represents the constraint which is exerted on the wall in the tangential direction.

It is expressed as :  $\tau = P.r / h$

When blood runs out, he exerts a force of friction on the endothelial surface. This force results in shear stress  $\tau$  at the endothelium definite as the product of the viscosity of the blood and the gradient blood speed measured on the the wall. In the case of a laminar flow, the shear stress is expressed like:

$$\tau = 4 \mu Q / \pi r^3$$

with :  $\mu$  = viscosity of blood

$Q$  = volume flow

The value of the shear stress considered in calculations is equal to 1.5 Pa [12].

## Results and discussions.

For numerical simulation, the drawing and the design were realize on Solidworks and calculations on Cosmos works.

### a) Stent in Nitinol.

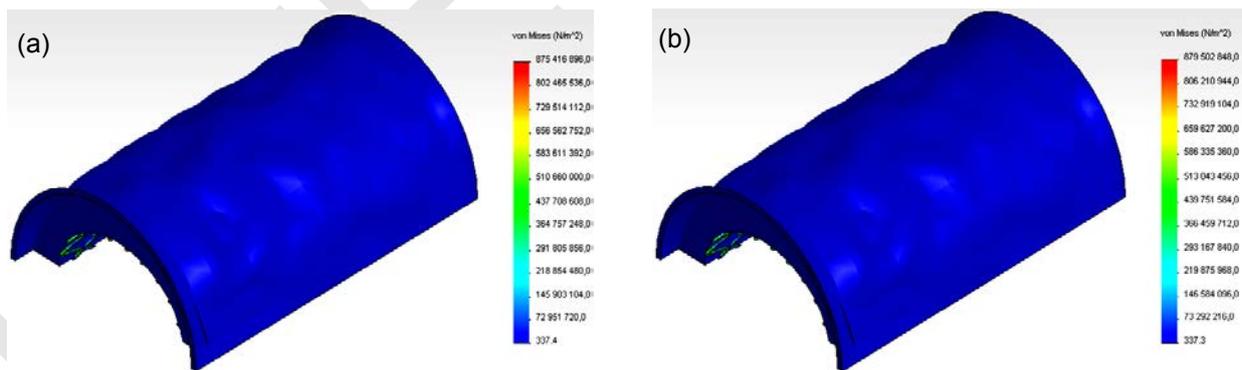


Figure 5: VonMises nodal stresses, (a) Systolic pressure case, (b) diastolic pressure case

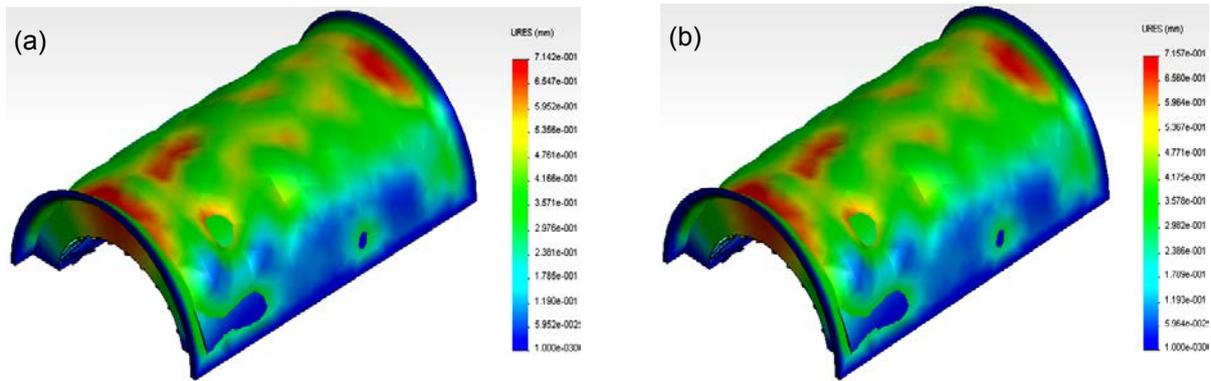


Figure 6: generalized nodal displacement, (a) Systolic pressure case, (b) diastolic pressure case

### b) Stent in stainless steel 316L.

The values of the Von Mises stresses obtained indicate that deployed stent is in a plastic state. Consequently, stent is unable to become deformed under the action of other charges. The constraints largely exceed the value of the elastic yield stress of material. for stent in Nitinol and in the case of the diastolic pressure, the maximum value of Von Mises stress is of 879 MPa.

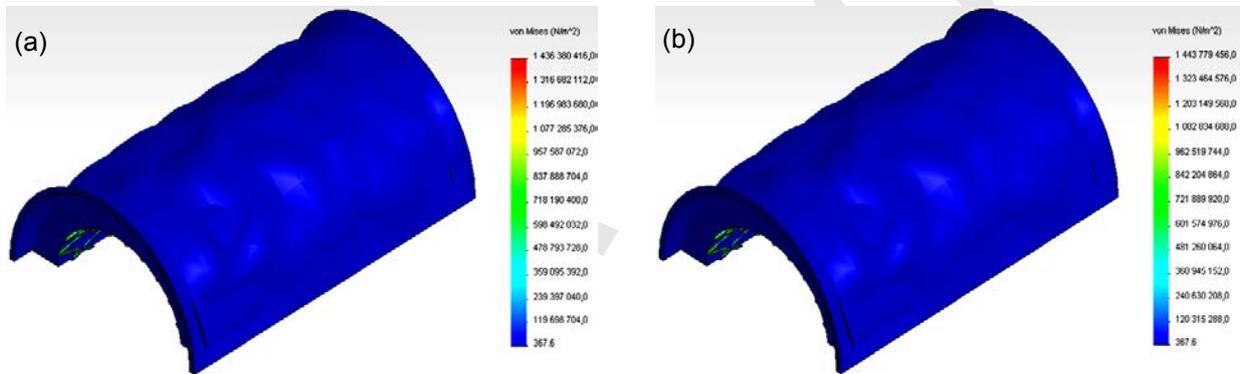


Figure 7: VonMises nodal stresses, (a) Systolic pressure case, (b) diastolic pressure case

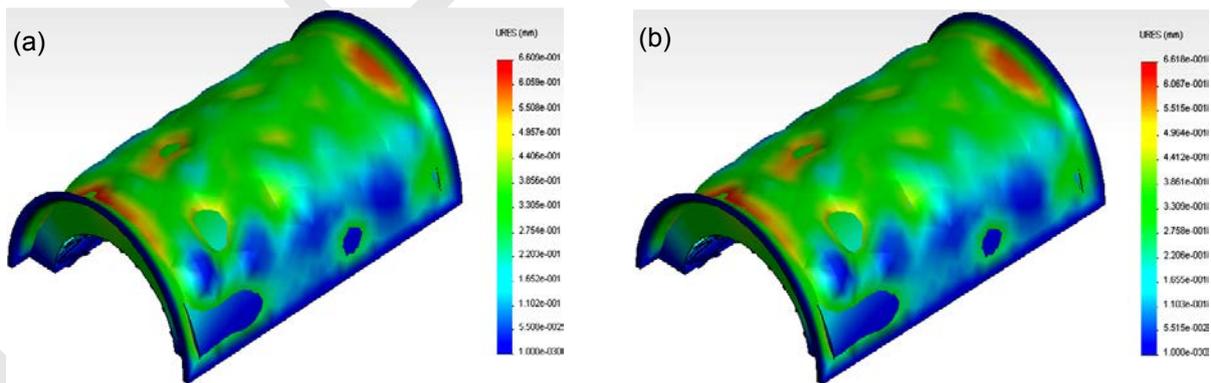


Figure 8: generalized nodal displacement , (a) Systolic pressure case, (b) diastolic pressure case

The Von Mises stresses obtained for the stent in stainless steel are largely exceed those obtained in nitinol one. Indeed, the maximum value reached by the Von Mises stress is equal to 1443 MPa at the nodes of stent, what makes them fragile and they are, consequently, prone to a rupture.

Once deployed, stent it does not have to move and must adhere completely to the arterial wall. In order to examine this property for the nitinol stents we calculate nodal displacements resulting from the axial components. The figure (6) indicates that the displacement of stent can reach 0,715 mm, and a maximum rate of deformation equal to 0.28%. The value of axial displacement for stent in stainless steel does not exceed 0.7 mm. It is slightly lower that obtained in the case of nitinol

## Comparative study.

In order to look closely the evolution of the yield stress according to the coefficient of friction of materials chosen, we considered an interval of variation of the coefficients of friction between 0.01 and 0.06. The objective of this comparison is to see whether the proposal of a coating of material is necessary. It seems that, for two materials, the constraint is rather high and the plastic deformation is reached conferring on stent a satisfactory fixing.

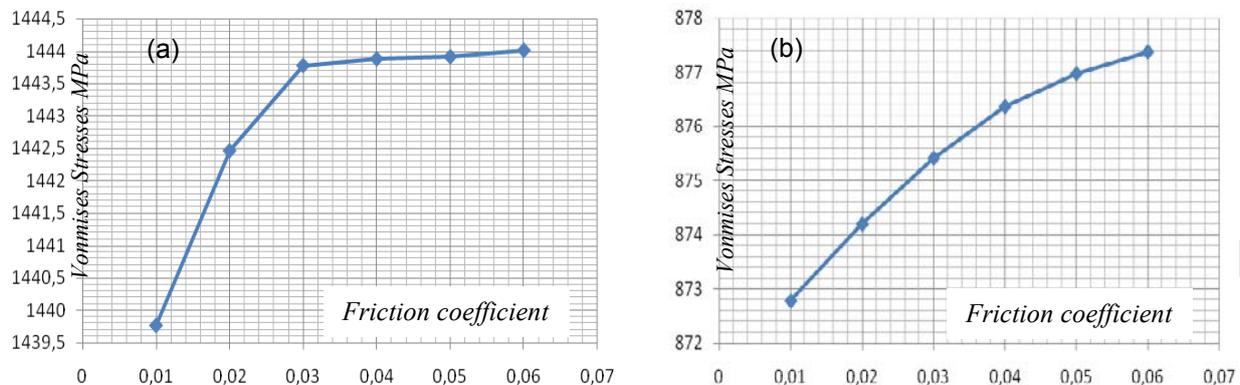


Figure 9: Evolution of the Von Mises stress yield according to coefficient of friction, (a) Stent in stainless steel, (b) Stent in Nitinol.

## Conclusions

The comparative study between stent in nitinol and stent in stainless steel 316 L shows that the nitinol stents have a better behavior than the steel 316L stents when the constraint is applied locally or overall. The elastic return is defined by the loss of diameter of stent after withdrawal of the inflated balloon. This parameter is very important in clinical practice since it is known that the diameter post-angioplasties is the major predictive factor of the restenose. In this case, the installation of stent is accompanied by a plastic deformation whereas a rate of deformation of 0,28% is noted. We in addition, calculated the evolution of the constraints and displacements according to the coefficient of friction. The results show that displacement is nearly constant for the margin of the coefficients of frictions taken.

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# THE INFLUENCE OF STUDENTS' LEARNING MOTIVATION ON PROGRAMMING LEARNING PERFORMANCE IN A ROBOTICS COURSE

Chun Hung Lin<sup>a\*</sup>, Eric Zhi Feng Liu<sup>a,b</sup>, Wan-Ling Chang<sup>a</sup>

<sup>a</sup>Graduate Institute of Learning and Instruction, National Central University, No.300, Jhongda Rd., Jhongli City, Taoyuan County 32001, Taiwan (R.O.C.)

<sup>b</sup>Center of Teacher Education, National Central University, No.300, Jhongda Rd., Jhongli City, Taoyuan County 32001, Taiwan (R.O.C.)

**Abstract** The main purpose of this article was to investigate the influence of learning motivation on students' programming learning performance and learning strategies use. In this study, there were 119 junior high school students participated in the study. The results indicated that students have high motivation to participate in the robotics programming learning activities. Besides, it was also found that intrinsic, extrinsic motivation, self-efficacy, and learning anxiety were positively correlated with learning performance. Moreover, the results of regression analysis indicated that self-efficacy is an effective predictor of learning performance. Furthermore, it was also found that students with high self-efficacy would use more self-regulated learning strategies than students with moderate self-efficacy. After analyzing the usage of learning strategies between students with different self-efficacy, it was found that student with high self-efficacy would apply more self-regulated learning strategies during the learning process than students with moderate self-efficacy. According to the findings, we proposed some suggestions for programming instruction, and some directions for future studies.

**Keywords:** *Motivation; programming learning; robotics; learning strategies; LEGO Mindstorms*

## THE INFLUENCE OF THE CUTTINGS ON THE RHEOLOGICAL CHARACTERISTICS A DRILLING MUD.

Mellak Abderrahmane and Benyounes Khaled  
Department Mining and Oil Deposits - LGPH.  
Faculty of Hydrocarbons and Chemistry.  
University of Boumèrdes - 35000 - Algeria.  
Mellakabder@yahoo.fr

Abstract: Today, the drilling mud is of paramount importance for the realization of an oil well as a mud inappropriate to the drilled formation can lead to loss of the well.

The drilling fluid serves multiple roles whose primary role is the continuous rise of rock drilled cuttings (cuttings) by the drill bit to clean optimally the well bottom and allow better progress of the tool (to increase the number of meters drilled) which remains the best performance criterion.

Originally Rotary drilling, the only way to remove the cuttings was the settling of mud in mud tanks, which was not very effective and made the control of the mud very random.

The technique has evolved many ways to remove solids, contained in drilling mud have been developed to minimize problems that can cause the elimination of these non-solid, having a negative influence both on the physical characteristics that rheological the drilling mud.

This study examines the influence of solids content and its effects on the physical characteristics (density) and rheological (viscosity, yield value and gels) to improve the advancement of the tool, eliminating or at least greatly reduce the risk of loss of mud into the formation and reduce the risks of sticking by differential pressure ( $\Delta P$ ) by improving the impermeability of the cake of the drilling mud.

Keywords: Oil wells, drilling mud, solids content, rheological characteristics.

# THE INVESTIGATION OF INDUCTION MOTORS UNDER ABNORMAL CONDITION

Benamira Nadir<sup>1</sup>, Rachedi Mohamed Faouzi<sup>2</sup>, Bouraiou Ahmed<sup>3</sup>

<sup>1,2</sup>Electromechanical department, Badji Mokhtar-Annaba University, P.O box 12, 23000 Annaba, Algeria

<sup>3</sup>Electrical engineering department, 20<sup>th</sup> August 1955-skikda University, B.P. 26, 21000 Skikda, Algeria  
Nadir-benamira@live.fr

**Abstract:** This paper aims to present the negative effects of the unbalanced sinusoidal voltage on the operating of induction motors; this voltage quality anomaly could cause serious problems such as highly unbalanced currents on the stator, mechanical oscillations and interference with control electronics. In this research the detection of this unhealthy situation of the motors has been investigated; using firstly, the stator currents data patterns recognition, as a preliminary diagnosis. Secondly, the focus on the second harmonic of the supply frequency in the torque spectrum signal has shown its effectiveness as a complementary indicator of voltage unbalance. The steady-state of the induction motor and the several unbalanced voltage systems presented, were done by a simulation using the well-known Matlab.

**Key words:** induction motors, Voltage unbalance, Fault detection, Current patterns, THA.

## Introduction

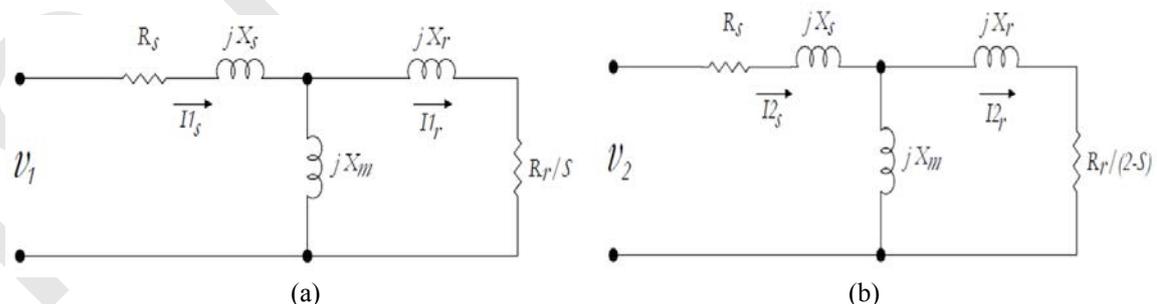
The three-phase squirrel cage induction motors are widely used in modern industry because of their Simple construction and ruggedness. However condition monitoring of the induction motor (IM) becomes a necessity to prevent any unplanned stops and breakdowns (Çakır et al, 2009).

Various phenomena can create difficult problems in the performance of IM. The stator unbalanced voltages is one of them, the most of IM is directly connected to the power grid. Hence, it is very important to clarify the effect of voltage unbalance on the characteristics of IM.

The effects of voltage unbalance on the induction motors are stated as reduction on efficiency, mechanical oscillations and highly unbalanced currents on the stator; this last lead to a temperature rise, and decrease the insulation of the electrical conductors in the stator. This thermal stresses lead to the loss of life in induction motors (Çakır et al, 2009).

Voltage unbalance generates negative sequence component in the voltage. The sense of rotation of the field corresponding to the negative sequence is opposed to the one of the field corresponding to the positive sequence. That is why in the case of unbalanced voltage, the resulting magnetic field becomes elliptic rather than circular. This negative sequence flux produces several adverse effects, such as increased copper losses in the stator and in the rotor, power pulsations and torque pulsations. This last is because of a supplementary torque with a double frequency of the applied voltage (Çakır et al, 2009, Donolo et al, 2011).

In this paper the behavior of a simulated IM, under an unbalanced supply voltage have been studied using the well-know MATLAB/Simulink.



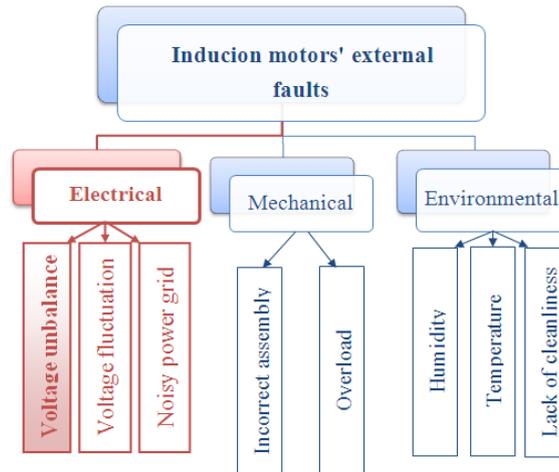
**Figure 1:** Single-phase equivalent circuits of the motor: (a) Positive-sequence, (b) negative-sequence.

The subscripts s and r denote the stator and rotor, 1 and 2 refers the positive and the negative sequences respectively.

## Classification of the voltage unbalances and its different cases

The appearance of some symptoms in the induction motors like vibrations, increased noise levels and the temperature rises in the stator is not necessarily an evidence of an internal fault, like Bearing Faults or stator

short-circuit... etc. The stator unbalanced voltage is an external fault, which may cause these symptoms. So, the faults that affect the motor are divided into two parts: internal and external faults, the following figure summarize the various external faults:



**Figure 2:** Classification of the external faults

The different unbalanced cases in the three phase systems are (Lee, 1998):

Single phase under-voltage unbalance (1Φ-UV), two phases under-voltage unbalance (2Φ -UV), three phases under-voltage unbalance (3Φ-UV), single phase over-voltage unbalance (1Φ -OV), two phases over-voltage unbalance (2 Φ -OV), three phases over-voltage unbalance (3 Φ -OV), unequal single phase angle displacement (1 Φ -Ang), unequal two phase angles displacement (2 Φ -Ang).

## Analysis of balanced and unbalanced condition

### Balanced case

The simulated motor (0.75 kW) was supplied by its rated voltage which is 311.12(V) peak for each phase. The simulation of the motor in the steady state and the unbalanced operation is done at no-load condition.

Most of the common methods used to identify faults in induction motor are based on the analysis of the stator currents. The Park's vector and the 3D current pattern approaches, also use the analysis of stator currents. However, in these methodologies, the fault detection will be converted into the pattern and depends on the change on this latter (Samsi et al, 2009). Considering three-phase induction motors without neutral connection, and ideal conditions for the motor and with "unbalanced voltage supply" (Martins et al, 2011), the stator currents are given by:

$$\begin{cases} I_A = I_m \sin(\omega t - \varphi) \\ I_B = I_m \sin(\omega t - \frac{2\pi}{3} - \varphi) \\ I_C = I_m \sin(\omega t - \frac{4\pi}{3} - \varphi) \end{cases} \quad (1)$$

Where  $I_A$ ,  $I_B$ , and  $I_C$  :are the three stator currents;  $I_m$  : maximum value of the supply phase current;  $\omega$  : Supply frequency;  $\varphi$  : The phase angle;  $t$ : Time variable.

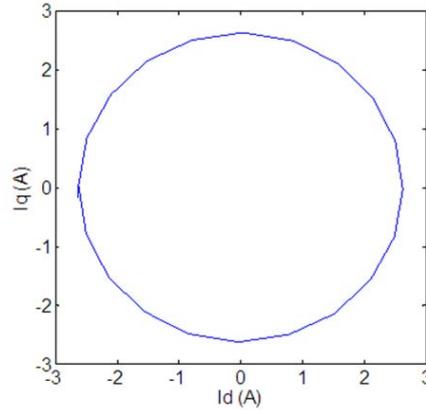
The components of the stator current in a reference system formed by two octagonal shafts which are fixed to the stator are obtained by the following reports:

$$\begin{cases} i_d = \sqrt{\frac{2}{3}} I_A - \frac{1}{\sqrt{6}} I_B - \frac{1}{\sqrt{6}} I_C \\ i_q = \frac{1}{\sqrt{2}} I_B - \frac{1}{\sqrt{2}} I_C \end{cases} \quad (2)$$

Where  $i_d$  and  $i_q$  are the direct and quadrature axis currents respectively, under ideal operating conditions, when the supply currents constitute a positive sequence system, the three phase currents lead to a Current Park's vector with the components:

$$\begin{cases} i_d = \frac{\sqrt{6}}{2} I_m \sin(\omega t) \\ i_q = \frac{\sqrt{6}}{2} I_m \sin(\omega t - \frac{\pi}{2}) \end{cases} \quad (3)$$

Under this Ideal condition the direct and quadrature axis currents represent a circle centered at the origin of the coordinators. So, this is very simple reference figure that allows the detection and the identification of abnormal conditions by monitoring the deviations of acquired patterns (Cruz et al, 2001).



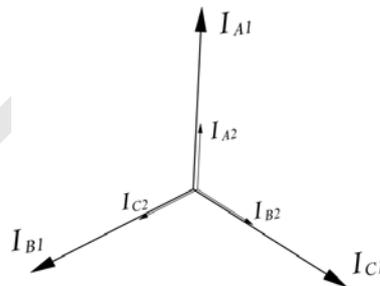
**Figure 3:** Current Park's vector pattern for ideal operating condition

In the 3D stator current pattern, also we denote a circle centered at the origin of the coordinates, for ideal condition where its radius  $R$  is:

$$R^2 = I_A^2 + I_B^2 + I_C^2 \quad (4)$$

### Unbalanced cases

The stator asymmetry is a general concept of any stator unbalance, whether stator winding fault or/and voltage unbalance. So under these abnormal conditions, the previous circle pattern no longer appears because the motor supply current will contain negative-sequence component besides the positive-sequence component.



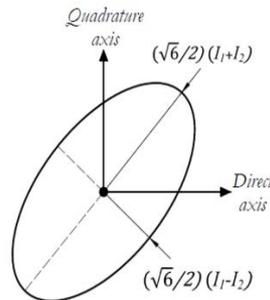
**Figure 4:** Induction motors' currents under unbalanced voltage

$$\begin{cases} I_A = I_{A1} \sin(\omega t - \varphi) + I_{A2} \sin(\omega t - \varphi) \\ I_B = I_{B1} \sin\left(\omega t - \frac{2\pi}{3} - \varphi\right) + I_{C2} \sin\left(\omega t - \frac{4\pi}{3} - \varphi\right) \\ I_C = I_{C1} \sin\left(\omega t - \frac{4\pi}{3} - \varphi\right) + I_{B2} \sin\left(\omega t - \frac{2\pi}{3} - \varphi\right) \end{cases} \quad (5)$$

The motor supply current can be expressed as the sum of a positive and a negative- sequence component. It can also be shown that the length of the major axis is directly proportional to the sum of the amplitudes of the positive and negative-sequence components of the motor supply current, while the difference between the amplitudes of these two components is directly proportional to the length of the minor axis.

$$\begin{cases} i_d = \frac{\sqrt{6}}{2} (I_1 + I_2) \sin(\omega t) \\ i_q = \frac{\sqrt{6}}{2} (I_1 - I_2) \sin(\omega t - \frac{\pi}{2}) \end{cases} \quad (6)$$

So for an induction motor with a stator asymmetry the current pattern assumes an elliptic pattern whose major axis orientation is associated with the faulty phase (Cruz et al, 2001, Pires et al, 2010, Nejari, Benbouzid, 2000).



**Figure 5:** Current Park's vector representation for a stator asymmetry (Cruz et al, 2001)

As the stator currents differ from each other by  $120^\circ$  electrical, it is important to note that the three ellipses' major axis differ from each other by  $120$  spatial degrees in both park's vector approach and the 3-D current referential (Pires et al, 2010, Martins, 2011). The severity of the motor fault must be reported, which is related with the eccentricity of the ellipse. In this way, the new index is proposed, allowing the pattern identification and the fault severity measure.

$$S_{st} = 1 - \frac{\lambda_{low}}{\lambda_{high}} \quad (7)$$

The parameters  $\lambda_{high}$  and  $\lambda_{low}$  denote respectively, the highest and lowest length of the ellipse axes. It is important to note that  $\lambda_{high}$  refers to the axis where the fault occurs - principal direction carrying more energy (Morsia, El-hawary, 2011, Martins, 2011). This severity index assumes values between zero and one, being the absence of any fault reported by a zero severity index ( $S_{st} = 0$ ).

The symmetrical components transformation (Fortescue transformation) is ubiquitous and is used to transform any three-phase system voltages or currents into three single-phase systems using the following symmetrical components transformation matrix in the phasor domain:

$$\begin{bmatrix} V_0 \\ V_1 \\ V_2 \end{bmatrix} = \frac{1}{3} \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix} \begin{bmatrix} V_A \\ V_B \\ V_C \end{bmatrix}, \begin{bmatrix} I_0 \\ I_1 \\ I_2 \end{bmatrix} = \frac{1}{3} \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix} \begin{bmatrix} I_A \\ I_B \\ I_C \end{bmatrix} \quad (8)$$

the subscripts A, B, and C, refer to each one of the components of the phase of the real system, while 0, 1, and 2, are the zero, positive and negative sequence voltages and currents respectively, The operator 'a' is the Fortescue operator:  $a = 1 \angle 120^\circ$ .

In this paper the obtained elliptic patterns in the following simulation experiments, are resulted from the unbalanced voltage.

## Fault detection

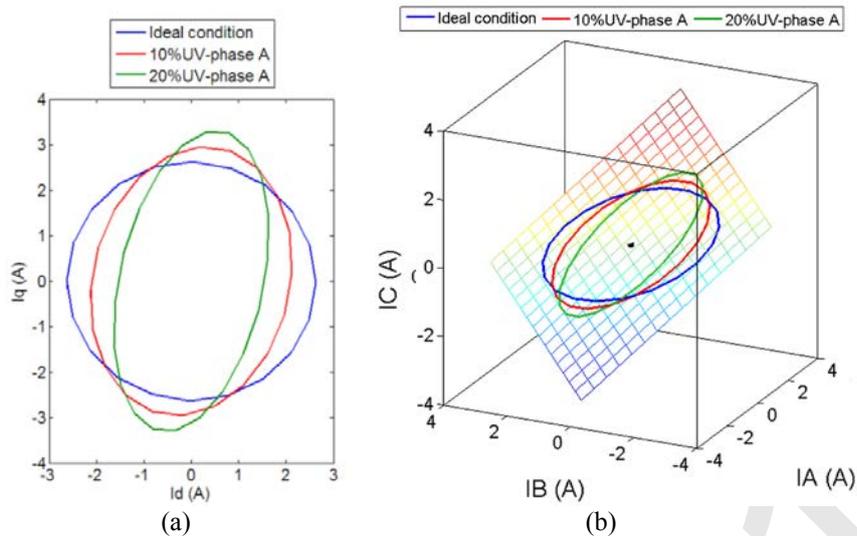
### Unbalance in the voltages magnitude

- Under voltage in phase A and healthy state for phase B and phase C:

First an unbalance of 10% after this, an unbalance of 20% of the rated voltage is assumed for phase A. The values of the voltage for the three phases in these two cases are:

10% UV-phase A  $\{V_A=280 \quad V_B=311.12 \angle 20^\circ, V_C=311.12 \angle 40^\circ\}$

20% UV-phase A  $\{V_A=248.89 \quad V_B=311.12 \angle 20^\circ, V_C=311.12 \angle 40^\circ\}$



**Figure 6:** (a) Current Park's vector pattern, (b) 3D stator current pattern; for 10% and 20% under voltage in phase A

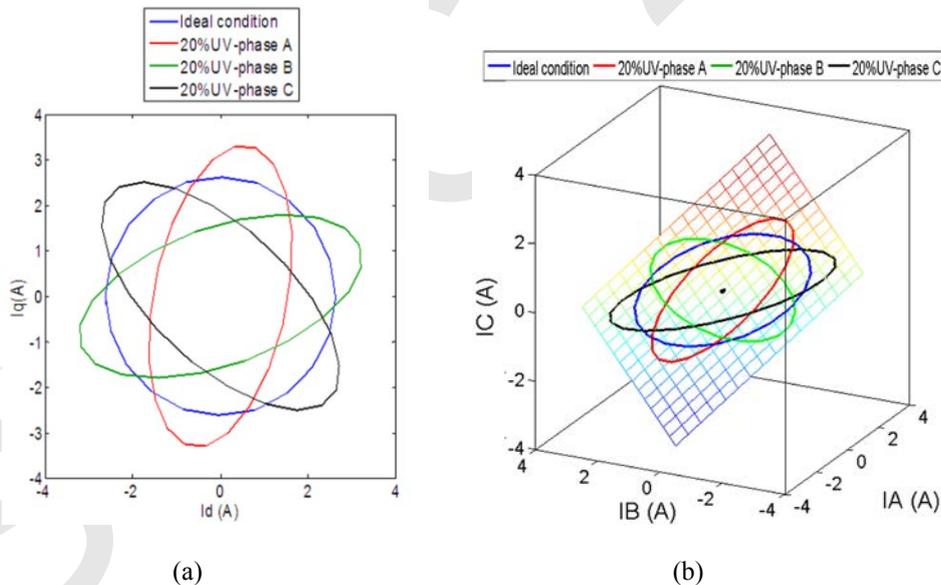
- Under voltage in phase A, B and C:

An unbalance of 20% of the rated voltage is assumed for phase A, B and C. The values of the voltage for the three phases in these cases are:

$$20\%UV\text{-phase A } \{V_A=248.89 \angle 0^\circ, V_B=311.12 \angle -120^\circ, V_C=311.12 \angle -240^\circ\}$$

$$20\%UV\text{-phase B } \{V_A=311.12 \angle 0^\circ, V_B=248.89 \angle -120^\circ, V_C=311.12 \angle -240^\circ\}$$

$$20\%UV\text{-phase C } \{V_A=311.12 \angle 0^\circ, V_B=311.12 \angle -120^\circ, V_C=248.89 \angle -240^\circ\}$$



**Figure 7:** (a) Current Park's vector pattern, (b) 3D stator current pattern; for 20% under voltage in phase A, B and C

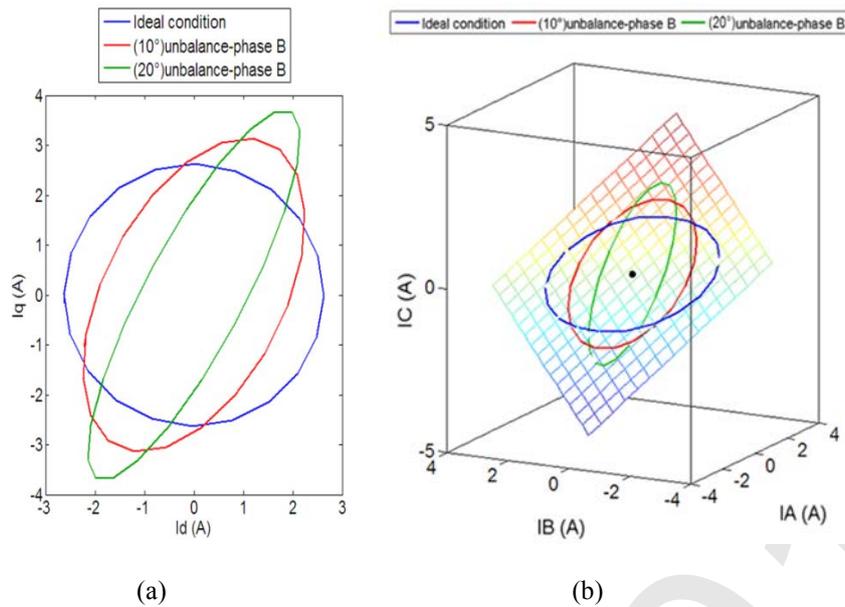
### Unbalance in the voltage phase

- (10°) and (20°) angle unbalance displacement of angle's phase B :

First an unbalance of 10° after this, an unbalance of 20° are assumed for the phase A, the values of the voltage for the three phases in these two cases are:

$$(10^\circ) \text{ unbalance -phase B } \{V_A=311.12 \angle 0^\circ, V_B=311.12 \angle -110^\circ, V_C=311.12 \angle -240^\circ\}$$

$$(20^\circ) \text{ unbalance -phase B } \{V_A=311.12 \angle 0^\circ, V_B=311.12 \angle -100^\circ, V_C=311.12 \angle -240^\circ\}$$



**Figure 8:** (a) Current Park's vector pattern, (b) 3D stator current pattern; for (10°) and (20°) angle displacement in phase B

In certain research the obtained elliptic pattern from the Park's vector approach is considered as direct sign of an unbalanced voltage. Other researches consider the elliptic plot from the 3D currents pattern as sign of a stator winding fault. From a physical point of view, it should be considered as a stator asymmetry in general (stator winding fault and/or voltage unbalance). So, in this work we consider these results as a preliminary diagnosis. And the voltage unbalance must be distinguished from stator winding fault signatures. So using another complementary technique to finalize the investigation is necessary, and that is the content of the next section.

### Torque harmonic analysis (THA)

A variety of researches have been done on modeling of unbalanced voltage condition (Phase or Magnitude) in induction motors. To detect this anomaly, has turned to the use of the torque harmonic analysis (THA), in the case of unbalanced voltage, the component spectrum that appears is (100Hz) in the spectrum of the torque, this effective technique will be used in this research. The torque can be written by the following equation (Mirabbasi et al, 2009, Khoobroo et al, 2008):

$$T = \frac{P}{\omega} = \frac{P_0 + P_2}{\omega} = T_0 + T_2 \quad (9)$$

$T_0$  is the DC torque;  $T_2$  is the torque component whose frequency is twice the supply frequency.

In order to simplify the survey, we suppose that the induction motor is as an RL load, the torque will be written as follows:

$$T = \left( \frac{1}{\omega} \right) \times \eta \times V \times I \quad (10)$$

$V$  is the input voltage,  $I$  is the current of each phase,  $\eta$  is the motor efficiency.

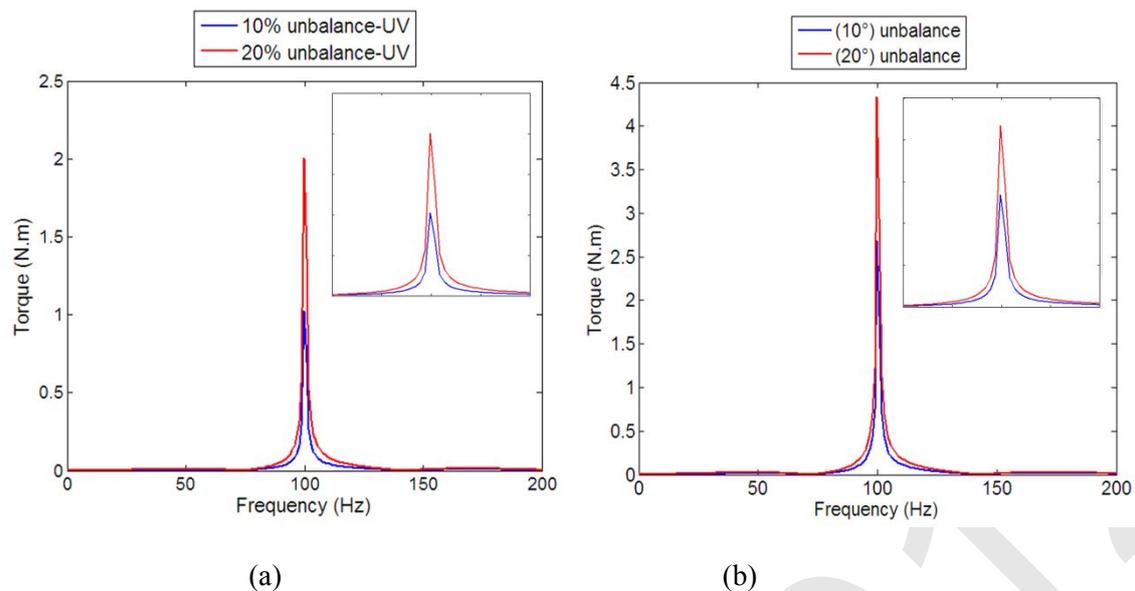
As we supposed previously, sinusoidal waveforms for voltage and current is applied, so the equation can be rewritten as:

$$T = K \cos(2\pi 50t + \alpha) \times \cos(2\pi 50t + \beta) \quad (11)$$

So,

$$T = K' \{ \cos(\alpha - \beta) + \cos(2\pi 100t + \alpha + \beta) \} \quad (12)$$

Based on this equation the resulting torque would include a DC term and a term with twice of the fundamental frequency of the applied voltage ( $2fs$ ) as expected, this component which is absent in normal operating condition, can detect the fault. So any kind of unbalanced voltage in induction machines is detectable via torque harmonic analysis.



**Figure 9:** Torque harmonic analysis in case of (a) 10% and 20% under voltage; (b) 10° and 20° angle displacement

## Conclusion

It has been reviewed that the stator voltage imbalance has a negative effects on the performance and the efficiency of the induction motors.

In order to detect this anomaly the stator currents data pattern (Park's vector approach or 3D stator currents pattern) is used. Because of the similarity of the obtained signatures between the stator unbalanced voltage and the stator winding fault, these last are considered as an initial diagnosis. To distinguish between these two faults, the torque harmonic analysis is used as a complementary technique in this study. The second frequency component ( $2f_s$ ) that appears in the spectrum of the torque can detect and specify any kind of voltage unbalance in the induction motors.

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## THE RESPONSE OF THE ACCUMULATED BIOMASS AND THE EFFICIENCY OF WATER USE IN FIVE VARIETIES OF DURUM WHEAT LINES UNDER WATER STRESS

Melle Fellah Sihem, M A Department of Dental Surgery, Faculty of Medicine, Constantine, Algeria

The optimal use of soil moisture by culture, is related to the leaf area index, which stood in the cycle and its modulation according to the prevailing stress intensity (Siman et al., 1993, Tardieu, 2003). For a given stock of water in the soil, cultivar adapted and saving water is one that is no luxury consumption during the prèanthese (Siddique et al., 1989; Passioura, 2002). It modulates the leaf area index to regulate sweating in the degree of its water supply (Siman et al., 1993, Richards et al., 2002). In plants water saving, avoidance of dehydration is related to the reduction of water loss by cuticular and stomatal pathways. Muchow and Sinclair (1989) reported that the test of relative water content (TRE) is considered the best indicator of leaf water status. The search for indicators of the ability of the plant to make good use of the water, under water stress is a prerequisite for progress in improving performance under water stress (Blum, 1988; Araus and al., 2002). This experiment aims to characterize a set of durum wheat varieties, tested jars and vegetation under different levels of water stress to the surface of the leaf, relative water content, cell integrity, the accumulated biomass and efficiency of water use.

The experiment was conducted during the 2005/2006 academic year, at the Agricultural Research Station of the Field Crop Institute of Setif, under semi-controlled conditions. Five genotypes of durum wheat (*Triticum durum* Desf) were evaluated for their ability to tolerate moderate and severe water stress. The results showed that genotypes respond differently to water stress. Dry matter accumulation and growth rate varied among genotypes and were significantly reduced. At severe water stress biomass accumulated by Boussalam was the least affected.

**Keywords:** Water stress, *Triticum durum*, biomass, cell membrane integrity, relative water content.

### INTRODUCTION

Cereal cultivation is the predominant speculation Algerian agriculture. It covers nearly six million hectares in a system which is the dominant two-year fallow / cereal. Most of the acreage is located on the high plains characterized by the altitude, cold winters, an insufficient and irregular rainfall, frequent spring frosts and the onset of Sirocco end of the cycle (Annichiarico et al., 2002). Cereal production in rainfed dry remains low and irregular in space and time. The search for a better adaptation to environmental change has become a necessity to stabilize yields in these regions (Benmahammed et al., 2005).

Lack of water is, however, the most limiting factor faced by the Rainfed cereals, followed by negative effects caused by low winter temperatures and spring (Annichiarico et al. 2002; Annichiarico et al. 2005; Bahlouli and al. 2005; Mekhlouf et al., 2007). This makes the improvement of production techniques is centered, increasingly, around the efficiency of water use (Chenaffi et al., 2006).

This paper aims to characterize a set of varieties of wheat (*Triticum durum* Desf.) Pots of plants tested under different conditions of water stress, the expression for the surface of the sheet, the relative water content, cellular integrity, biomass, and efficiency of water use

### Materials and methods

The experiments conducted during the 2006/07 season, includes the establishment of a test under plastic cover in order to control the water factor. Five durum wheat varieties whose seeds are courtesy of station (CETO) Setif, were tested. Water treatments studied have a witness to the capacity of irrigated pot (100% CP), a treatment representing a moderate water stress in 70% of the capacity of the pot (70% CP) and a third treatment simulating severe stress by 40% the capacity of the pot (40% CP).

### Plant material:

Five varieties were used as plant material, it is Mohamed Ben Bachir, Waha, Korifla, Oum rabia and Boussalam

### Measurements carried out:

The average area of the last fully developed leaf was estimated by the product  $SF (cm^2) = [0.607 (L \times I)]$

Specific leaf weight was calculated by the ratio of the weight of the dry matter of leaf area standard

$$PSF (mg / cm^2) = PS (mg) / SF (cm^2)$$

$$ERR (\%) = 100 (PF-PS) / (PT-SP),$$

with TRE is the leaf relative water content, PF, PT and PS are respectively the weight (mg) fresh, turgid and dry leaf samples.

The percentage of cells damaged by water stress was estimated as described by Bajja et al, (2001), as follows:  $IC (\%) = 100 (ECI/EC2)$

The number of grains per ear (NGE) is derived by calculating it using the following formula:  $NGE = (1000 \times RTD) / (x PMG NE)$ .

### Results and Discussion

The yield is a complex, low heritability and more subject to genotype x environment interactions (Annichiarico et al., 2006). The selection is made, in addition to grain yield, based on physiological characteristics to balance yield potential and tolerance of environmental stresses (Brin, 1995; Benmahammed et al. 2001; Passioura et al., 2002). A better understanding of morpho-physiological mechanisms involved in resistance to water stress is therefore essential for the selection of resistant genotypes (Zhang et al. 1999).

Three climatic factors interact to allow the externalization or inhibition potential of a given genotype. These factors are the low temperatures, the accumulated degree-days and cumulative rainfall (Kabouche et al. 2001; Mekhlouf et al., 2001). If the response of genotypes to the variation of climatic factors is predictable, the advent of these constraints is the realm of the unpredictable, so the selection of a given genotype to express that this genotype is potentially productive, but also he has the ability to absorb changes in settings that will suffer, once adopted (Bouzerzour et al., 2001).

The objective of this study is to determine the effects of water stress on morphological and physiological characteristics of contrasting genotypes of durum wheat. The results indicate that water stress significantly reduced virtually all the variables measured. In the absence of water stress, and MBB Waha present rates of accumulation of biomass highest. Korifla hand with a capital of DM significantly higher at the beginning of the cycle, while Boussalam and MBB earn relatively less biomass in beginning of the cycle, with low temperatures. Waha and MBB adopt a growth rate higher end of the cycle.

Water stress, moderate, significantly reduces the average speed of accumulation of biomass of about 45.0% of all varieties.

MBB and Waha are less sensitive to lack of water. Under severe water stress, and MBB Boussalam manage to do better yields of dry matter in the end of the experiment, while Waha, and MRB5 Korifla are most affected.

The results indicate the presence of genotypes that accumulate more biomass in the absence as in presence of water stress and in the case of MBB. Genotypes that accumulate more biomass in the absence of water stress and under moderate water stress, in the case of Waha and Korifla. Genotypes that accumulate more biomass under severe stress and it is only the case of Boussalam. MBB

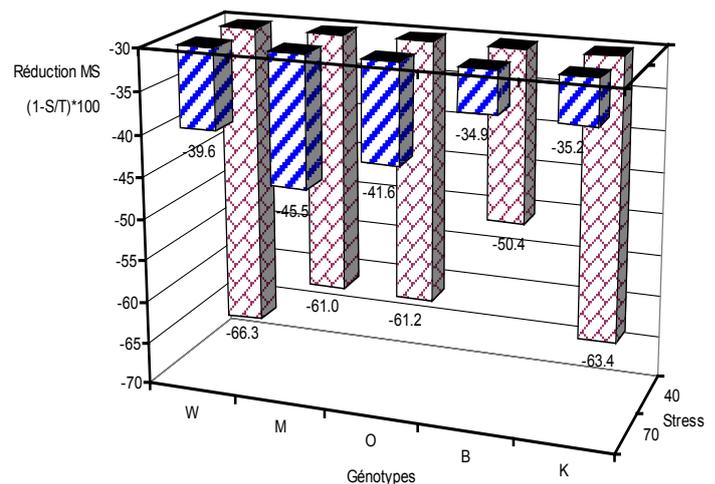
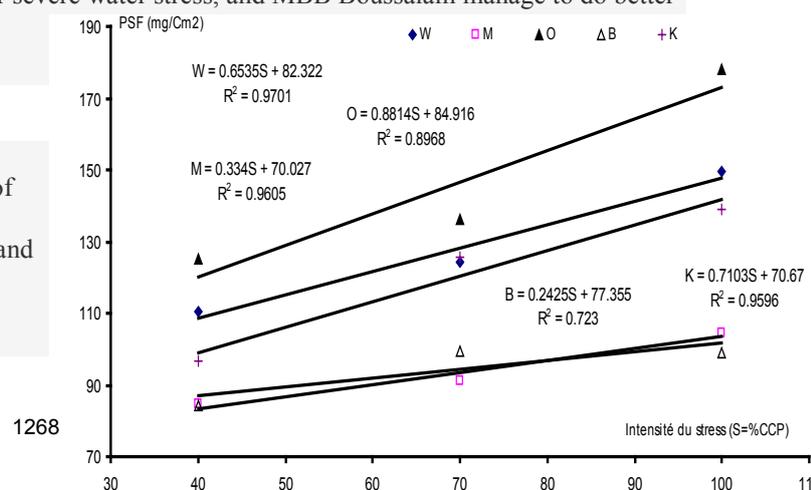


Figure 1. Change in amounts of dry air produced by different genotypes evaluated in the absence and under water stress

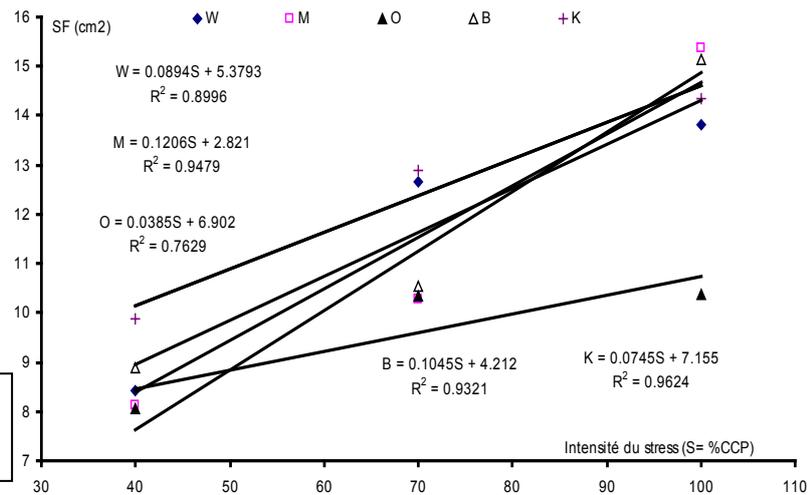


develops slowly in the beginning of the cycle and accelerates its growth at the end of cycle. By cons Korifla is growing faster at the beginning of the cycle and slowing growth at the end of cycle. The best genotype for semi-arid environments is the type Korifla.

The effect of water stress is marked on the surface, the weight specific and leaf water status, but it is not noticeable on cellular integrity.

Korifla develops a large leaf surface that is relatively less reduced under the effect of water stress. Waha, MBB and Boussalam development of broad leaves whose surface is greatly reduced as a result of water stress. MRB5 produced a sheet of small area, which is slightly reduced due to the effects of water stress

Figure 3 Influence of water stress on the development of the middle surface of the sheet of different genotypes



Reductions in specific leaf weight, under severe stress, are 26.2%, 19.1%, 29.6%, 14.7% and 30.6% respectively for Waha, MBB, Boussalam, and MRB5 Korifla. Genotypic differences for the TRE are relatively more important under severe water stress. Korifla reduced its relative content more significantly, by cons MRB5 shows some stability for the leaf water status. In relative reduction in relative water content of 4.1, 5.3, 2.3, 8.5 and 11.4% respectively for Waha, MBB, MRB5, and Boussalam Korifla.

For the cellular integrity genotypes rise significantly different. Waha genotype is less damaged compared to Boussalam which shows the highest percentage of cell damage. Damage to the cell membrane are less obvious in moderate stress for four of the five genotypes studied, but they become consistent in severe stress Boussalam which expresses the most damage while Mohamed Ben Bachir and Korifla are the most tolerant to this feature .

In relative terms, moderate water stress reduces yield and yield components of 13.5%, 4.1%, 21.3% and 0.0% for grain yield, number of ears, number of grains per ear and weight of 1000 grains. Severe water stress affects the same variables in the proportions 49.5%, 17.5%, 37.9% and 3.4%.

In the absence of water stress MBB has a low yield, while the other four genotypes have significantly higher yields and equal. Under moderate water stress, the yield is greatly reduced MBB followed Boussalam. Waha, and MRB5 Korifla minimize, for cons, the reduction of moderate performance stress. Under severe stress, Waha, and MBB Boussalam are very sensitive to water stress, while MRB5 and Korifla to show relatively more tolerant. In terms of selection of genotypes for specific adaptation in the absence of coercion,

MBB excluding the other genotypes give yields Similar grain.

Under moderate water stress, the choice is Waha, and Korifla MRB5 that are relatively more tolerant this degree of water stress.

Severe water stress, and Korifla MRB5 maintain a relatively high yield.

For a general adjustment, the choice of genotype is on Korifla, MRB5 and to a lesser extent Boussalam. These genotypes have the ability to minimize the reduction of grain yield under water stress.

The values taken by the number of grains per ear, in the absence of water stress varied from 22.2 (index 100) at MBB in 19.5 (87.8%) in Korifla. Under moderate stress, they drop to 90.5% for Waha and 55.0% of the maximum value for

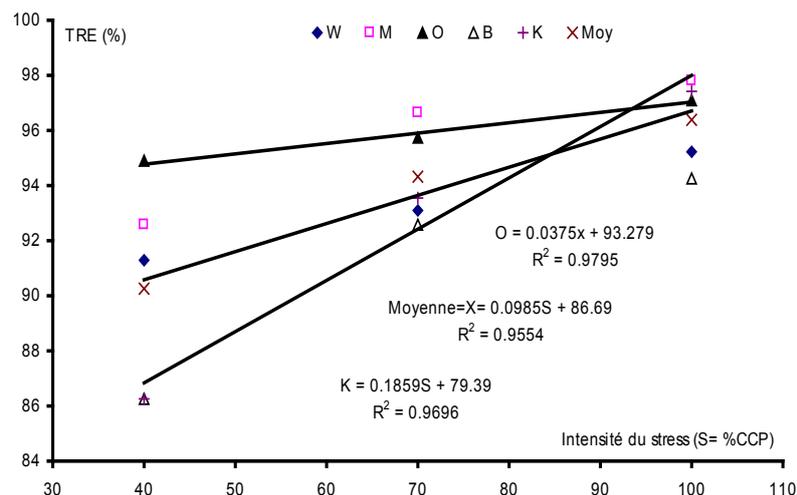


Figure 4 Influence of water stress on leaf water status of different genotypes

MBB. Under severe stress, they drop to 34.2% for Waha, and remain at a level similar to that observed under moderate stress and Boussalam Korifla be 70.7 and 77.5% of the maximum value. The accumulated biomass at maturity passes 63.1g/pot, average 5 genotypes and in the absence of stress, to 24.7 g / pot under severe stress. Stubble height is reduced by 96.9 to 80.8 cm, a lowering of 16.6%. The ratio of the weight of the ears on the ground biomass measured at maturity, falling 38.3% to 34.4%. The average harvest index increases, against, as a result of water stress, it goes from 17 to 21%.

The efficiency of water use of biomass is not significantly affected by the performance against the increases under the effect of water stress of 1.45 to 1.95 mg / ml water per pot. Under water stress the biomass and the ratio of the weight of the ears of the biomass, the higher are rated at MBB, Waha and Korofla. MRB5 Korifla and express the best harvest index while MBB Boussalam and are distinguished by the greater efficiency of water use for the that to produce grain.

The grain yield was positively correlated with grains per year, weight of ears at the above ground biomass measured at maturity, the ratio of the weight of the ears on the ground biomass to leaf area, specific leaf weight, content in chlorophyll a and b. These correlations indicate that the genotype happens to be a good grain yield in the absence of coercion, such as water stress, must have values greater than the average for the variables listed above and are positively related to grain yield. In other words, the genotype that minimizes the reduction of the average value of these variables, as a result of water stress, at the same time minimizes the drop in performance because it is tolerant.

According Villages et al., (2001) grain yield in rain-fed cereal lines is determined by the accumulated biomass and harvest index. Under water stress genotypes that are able to support the accumulation of dry matter often minimizes the effect of stress on the expression of performance gains. The accumulation of high biomass at maturity stage is due to a relative high growth rate.

Khanna-Chopra et al., (1991) indicate that water stress reduced the number of grains per ear and number of ears produced per unit area. The effect of the reduction of these two components of grain yield, however, is variable depending on the genotypes, in some genotypes, it is reducing the number of grains per ear which is decisive, whereas in other genotypes c is the effect of the number of ears which is crucial in reducing the grain yield.

This variation of the effect of the components and characteristics related to performance on the reduction of grain yield suggests that the expression of grain yield under stress and in the absence of stress is not necessarily maximized by the same alleles. This suggests that under favorable environment must aim at the selection of genotypes with high yield potential regardless of their stress response while in unfavorable environments should mainly reflect the response vis-à-vis the stress that is factor in the expression of grain yield.

Kirnak et al., (2001) indicate that water stress induced a significant decrease in chlorophyll content, the relative water content of the foliage of vegetative growth and increased leakage of the electrolyte. The severe water stress reduced 46%, the total accumulated dry air of 43% and leaf elongation of 75%. These reductions are the result of reducing the rate of elongation and leaf transpiration.

The ratio of root dry matter on the dry air increases under stress by a factor of 2.1, suggesting a diversion of newly produced assimilates to the roots as much to the aerial part, to improve accessibility to more soil moisture.

Bajja et al., (2001) indicate that water stress induces an increase in the concentration of soluble sugars and proline, but to varying degrees depending on the response genotype. Water stress also affects the number of leaves developed which contribute to a reduction in transpiring surface stress, but at the same time reduced image synthesizing capacity of the plant under stress.

Retention under water stress, high mean values of characters such as leaf weight, nitrogen content and chlorophyll content of the leaf is considered a good indicator of the stability of photosynthetic tissues. The chloroplasts are under stress when the absorbed energy is far superior to the usability of photosystems, which leads to the photo inhibition of photosynthesis that occurs when the rate of transfer of excitation energy in the center of the antennas photochemical reaction exceeds the rate of transit of the electrons, causing damage to the thylakoids.

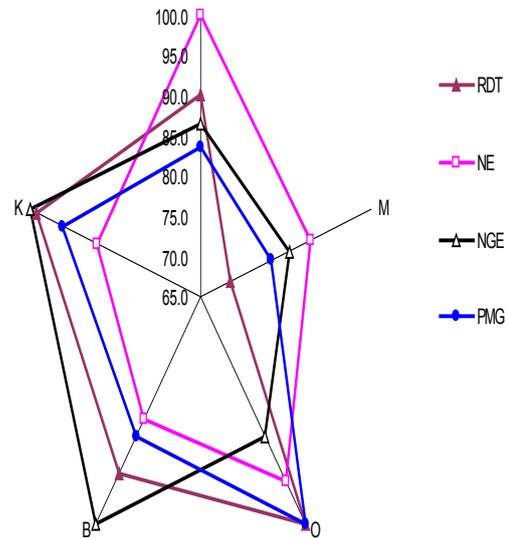


Figure 5. The yield and its components, the different genotypes, expressed in% of the maximum value

According Pooter and Farquhar (1994) genotypes that are characterized by slow growth early in the cycle, have the advantage not to use a luxury available resources of the environment, saving for the end of the cycle that is often more stressful. Nageswara Rao et al., (1995) mention the significant correlation between the isotope discrimination ( $\Delta$ ) and specific leaf weight, whereas Wright et al., (1993) report a significant positive correlation between specific leaf weight and photosynthetic capacity. Stomatal closure is related to the loss of turgor of stomatal guard cells. Martin et al., (1996) reported that genotypes that tolerate water stress maintain a TRE high under conditions of moderate stress and severe compared to susceptible genotypes. Similarly Rekik et al., 1998 note that maintaining a TRE Waha high water stress by osmotic adjustment capacity. Merah et al., (2001) report that Waha is characterized by the values of  $\Delta$  and grain of the paper high. The genotypes that have a high capacity to adjust, under water stress, manage to maintain a TRE high under these conditions, by controlling stomata gas exchange. The genotypes that maintain a high  $g_s$  sweat more, have a value  $\Delta$  and high ash content (Voltas et al., 2002). It is well known that stomatal closure leads to an increase in leaf temperature, which induces increased sweating and reduced the activity of CO<sub>2</sub> fixation by Rubisco (Van den Boogaard et al., 1996). When grain yield was positively correlated with  $g_s$ , this effect is associated with the cooling of leaves by transpiration permitted by a high stomata conductance, which often allows the maintenance of photosynthetic activity (Lu et al., 1998). Thus the depression of the temperature of the canopy relative to that of the ambient air is most often associated with grain  $\Delta$  and yield under stress conditions hydriques. participation of assimilates formed before heading can often be significant under stressful conditions. This contribution increases relatively in terms of limiting water, as the photosynthetic activity is reduced by the effect of stress that accelerate leaf senescence. In this context, the straw genotypes have a high storage capacity of assimilates most important, which is located in the neck of the ear and between the penultimate node (Rebetzke et al., 2007). The ratio of the length of the neck of the spike on the stubble height is an indicator of the ability of assimilates stored and transferred to the grain (Rekik et al., 1998).

## CONCLUSION

The search for indicators of capacity for better use of water by the plant such as leaf water status, net assimilation and relative growth under stress is a necessary prerequisite to hope to make progress in matters of improvement of production under water stress. The results of this paper indicate that water stress significantly reduced all variables measured. Among the genotypes evaluated MBB accumulate more biomass in the absence as in presence of water stress by Korifla against Waha and accumulate more biomass in the absence of water stress and water stress in moderate Boussalam while accumulating more biomass in Only severe stress. MBB develops slowly in the beginning of the cycle and accelerates its growth at the end of cycle. By cons Korifla is growing faster at the beginning of the cycle and slowing growth at the end of cycle.

The effect of water stress is very pronounced on the surface, the weight and leaf water status. Korifla develops a large leaf surface that is relatively less reduced under the effect of water stress. Waha, MBB and Boussalam develop large leaves whose surface is greatly reduced as a result of water stress. MRB5 produced a sheet of small area, which is slightly reduced due to the effects of water stress. Genotypic differences in the relative water content and cellular integrity are relatively more important under severe water stress. Korifla reduced its relative water content to a greater extent, by cons MRB5 shows some stability for the leaf water status. Damage to the cell membrane are less obvious in moderate stress, but they become consistent in severe stress Boussalam which expresses the most damage while Mohamed Ben Bachir and Korifla are the most tolerant to this feature.

Under moderate water stress, the choice is Waha, and Korifla MRB5 that are relatively more tolerant to the degree of water stress. Severe water stress, and Korifla MRB5 maintain a relatively high yield. For a general adjustment, the choice of genotype is on Korifla, MRB5 and to a lesser extent Boussalam. These genotypes have the ability to minimize the reduction of grain yield under water stress. The accumulated biomass at maturity increased from 63.1 g/pot, average of 5 genotypes and in the absence of stress, to 24.7 g / pot under severe stress. Stubble height is reduced by 96.9 to 80.8 cm, a lowering of 16.6%. The ratio of the weight of the ears on the ground biomass measured at maturity, falling 38.3% to 34.4%. The average harvest index increases as a result of water stress from 17 to 21%. In terms of selection of genotypes for specific adaptation in the absence of constraint, except MBB, other genotypes gave similar grain yield. Under moderate water stress, the choice is Waha, and Korifla MRB5 that are relatively more tolerant to the degree of water stress. Severe water stress and Korifla MRB5 maintain a relatively high yield.

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## THE ROLE OF USING FACEBOOK IN IMPROVING ENGLISH

Dr. Seham Al-Smadi

Albalqa Applied University/Ajloun College/Basic Sciences-English Department

**Abstract:** This study aimed at investigating the role of using facebook in improving Ajloun College English Students' Achievement, It attempted to answer the following main question:

1. What is the role of facebook in improving English skills?

To answer the question of the study, the researcher prepared a project based on facebook for the experimental group. Thirty female students were purposefully chosen from Ajloun College-English Department in the summer semester of the academic year 2012. The participants of the study consisted of two assigned sections. The experimental groups were taught according to facebook; while the control group was taught according to the conventional way (Lecture Method). The researcher used a test as an instrument. A suitable statistical treatment was used to find out the effect of the instructional program on the students' achievement in **vocabulary**. On the basis of the results of the present study, the researcher proposed a number of recommendations and suggestions for future research.

**Keywords:** Computer assisted language learning, achievement, instructional program, facebook

# THE STUDIES ON TOTAL POLYPHENOL, TOTAL FLAVONOID AND ANTIOXIDANT ACTIVITY OF MALAYSIA UNFERMENTED COCOA BEAN: POTENTIAL APPLICATION FOR HALAL COSMECEUTICAL

Norliza Abdul Wahab, Russly Abdul Rahman, Puziah Hashim, Amin Ismail, Shuhaimi Mustafa  
Halal Products Research Institute,  
University Putra Malaysia  
Malaysia  
[puziah\\_h@putra.upm.edu.my](mailto:puziah_h@putra.upm.edu.my)

**Abstract:** Cocoa (*Theobroma cacao*) is a well known plant and widely used, conventionally in chocolate and beverage industries. Various studies have demonstrated cocoa beans contain polyphenol compound and possess health promoting effects. However, studies regarding total phenolic and flavonoid content of unfermented cocoa bean are still limited. In this study, 10 selected Malaysia cocoa clones were extracted using water and 70% ethanol. The total phenolic content (TPC) of water and ethanol extraction ranged from 129.16 to 144.44 and 186.23 to 200.85 mg GAE/g extract, respectively; whereas the total flavonoid content (TFC) ranged from 46.49 to 60.41 and 67.04 to 75.70 mg RE/g extract, respectively. Statistical analysis showed that for TPC and TFC, there is significant evidence for extraction process\*cocoa clone interaction effect ( $P < 0.05$ ) whereas types of cocoa clone significantly did not influence the TPC and TFC of unfermented cocoa bean extract (CBE). Both PBC123 and PBC140 appeared to contain the highest TPC,  $200.85 \pm 3.80$  and  $200.79 \pm 3.27$  mg GAE/g extract, respectively whereas TFC values were  $75.70 \pm 2.43$  and  $72.29 \pm 1.18$  mg RE/g extract, respectively. Antioxidant activity by 2,2-diphenyl-2-picrylhydrazyl (DPPH) scavenging assay exhibited clone PBC123 and PBC140 having the highest activity,  $EC_{50} = 0.038$  and  $0.040$  mg/ml, respectively. Thus, unfermented cocoa bean extract has potential application as an alternative ingredient in the halal cosmeceutical industry.

**Key words:** *Theobroma cacao*, unfermented CBE, polyphenol content, DPPH, Halal cosmeceutical

## Introduction

The Halal Standard that was developed by the Malaysian Halal Council requires cosmetic manufacturers to comply with the relevant parts of food standard MS 1500, i.e. all ingredients must comply to Halal and *Syariah* requirements, does not contain any ingredient derived from human parts and animal forbidden to Muslim, no ingredient from khamr, no contamination from najas during preparation, processing, manufacturing as well as storage and safe (non-hazardous) for consumer and user (MS 2200:2008). This top-level philosophy is relatively easy to comply with if one is making traditional and predominantly 'natural' cosmetic products. However, those seeking to enter the booming cosmeceutical or functional product markets will require more clarification and scientific challenges exist both in the supply chain and in the way that these products are to be used by the public. Cosmeceutical is a cosmetic product that exerts a pharmaceutical therapeutic benefit but not necessarily a biologic therapeutic benefit. Furthermore, it is not regulated by the U.S. Food and Drug Administration (FDA) and, thus, is not subject to premarket requirements for proof of safety or efficacy. Cosmeceutical products often tested through *in vitro* studies using silicone replicas of skin. The rigorous testing usually required for pharmaceuticals is not mandatory for cosmeceutical products (Christine and Diane, 2006). According to Euromonitor (2009), the leading market research company, global cosmetic/cosmeceutical market is now worth US\$334 billion. Out of this, natural health and beauty markets are the most dynamic and are predicted to be worth US\$14 billion in the US by 2014 with a growth rate of 74% between the years 2009 to 2014. Moreover, according to AME info.com, the market for halal cosmetics is booming across the Middle East, growing at 12% annually to reach US\$2.1 billion in 2006 and approximately US\$2.75 billion at the current market. With the Middle East only accounting for 20% of the global Muslim population, the overall market could be worth in excess of US\$13 billion, regardless of the non-Muslim whom are going beyond 'natural', looking for products that align with their ethics.

Many researchers seek alternatives from plant derived ingredients for skincare due to its safe and non-hazardous constituent. These phytochemical products have been proven to exhibit significant antioxidant (Saravi, 2010), emollient (Maria Elena Cartea et al., 2011) and UV-B protection (Perona et al., 2006) properties that are crucial for formulating skincare products. Furthermore, the natural ingredients are easier to be absorbed by the superficial layers of the skin and lower skin allergy problems as well. Chia-Jung et al. (2010) reported that polyphenol compounds, namely catechin and epicatechin from different sources of plants have been extensively utilized in skincare products to protect the skin from ultraviolet (UV) damage. In term of aging process, free radicals which have always been associated with damaging of the cellular components, lipid membranes, mitochondria and DNA will subsequently affects a transforming growth factor- $\beta$  (TGF- $\beta$ ) of cytokine and eventually contributes to the formation of wrinkles (Mukherjee et al., 2011). One of the most well-known methods to delay or slow down the process of skin aging is by enhancing the condition of collagen

in the skin layer. Collagen is a major structural protein in the skin, composed of three protein chains round together in a triple helix. It makes up 70-80% of our skin and is produced by fibroblasts in the dermis layer of the skin. As the body aged, the fibroblast cells will gradually deteriorate as well, resulting in a loss of collagen and less firmness to the body tissues (Phillips et al., 1994; Nair et al., 2010). Recently, cosmetic manufacturers have been using collagen derived from the bones and cartilages of slaughterhouse animal carcass such as cows, pigs and sheep. However, due to the outbreak of bovine spongiform encephalopathy (BSE), transmissible spongiform encephalopathy (TSE) and the foot-and-mouth disease (FMD) crisis, the uses of collagen and collagen-derived products of land animal origin have become of more concern. Literally for Muslims, porcine collagen is against the *Syariah* law and cannot be consumed by the Jews as well (Jongjareonrak et al., 2005). Therefore, anti aging effort is now being focused on utilization of polyphenol compounds in the skincare cosmeceutical in order to minimize the collagen degradation and hence, increasing the collagen synthesis by fibroblast cells.

A number of studies have shown that consumption of cocoa and chocolate products have positive health effects on humans (Campia & Julio, 2008; Francene et al., 2003; Guillermo et al., 2010). These health effects are attributable to the high antioxidant capacity (AOC) of flavonoids in cocoa which is greater than those in tea and red wine per serving (Kim & Keeney, 1984). Procyanidins are the major flavonoids in cocoa which consist of oligomers and polymers of (+)-catechin and (-)-epicatechin. It comprises approximately 35% of the total phenolic content in unfermented cocoa beans (Niemenak et al., 2006). According to Kim and Keeney (1984), the unfermented cocoa bean contains about 120-180 g/kg of polyphenolic compounds, with (-)-epicatechin (~35%) being quantitatively the main compound (Shahidi & Naczsk, 2003). It is a major component of the polyphenols in cocoa beans and it is a monomer of procyanidins. Furthermore, unfermented cocoa beans are also referred to the sun-dried without fermentation or fermented for only 1-2 days (Misnawi et al., 2002). Polyphenols and flavonoids have many positive effects, however, there is limited information on the composition of these biologically active compounds in different types of cocoa clones. Therefore, the study was carried out to determine i) the total phenolic content (TPC) and total flavonoid content (TFC) of unfermented cocoa bean extract (CBE) from different types of cocoa clones, (ii) to compare the TPC and TFC of unfermented CBE affected by water and 70% aqueous ethanol extraction, and (iii) to determine an antioxidant activity of unfermented CBE.

## Materials and Method

### *Sample preparation and extraction*

Ten cocoa clones (MCB C1, MCB C4, MCB C5, MCB C6, KKM 1, KKM 5, KKM 22, PBC 140, PBC 123 and QH 1003) were acquired from the Cocoa Research and Development Center, Jengka, Pahang. Fresh beans were collected from healthy pods and their testa removed manually before oven-dried at 60°C. The dried cocoa beans were manually deshelled prior to grinding where the particle size was reduced to ~90 µm. Lipids were removed from 100 g of the ground beans by extracting three times with 450 ml of hexane and air-dried to yield ~45 g of fat-free materials (Hammerstone et al., 1999). The fat-free materials were later extracted with water and 70% aqueous ethanol at a ratio of 1:25 for 2 h at 50°C using an orbital shaker. The mixture was filtered and stored before analysis.

### *Determination of total phenolic content and total flavonoid content*

The principle of Folin-Ciocalteu (FC) colorimetry with regard to the TPC is based on a chemical reduction of the reagent, a mixture of tungsten and molybdenum oxides (Singleton and Rossi, 1965). The product of the metal oxide reduction has a blue color that exhibits a broad light absorption with a maximum at 765 nm. The intensity of light absorption at that wavelength is proportional to the concentration of phenols. The TPC was determined from a gallic acid calibration curve prepared and analyzed concurrently with the crude extract. Meanwhile, the principle of aluminium chloride (AlCl<sub>3</sub>) colorimetric method of TFC is a complexation of C-4 of keto group with either the C-3 or C-5 hydroxyl group of flavones and flavonols. In other words, aluminium chloride forms acid labile complexes with the orthodihydroxyl groups in the A- or B- ring of flavonoids. The TFC was determined from a rutin calibration curve prepared and analyzed concurrently with the crude extract.

### *2,2-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay of antioxidant*

The antioxidant scavenging activity was estimated according to the method Lai et al. (2001) with some modifications. An aliquot of unfermented CBE (30 µl, 0.0781-1.000 mg/ml in ethanol) and gallic acid of the same respective concentrations were mixed with 0.5 ml DMSO acetate buffer and 3 ml ethanol. Then 1.2 ml of 500 µM DPPH previously prepared in ethanol was added. The mixture was shaken vigorously and left to stand for 30 min at room temperature in a dark room. Absorbance was read using a spectrophotometer at 550 nm. The scavenging effect of the DPPH radical was calculated using the following equation:

Scavenging effect (%)

$$= \left[ 1 - \frac{\text{Absorbance of sample at 550 nm}}{\text{Absorbance of control at 550 nm}} \right] \times 100$$

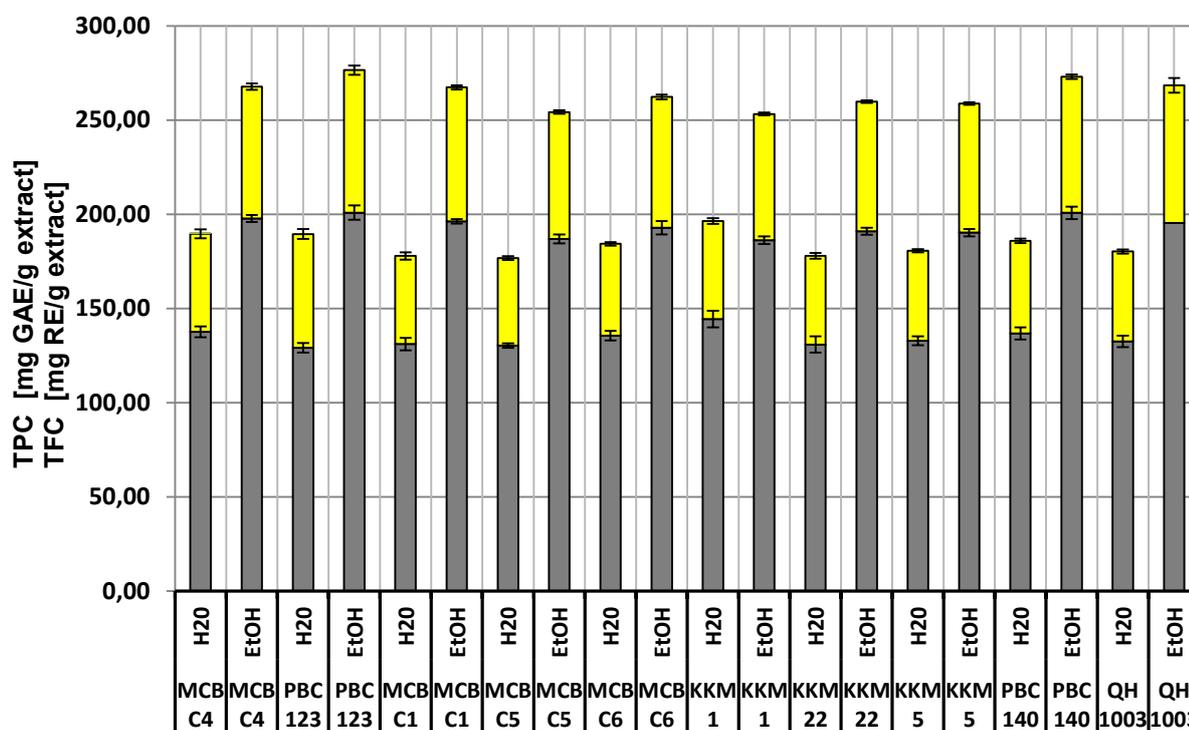
IC<sub>50</sub> value was determined from the plotted graph of scavenging activity against the concentration of unfermented CBE, which is defined as the total antioxidant necessary to decrease the initial DPPH radical concentration by 50%. Triplicate measurements were carried out, and their scavenging effect was calculated based on the percentage of DPPH scavenged.

### *Experimental Design*

The studies were carried out in 2 factors, using factorial design with three replications. The treatments were extraction medium, consisting of 70% aqueous ethanol and water whereas another factor was 10 local cocoa clones, namely MCB C1, MCB C4, MCB C5, MCB C6, KKM 1, KKM 5, KKM 22, PBC 140, PBC 123 and QH 1003. Data were expressed as means ± standard deviations (SD) of three replicate determinations and analyzed by MINITAB 14. A one-way analysis of variance (ANOVA) by Fisher's comparison was used to determine whether the differences between measurements are significant and a two-way analysis of variance with a significance level of  $p=0.05$  was performed to determine the efficiency of the extraction process and clone on TPC and TFC (main effects) and both (their interaction effect). Differences at  $p<0.05$  were considered to be significant.

### **Results and discussion**

In this study, two extraction mediums were used for preparing the unfermented CBE. Previous studies reported that the yield of TPC was influenced by different extracting solvents (Sun & Ho, 2005). Moreover, from a toxicological point of view, ethanol and water are safer and considered to be halal compliance compared to acetone, methanol and other organic solvents (Oktay et al., 2003). The TPC of water and ethanol extraction were in the range of 129.16 to 144.44 and 186.23 - 200.85 mg GAE/g extract, respectively; whereas the TFC were in the range of 46.49 to 60.41 and 67.04 to 75.70 mg RE/g extract, respectively (Figure 1). The two-way ANOVA has shown that there is significant evidence for extraction process\*cocoa clone interaction effect ( $P<0.05$ ) for both TPC and TFC. This is best demonstrated by higher extraction efficiency yielded in 70% ethanol extracts compared to water extracts. According to previous report, TPC of cocoa extracts varies greatly depending on the solvent and procedure used for the extraction of polyphenols (Sun & Ho, 2005). The recovery yield for identified phenolic compounds was highest in acetone extract and lowest in water extract (Demiray et al., 2009). Extraction with 70% aqueous solvent (70% ethanol) was more efficient, primarily due to the water-soluble nature of plant phenolics enhanced by the presence of an organic solvent, which facilitates solubilization through penetration in plant cell structure (Belščak et al., 2009). Moreover, there are significant evidences for extraction process main effect for both TPC and TFC ( $F_{\text{TPC}} = 4517.49$  and  $F_{\text{TFC}} = 1488.67$ ) compared to the cocoa clone effect ( $F_{\text{TPC}} = 4.70$  and  $F_{\text{TFC}} = 13.53$ ). The type of local cocoa clone does not significantly influence the TPC and TFC of unfermented CBE. In other words, regardless of the clonal type, unfermented CBE did contain equally high level of TPC as well as TFC. Both PBC 123 and PBC 140 clones appear to contain the highest TPC, 200.85 and 200.79 mg GAE/g extract, respectively, whereas TFC values are 75.70 and 72.29 mg RE/g extract, respectively. Several studies had shown a positive correlation between antioxidant activity and phenolic content (Nagai et al., 2003; Velioglu et al., 1998; Yang et al., 2002). Thus, the presence of high TPC and TFC is likely to promote unfermented CBE as a great potential ingredient for halal cosmeceutical application.



According to Nazaruddin et al. (2006), unfermented Malaysian cocoa beans contained 11.87 mg epicatechin/g extract while fermented cocoa beans contained only 9.85 mg epicatechin/g extract. It has also been reported that freshly harvested and 2 days fermented cocoa beans contained 67 to 149 and 101 to 144 mg epicatechin/g DM, respectively (Niemenak et al., 2006). The results of ethanolic extracted TPC presented in Table 1 are significantly higher than the previously reported data; however, the results were unable to be compared due to the differences in the applied extraction solvent and presentation of the results (Nazaruddin et al., 2006; Niemenak et al., 2006). In addition, the unit used in the previous results is expressed as mg of epicatechin equivalent, whereas our result is in mg of gallic acid and rutin equivalent for TPC and TFC, respectively, which also, contributes to minor discrepancies between the results.

**Table 1:** The unfermented CBEs of ten Malaysia cocoa clones in terms of TPC (mg GAE/g extract) and TFC (mg RE/g extract)

| Cocoa clone | TPC (mg GAE/g extract)      |                             | TFC (mg RE/g extract)      |                            |
|-------------|-----------------------------|-----------------------------|----------------------------|----------------------------|
|             | Water extraction            | Ethanol extraction          | Water extraction           | Ethanol extraction         |
| MCB C4      | 137.66 ± 2.87 <sup>b</sup>  | 197.75 ± 1.85 <sup>a</sup>  | 51.99 ± 2.38 <sup>b</sup>  | 70.06 ± 1.66 <sup>a</sup>  |
| PBC 123     | 129.16 ± 2.61 <sup>bc</sup> | 200.85 ± 3.80 <sup>a</sup>  | 60.41 ± 2.55 <sup>b</sup>  | 75.70 ± 2.43 <sup>a</sup>  |
| MCB C1      | 131.16 ± 3.32 <sup>bc</sup> | 196.22 ± 1.19 <sup>a</sup>  | 46.72 ± 1.90 <sup>bc</sup> | 71.14 ± 1.14 <sup>a</sup>  |
| MCB C5      | 130.29 ± 1.20 <sup>bc</sup> | 186.97 ± 2.42 <sup>ab</sup> | 46.49 ± 1.03 <sup>bc</sup> | 67.31 ± 0.88 <sup>ab</sup> |
| MCB C6      | 135.57 ± 2.57 <sup>b</sup>  | 192.85 ± 3.59 <sup>ab</sup> | 48.81 ± 0.93 <sup>b</sup>  | 69.43 ± 1.29 <sup>ab</sup> |
| KKM 1       | 144.44 ± 4.42 <sup>b</sup>  | 186.23 ± 2.07 <sup>ab</sup> | 52.00 ± 1.59 <sup>b</sup>  | 67.04 ± 0.75 <sup>ab</sup> |
| KKM 22      | 130.88 ± 4.33 <sup>bc</sup> | 191.00 ± 1.85 <sup>ab</sup> | 47.12 ± 1.56 <sup>bc</sup> | 68.76 ± 0.67 <sup>ab</sup> |
| KKM 5       | 132.88 ± 2.30 <sup>bc</sup> | 190.32 ± 1.94 <sup>ab</sup> | 47.84 ± 0.83 <sup>bc</sup> | 68.51 ± 0.69 <sup>ab</sup> |
| PBC 140     | 136.75 ± 3.27 <sup>b</sup>  | 200.79 ± 3.27 <sup>a</sup>  | 49.23 ± 1.17 <sup>bc</sup> | 72.29 ± 1.18 <sup>a</sup>  |
| QH 1003     | 132.54 ± 3.05 <sup>bc</sup> | 195.38 ± 0.00 <sup>a</sup>  | 47.72 ± 1.10 <sup>bc</sup> | 73.10 ± 3.90 <sup>a</sup>  |

Mean value ± standard deviation (n=3) with same letter in the same column at every TPC (mg GAE/g extract) and TFC (mg RE/g extract) are not significantly different (P>0.05)

The proton radical scavenging action is known to be one of the various mechanisms for measuring antioxidant activity. DPPH is one of the compounds that possess a proton free radical and shows a maximum absorption at 517 nm. When DPPH encounters proton radical scavengers, its purple color fades rapidly. This assay determines the scavenging of stable radical species of DPPH by unfermented CBEs. The scavenging activity (EC<sub>50</sub>) value was determined from the plotted graph of scavenging activity against the concentration of unfermented CBE, which is defined as the amount of antioxidant necessary to decrease the initial DPPH radical concentration by 50%. The lower EC<sub>50</sub> indicates the stronger ability of the extract to act as DPPH scavengers (Krishnanand et al., 2012). As mentioned earlier, the PBC 123 and PBC 140 of ethanolic extracts showed the highest TPC and TFC, thus these two clones are more likely to exhibit the highest scavenging effect among others. Furthermore, a study by Cheung et al. (2003) on mushroom (*V.volvaco*) found the scavenging activity of methanolic extracts was significantly higher than aqueous extracts. The PBC 123 showed a slightly

higher scavenging effect than PBC 140, i.e.  $IC_{50}=0.038$  and  $0.040$  mg/ml, respectively (Figure 2 and 3). However, there was no significant difference between the two clones. The scavenging activity for both cocoa extracts on DPPH radicals rapidly increased from 0 to  $0.092$  mg/ml. Results showed that scavenging activities were increasing as the concentration of extracts increased until a plateau was reached after  $0.1$  mg/ml. According to the previous study of Sun and Ho (2005), significant correlation was found between total phenolics and scavenging ability of buckwheat extracts on DPPH radicals. This finding was parallel to the present study where scavenging effects of both PBC 123 and PBC 140 were significantly contributed from their high total phenolic contents, i.e.  $200.85\pm 3.80$  and  $200.79\pm 3.27$  mg GAE/g extract. There are number of previous studies regarding radical scavenging activity for cocoa extract being reported. Othman et al. (2007) revealed that  $EC_{50}$  value of ethanolic cocoa bean extracts from Malaysia, Ghana and Ivory Coast were  $1.3$ ,  $1.3$  and  $1.5$  mg/ml, respectively. In this study, the impact of scavenging activity exhibited by PBC 123 and PBC 140 were 34-fold and 32-fold, respectively, higher than the ones showed by Malaysia and Ghana cocoa bean (Othman et al., 2007). Dreosti (2000) has approved that 60% of the total phenolics in raw/unfermented cocoa beans are flavanol monomers (epicatechin and catechin) and procyanidin oligomers (dimer to decamer) which are significant contributor to its high antioxidant property. Moreover, beside phenolic compounds, the presence of methyl xanthine (theobromine and caffeine) and anthocyanins in cocoa beans might influenced the antioxidant capacity. In addition, these compounds are miscible in water or water-ethanol.

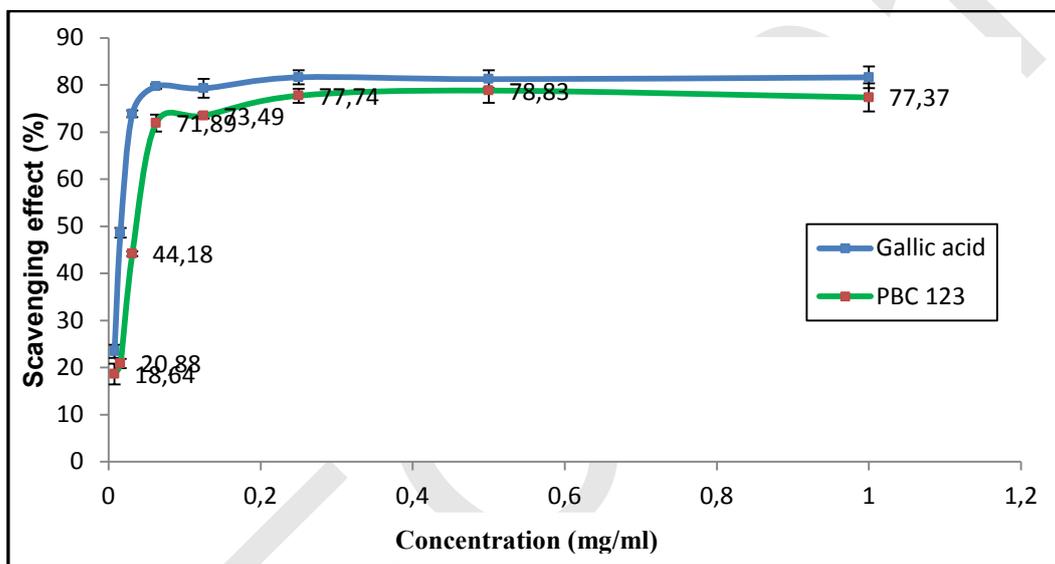


Figure 2: DPPH radical scavenging activity of unfermented CBE from PBC123

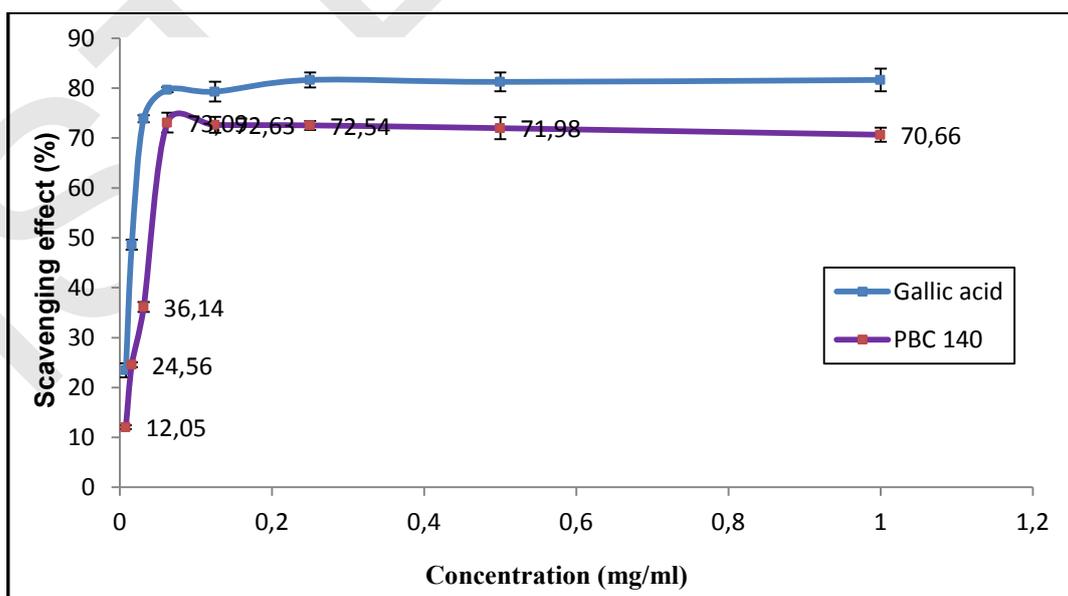


Figure 3: DPPH radical scavenging activity of unfermented CBE from PBC140

## Conclusions

The statistical analysis interaction effect showed that ethanol extraction is the significant factor which influenced the TPC and TFC yield of unfermented CBE. The unfermented CBE contains significantly high TPC and TFC which can serve as a potential key ingredient in halal cosmeceutical industry in maintaining the skin physiology and integrity. Cocoa clones of PBC 123 and PBC 140 contain the highest TPC and TFC. The impact of scavenging activity exhibited by PBC 123 and PBC 140 of unfermented CBEs were 34-fold and 32-fold, respectively higher than the ones showed by Malaysia and Ghana of typical fermented cocoa bean. As such, these clones will be used for further investigation particularly in dealing with growth promotion in human skin fibroblasts and keratinocytes. The promoting effects will be portrayed from the significant contribution of unfermented CBE in collagen synthesis and reduction of matrix metalloproteinase production.

## Acknowledgements

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# THE SURVEY STUDY OF LEARNING MOTIVATION AND STRATEGIES IN ROBOTICS OF LEARNING DOMAIN FOR TAIWAN ADOLESCENT STUDENTS FROM WRO COMPETITION

Yuan Yen Huang<sup>a</sup>, Eric Zhi Feng Liu<sup>a,b</sup>, Chun Hung Lin<sup>a</sup>, Pey-Yan Liou<sup>a,b</sup>

<sup>a</sup>Graduate Institute of Learning and Instruction, National Central University, No.300, Jhongda Rd., Jhongli City, Taoyuan County 32001, Taiwan (R.O.C.)

<sup>b</sup>Center of Teacher Education, National Central University, No.300, Jhongda Rd., Jhongli City, Taoyuan County 32001, Taiwan (R.O.C.)

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**Abstract :** The aim of this study was to explore the relationship among motivational and strategic variables in robotics of learning domain, and to predict the variance of each strategy using regression analysis. The inventory, RMSLQ-HS (robotics MSLQ-high school version), in this study was adapted from Motivated Strategy for Learning Questionnaire (MSLQ) for measuring Taiwan high school (13-18) students' motivation and strategies in robotics of learning domain. Besides, this study similarly examined the main effect of gender variables on motivation and strategies in learning robotics. In the result of RMSLQ-HS survey for 236 participants in WRO (World Robotics Olympics) competition, gender made significant difference in information seeking that boys are expert in technological and informational resources. Moreover, the scores in RMSLQ-HS indicated that students' personal and situational interest goal was significantly higher than other motivation, and that students' critical thinking and peer learning were significantly higher than other strategies. In addition to learning anxiety, most motivational variables were high significantly correlated to cognitive strategies. Additionally, personal and situational interest goal as well as self-efficacy explained 46% variance for critical thinking. According to the findings in RMSLQ-HS, we proposed some suggestions in robotics of educational and learning domain for instructors, coaches and parents.

**Keywords:** *adaptation of MSLQ for domain specific, robotics of learning domain, motivation, learning strategies, RMSLQ*

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## THEORETICAL STUDY OF COMPLEX OF POLY(PYRAZOLYL)BORATES TYPE $M(t\text{-BuTp}^{i\text{-Pr}})R$ (Where : $M = Fe, Ru$ et $R = Cl, Me$ )

A.Tayeb-Benmachiche<sup>1</sup> S\_M.Zendaoui,<sup>2</sup> N.Bouchakhri<sup>1</sup>, B. Zouchoune<sup>1,2</sup>

<sup>1</sup> *Laboratoire de chimie moléculaire du contrôle de l'environnement et des mesures  
Physico-chimiques Université Mentouri-Constantine*

<sup>2</sup> *Laboratoire de chimie appliquée et technologie des matériaux, Centre Universitaire  
D'Oum El- Bouaghi*

E-mail: [saratayeb@yahoo.fr](mailto:saratayeb@yahoo.fr)

**Abstract :** Since their discovery in 1967, the poly (pyrazolyl) borates have found wide application in chemistry of coordination and most of their complexes containing metals or metalloids were prepared. Our theoretical study, using ADF (Amsterdam Density Functional) and the data calculated are comparable with the experiment, carries on the complexes  $M(T\text{-BuTpi-Pr})R$  (where:  $M = Fe, Ru$  and  $R = Cl, Me$ ). The complexes were studied in  $C_{3v}$  symmetry and show that  $M$  is in a tetrahedral environment  $d^8ML_4$ . The presence of  $Fe$  stabilizes the state quintuplet (high spin) which their confers interesting magnetic properties. On the other hand and under the same conditions,  $Ru$  stabilizes the state singlet (low spin). The replacement of  $R$  by  $CH_3$  or  $Cl$  does not alter the structure, not the properties of the complex. Calculations of frequencies of the normal modes of vibration give no imaginary frequency confirming that the optimized geometries correspond at leasto the minimum energy. The UV-Vis spectra show that the transitions are mainly of type  $ML \rightarrow ML$  or  $M \rightarrow M$ .

**Key words :** DFT (density functional theory), iron complex, N-ligands, tris(pyrazolyl)borate, crystal structure, four-coordinate complex.

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# THERMAL BEHAVIOR OF MECHANICALLY ACTIVATED SEPIOLITE

Tuğba Tunç, H.Özkan Toplan, Kenan Yıldız  
 Metallurgy and Materials Engineering, Engineering Faculty  
 Sakarya University  
 Turkey

ttunc@sakarya.edu.tr, toplano@sakarya.edu.tr, kenyil@sakarya.edu.tr

**Abstract:** Sepiolite, a complex magnesium silicate mineral, was activated mechanically in a planetary mill and the changes in the mineral structure and thermal behavior of sepiolite were investigated by means of X-ray diffraction (XRD), scanning electron microscopy (SEM) and thermal analysis (TG-DTA). The results showed that particle size decreased and amorphization in the ore structure was occurred with increment of grinding times. The loss of zeolitic water in the structure was actualized during mechanical activation of sepiolite.

**Key words:** Sepiolite, mechanical activation, thermal behavior.

## Introduction

Sepiolite is a natural hydrated magnesium silicate clay mineral and its structural formula can be written as  $Mg_8Si_{12}O_{30}(OH)_4(OH_2)_4 \cdot xH_2O$ , ( $x=6-8$ ) (Mora et al., 2010). Three pyroxene-type chains  $(SiO_3)^{2-}$  exist in the structure and oxygen links the chains together so that doubly linked chains occur. This structural formation causes zeolite-like channels (Frost et al., 2003). Octahedral coordinated magnesium locates between the silica sheets (Mora et al., 2010). Water molecules that present in the sepiolite structure have been grouped into zeolitic water, bound water and hydroxyl water (Nagata et al., 1974). From the formula (OH) indicates the hydroxyl group,  $(OH_2)$  represent the bound (crystal) water and  $H_2O$  shows the zeolitic water (Mora et al., 2010). The surface of this mineral has silanol (Si-O) groups because of the discontinuity of the external silica sheets (Alkan et al., 2005). This formation play important role at the adsorption of organics on the clay surface. Furthermore sepiolites can be used as absorbents for cleaning gas and liquids (Can, 1992) wherefore its zeolitic channels that may be filled with water or organic molecules (Frost et al., 2003). Apart from this new utilization opportunities are constituted by different studies like usage for decolorization of sugar juice (Ünal et al., 1998) sulfur recovery from sour gas or hydrogenation activity on Ni supported on sepiolite (Jung et al., 2004) etc.

Several research that mainly concentrated on calcinations process have been made for explain the water type or transformation and interrelated temperature intervals by means of XRD (Bastida et al., 2006), DTA-TG (Frost et al., 2003) and FT-IR (Mora et al., 2010; Alkan et al., 2005) etc. Grinding process is a very common process in industry (Cornejo et al., 1988) but when mechanical activation process is performed size reduction, surface activation, chemical or decomposition reactions which take place above room temperature, occur simultaneously (Balaz, 2000). For this reason, in this study, the effects of mechanical activation on the structure and thermal behavior of sepiolitic clay were investigated by means of X-ray diffraction (XRD), particle size analysis, scanning electron microscopy (SEM) and thermal analysis (TG/DTA).

## Materials and Method

The mechanical activation of sepiolite from Kale Maden (Turkey) was performed in a Planetary Mono Mill Pulverisette 6 under the following conditions: the weight and diameter of tungsten carbide (WC) balls were 200 g and 10 mm respectively; the grinding bowl was 250 mL WC; the grinding times 30 and 60 min; the speed of the main disk was  $600 \text{ rev. min}^{-1}$ ; the grinding process was dry. Ball-to-mass ratios during mechanical activation were kept constant at 25.

For comparative study calcination was performed under atmospheric condition at 380, 540 and 580°C for one hour with  $10^\circ\text{C}/\text{min}$  heating rate. X-ray diffraction analysis was performed using a Rigaku Ultima X-ray diffractometer and Cu  $K\alpha$  radiation. The degree of amorphization (A) of the mechanically activated sepiolite according to X-ray diffracton results was calculated from equation (1),

$$A = \left( 1 - \frac{I_x}{I_0} \right) \cdot 100 \quad (1)$$

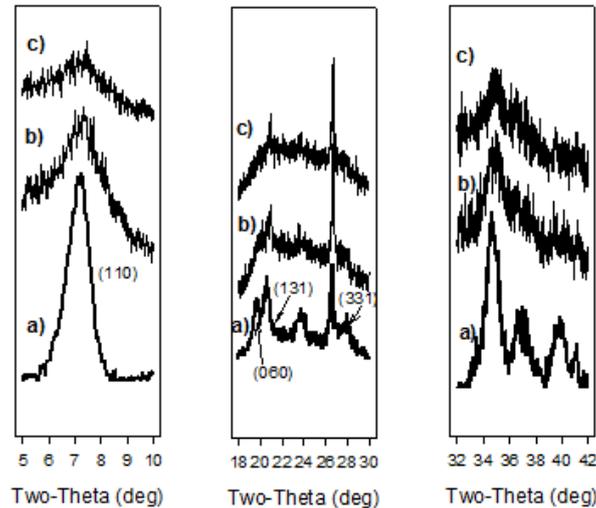
where  $I_0$  is the integral intensity of the diffraction peak for the non-activated sepiolite,  $B_0$  is the background of the diffraction peak for the non-activated sepiolite, and  $I_x$  and  $B_x$  are the equivalent values for the activated sepiolite (Balaz, 2000; Balaz, 2008). A JEOL 6060 LV scanning electron microscope (SEM) was used for morphological analysis of the non-activated and activated samples. DTA was performed using TA Instruments SDTQ 600 at heating rate of  $10^\circ\text{C} \cdot \text{min}^{-1}$  under atmospheric conditions and Mikrotrac S3500 was used for particle size distribution analysis.

## Results and Discussion

Chemical composition of sepiolite which was provided by Kale Maden (Çanakkale/Turkey) was given at Table 1. As seen from the table sepiolite is rich in silicon and magnesium. Lost on ignition value is only 11.74.

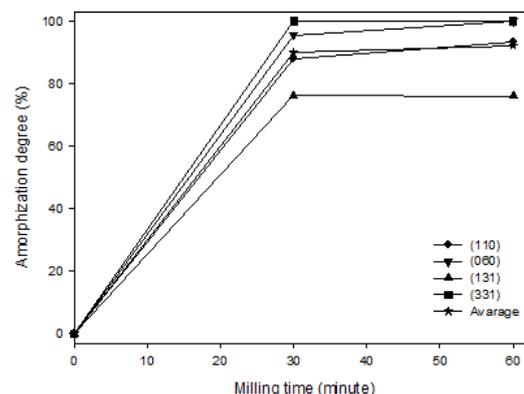
**Table 1.** Chemical composition of sepiolite

| SiO <sub>2</sub> | Al <sub>2</sub> O <sub>3</sub> | TiO <sub>2</sub> | Fe <sub>2</sub> O <sub>3</sub> | CaO  | MgO | Na <sub>2</sub> O | K <sub>2</sub> O | L.O.I |
|------------------|--------------------------------|------------------|--------------------------------|------|-----|-------------------|------------------|-------|
| 61.03            | 7.50                           | 0.20             | 0.95                           | 1.60 | 16  | 0.21              | 0.48             | 11.74 |

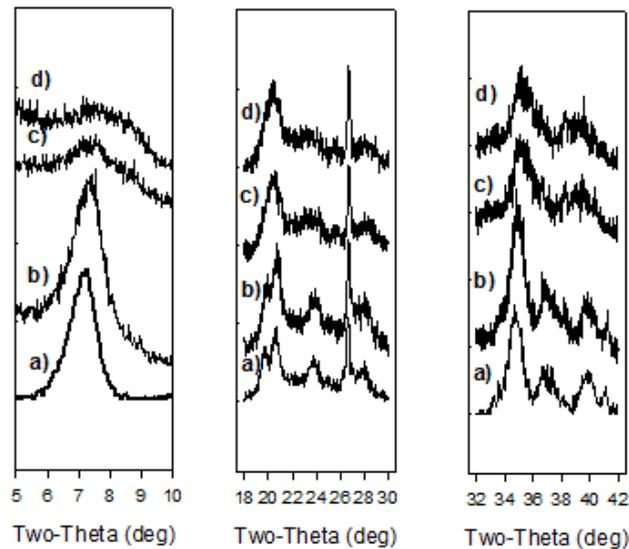


**Figure 1.** XRD patterns of (a) non-activated sepiolite, (b) activated for 30 min and (c) activated for 60 min

XRD patterns of the mechanically activated sepiolite samples were given in Fig 1. with respect to 5°-10° and 18°-30° and 32°-42° intervals. (110), (060), (131) and (331) reflections were determined at 7.2°, 19.7°, 20.6° and 28° respectively for non-activated sepiolite. According to Eq 1, amorphization degree of the peak that found at 7.2° reached 98 percent after 60 min mechanical activation. Amorphization is the situation that peak broadening and decreasing of intensity come along because of the grinding media interaction and material behavior against this media. Particles can be refined at critical size and after this energy accumulation in the volume or at the surface of crystals take place. This occurrence is the beginning of the amorphization. Furthermore because of the interaction local temperatures may be increased (Tunç et al., 2012a; Balaz, 2000; Tunç et al., 2000b). (060) reflection got amorphized approximately 95 percent at 30 min and got lost after this duration. (131) reflection that positioned at 20.6 got amorphized 76 percent after 30 min and stabilized. (331) reflection couldn't be determined for 30 and 60 min activated samples so it can be said that amorphization process took place and finished between 0 and 15 min for this pattern. Between 32°-42° same amorphization degrees were calculated. According to this values average degrees are 89.9 and 92.3 percentages for 30 and 60 min. respectively. Amorphization degrees for the reflections and average value for mechanically activated sepiolite were given in Fig 2. as graphically. Intensity of the (110) reflection decreased greater than the others in 30 min. After 30 min decreasing behavior of the all peaks are the same. This is the result that originated from first structural ribbons deformation and after atomic structure disruption (Cornejo et al., 1988).



**Figure 2.** Amorphization degree of mechanically activated sepiolite



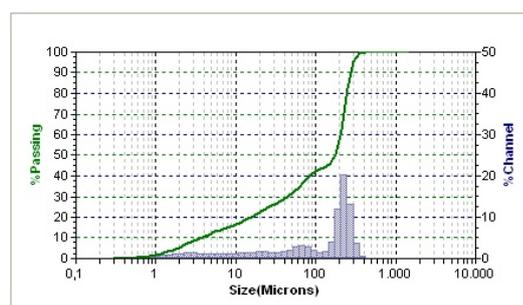
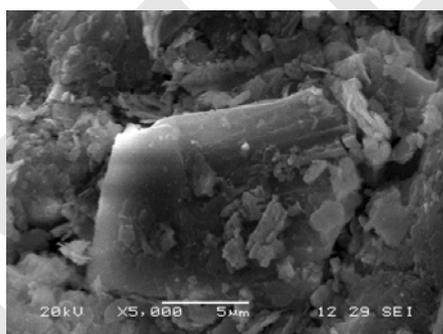
**Figure 3.** XRD patterns of the a) original sepiolite and calcined at b)380°C c)540°C and d)580°C sepiolite samples

Untreated sepiolite has sharp (110) = 12.1Å reflection that indicate the crystallinity of the sample as shown in Fig. 1 and Fig. 3. (110) diffraction pattern is the interlayer distance in sepiolite (Mora et al., 2010). After calcining at 380°C, (110) diffraction preserved itself in some degree. But after calcining at 540°C and 580 °C this peak disappeared and the structure of sepiolite was destroyed as took place in mechanical activation process.

Particle size analysis and SEM microscopy results were given in Table 2 and Fig. 4-6 respectively. Non-activated sepiolite has laminar structure and angled particles can be seen in Fig. 5. Diameter of the ninety percentages of the particles is 270.6 μm. In Fig. 5 and 6 instead of angled particle rounded particles were seen. Mechanically activated samples refined from this dimension to 37.89 and 94.13 for 30 and 60 min. activation duration respectively.

**Table 2.** Particle size analysis of the samples

| Milling Duration (min) | $d_{10}$ (μm) | $d_{50}$ (μm) | $d_{90}$ (μm) |
|------------------------|---------------|---------------|---------------|
| Non-activated          | 3,660         | 175,7         | 270,6         |
| 30                     | 0,688         | 2,834         | 37,89         |
| 60                     | 0,701         | 3,930         | 94,13         |



**Figure 4.** SEM micrograph and particle size analysis of non-activated sepiolite

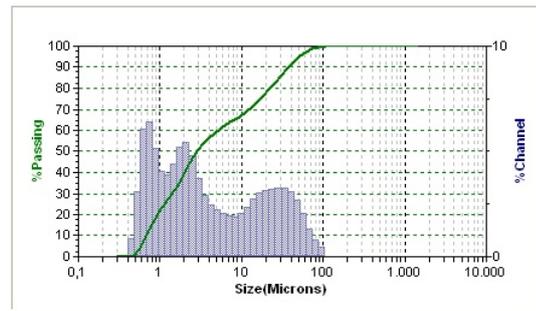
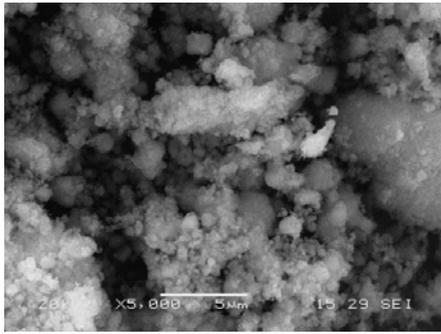


Figure 5. SEM micrograph and particle size analysis of activated sepiolite for 30 min.

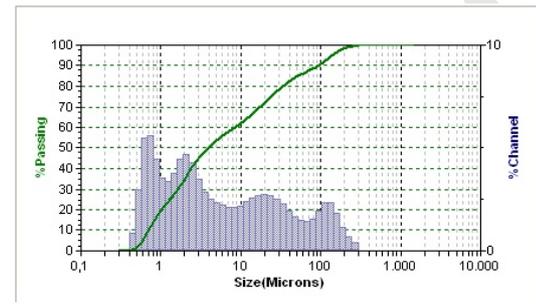
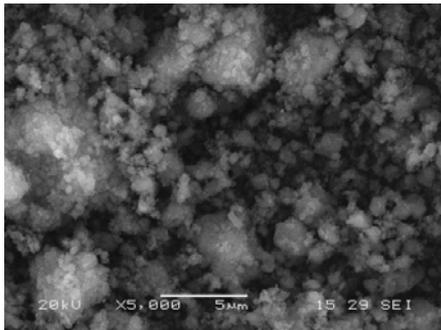


Figure 6. SEM micrograph and particle size analysis of activated sepiolite for 60 min.

The reason of increment in the dimension can be agglomeration that induced by mechanical activation which might be produced new surface area and this area can be more active than the former one (Balaz, 2008).

Thermal analysis of non-activated and activated samples was given in Fig 7. and Fig 8. with respect to thermogravimetric and differential thermal analysis. Curve of the non-activated sample has four parts that have different slopes. These slopes can characterize the process rapidity (Nagata et al., 1974). Frost and Ding (2003) stated that up to 200°C both hygroscopic and zeolitic water were lost. Between 250 and 450°C bound water were lost; more strongly bound water (co-ordinated water) and the hydroxyl units were lost in the temperature range 450-610°C. From these chemical equations theoretical weight losses determined as %11.1, %2.78, % 2.78, % 2.78 for each step respectively (Nagata et al., 1974). From this values and chemical equations step one and two are dehydration and step three and four are the dehydroxylation process (Frost et al., 2003).

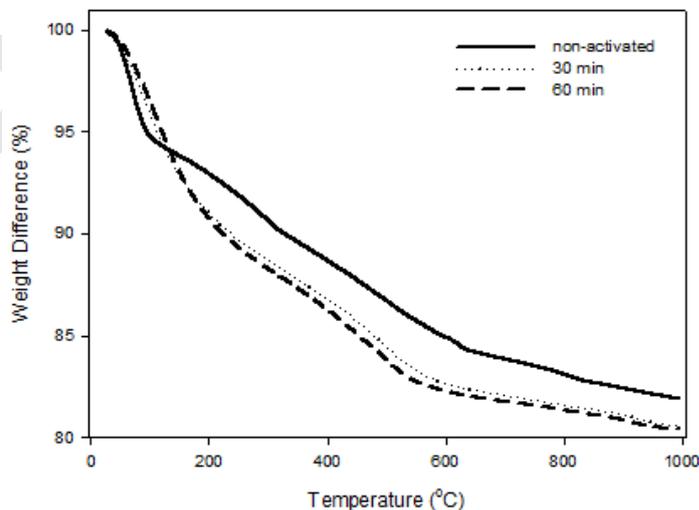
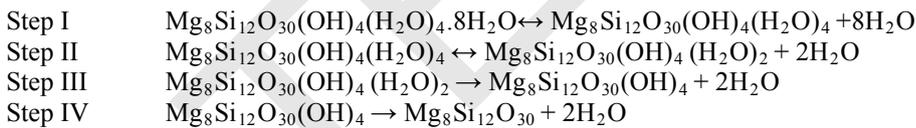


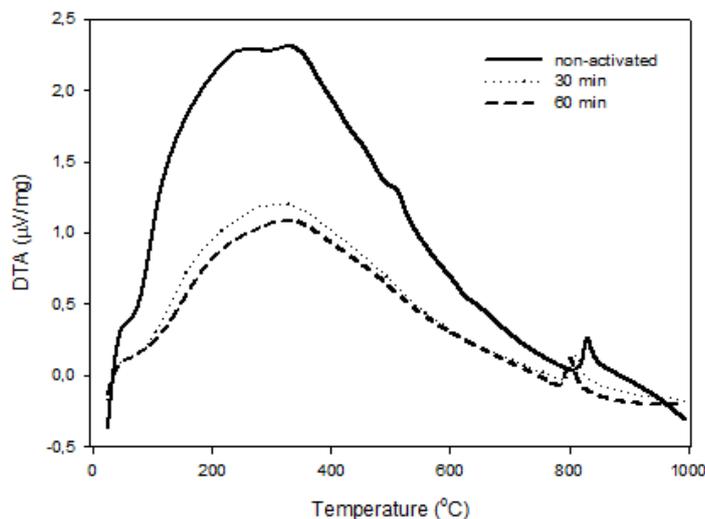
Figure 7. Thermogravimetric analysis of non-activated and activated sepiolite samples

For non-activated and activated sepiolite samples temperature intervals and related weight losses were given in Table 3. As seen from the table for non-activated sepiolite dehydration process did not completed in two steps with regards to hygroscopic and zeolitic water. In step three weight losses originated from residuary zeolitic water and part of the bound water were occurred. Similarly dehydroxylation process came after the loose of zeolitic water and did not completed end of the step four. In spite of non-activated sepiolite, dehydration occurrence finished in step one and dehydroxylation process occurred in step two as shown in Table 1 with regard to weight lost value. Step two and three are the dehydroxylation process for activated samples.

**Table 3.** Temperature intervals and weight losses for TG curves of the samples

|               | Step I  | WL    | Step II   | WL   | Step III   | WL   | Step IV   | WL   |
|---------------|---------|-------|-----------|------|------------|------|-----------|------|
| Non-Activated | 0-220°C | 7.47  | 220-320°C | 2.39 | 320-660°C  | 5.94 | 660-840°C | 1.46 |
| 30 min.       | 0-400°C | 13.17 | 400-580°C | 3.97 | 580-1000°C | 2.31 | -         | -    |
| 60 min.       | 0-380°C | 13.3  | 380-560°C | 4.07 | 560-1000°C | 2.23 | -         | -    |

\*WL=Weight Lost (%)



**Figure 8.** Differential thermal analysis (DTA) of the samples

The area of the peak is proportional to the quantity of heat absorbed or released during reaction (Seguin, 1973). In Fig. 8 the area of the peaks are different and decreased with increment of milling time. From this result it can be said that with elongated mechanical activation time need of energy for dehydration, dehidraxilation and phase transformation decreased because of the energy accumulation in the volume or at the surface of crystal due to the limit for fragmentation of a partical (Balaz, 2000; Balaz, 2008). As seen from the Table 3 and Fig. 7 for activated sepiolite samples dehydration and dehydroxylation process occurred before of the reference temperatures. Identically transformation in to enstatite occurred at 830°C for non-activated sepiolite, 809°C for 30 min activated sepiolite and 801°C for 60 min sepiolite.

## Conclusions

With mechanical activation the amorphization occurred in sepiolite structure and the structure was distorted. Dehidration was proceed in one step and dehydroxylation was completed in three steps. Transformation temperature was lowered after mechanical activation. Calcining sepiolite at 540°C gave same results with 60 min of mechanical activation with respect to amorphization that determined via X-ray diffraction analysis.

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## Tracking Single Bubble in Hall-Héroult Aluminium Cell: An Experimental and Numerical Study

Subrat Das, Guy Littlefair and Yos Morsi\* and Geoffrey Brooks\*  
School of Engineering, Faculty of Science and Technology  
Deakin University, Waurn Ponds  
Australia, [subrat.das@deakin.edu.au](mailto:subrat.das@deakin.edu.au)

\*Swinburne University of Technology, FEIS  
PB 218, Hawthorn, VIC 3122, Australia

**Abstract:** In simulations of the hydrodynamics of the multiphase flow in gas-liquid systems with finite sizes of bubbles, the important thing is to compute explicitly the time evolution of the gas-liquid interface in many engineering applications. The most commonly used methods representing this approach are: the volume of fluid and the phase field methods. The later has gained significant interest because of its capability of performing numerical computations on a fixed Cartesian grid without having to parametrise these objects (Eulerian approach) and at the same time it allows to follow the interface ( for example bubble's shape) that change the topology.

In this paper, both numerical (phase field method) and experimental results for the bubble shapes underneath a downward facing plane is presented. Experiments are carried out to see the bubble sliding motion underneath a horizontal and inclined anode. It is assumed that the bubble formed under the anode surface is deformed (flattened) due to buoyant field before it goes around the anode corner. The bubble elongates to form a tail-like shape. The change in shape of the bubble is almost instantaneous and has a significant effect on the localised hydrodynamics around the bubble, which could influence the dynamics of the flow patterns in the Hall-Héroult cell. This deformation is the main cause of the bubble wake and the induced flow field in the aluminium cell. Various parameters such as bubble size, deformation and its sliding mechanism at different surface tensions are discussed and compared with experimental results.

**Keywords:** Bubble induced flow, Phase Field Method, Hall- Héroult cell

### Introduction

Bubble flow in aluminium cells is a complex phenomenon due several factors such as magnetohydrodynamics forces, surface tension, buoyant field, current density, voltage fluctuations, convective forces due to temperature gradient, shape of anode, ACD and more importantly the electrolysis process itself. Gas is generated under the anode forms a relatively thin (about 4-5mm, up to 10-12 mm under dynamic conditions) bubble-laden layer (Kiss, 2006). The bubbles escape around the edge of the anode, accelerating the liquid bath and inducing horizontal movement. Bubble population density under the anode surface increases with current density. Occasionally, bubbles coverage increases because of the higher “gas-hold up” rate which in turn reduces anode surface area leading to very high local current density. Higher current density has several implications such as sudden growth of thin gas layer around the anode, magnetohydrodynamics instabilities due to higher local perturbations, local joule heating and also the change in wettability of the electrode.

However, the exact mechanism leading to the formation of this gas film, sliding of gas bubbles and the “gas-holdup” rate that may be different from case to case, is not known clearly. To date several experimental and theoretical works have been published on the bubble motion which actually never incorporated even one tenth of the actual complexity of Hall-Héroult process. This is because of the difficulty in modelling of two-phase flow in such dynamic condition and complex geometry at different length and time scale.

There are several techniques such as front tracking method (Unverdi, 1992), the volume of fluid method (Rider & Kothe, 1998), the Lattice-Boltzman method (Takada, Misawa, Tomiyama, & Fujiwara, 2000) and phase field methods (Sun & Beckermann, 2007, 2010; Takada, Misawa, & Tomiyama, 2006). The later has gained significant attention due to its capability of performing numerical computations on a fixed Cartesian grid without having to parametrise these objects (Eulerian approach), where the interface between two phases (i.e. bubble boundary) is assumed to be smooth boundary having a finite thickness. A non-conserved order parameter, the phase field,  $\phi$ , is introduced to describe the phase transition across this boundary. It has constant values in the bulk phases (from +ve 1 to -ve 1) and varies smoothly across the interface boundary. One of the most important features of the phase-field method is that all governing equations can be solved simultaneously without any a priori knowledge of the location of the interfaces. However, on the other hand, it is required to have an extremely thin interface to model all the relevant physical phenomena. Due to the existence of large gradients across the this interface Cahn–Hilliard/Navier–Stokes system (Badalassi, Cenicerros, & Banerjee, 2003) is used.

In this study, bubble formation underneath a horizontal and/or inclined plate was considered with a continuous supply of air. The effect of flow rates and surface tension were the main parameters investigated. Water and olive oil were used to investigate the effect of surface tension. Moreover, the size and shape of the bubbles were investigated experimentally using a high speed camera and the phase field method was used to analyse the bubble interface numerically using commercial FEA code, COMSOL Inc. (Liu, Herman, & Mewes, 2006). Thus, in this paper, both numerical and experimental results are presented to show the bubble sliding/deforming under the anode surface.

### Numerical Model

The time evolution the diffusive interface profile of phase field function  $\phi$  is governed by the Cahn–Hilliard equation:

$$\frac{\partial \phi}{\partial t} + \mathbf{u} \cdot \nabla \phi = \frac{\gamma \lambda}{\varepsilon^2} \psi \quad (1)$$

where  $\lambda$  is the mixing energy density (N) with the dimension of force (Jacqmin, 1999),  $\varepsilon$  (m) is a capillary width that scales with the diffuse interface width and the mobility parameter is defined as  $\gamma$  ( $\text{m}^3\text{s/kg}$ ).

Where

$$\psi = \varepsilon^2 \phi (\phi^2 - 1) \phi \quad (2)$$

The mobility, in equation 1, determines the time scale of the Cahn-Hilliard diffusion and must be large enough to retain a constant interfacial thickness but small enough so that the convective terms are not overly damped (Takada, et al., 2006).

The conservation mass and momentum equation with surface tension ( $F_{st}$ ) and gravity force can be written as:

$$\nabla \cdot \mathbf{u} = 0 \quad (3)$$

$$\rho \frac{\partial \mathbf{u}}{\partial t} + \rho (\mathbf{u} \cdot \nabla) \mathbf{u} = \nabla p - \eta (\nabla \cdot \mathbf{u} + \nabla^T \cdot \mathbf{u}) - F_{st} + \rho \mathbf{g} \quad (4)$$

Where density and viscosity are computed using volume fraction ( $V_f$ ) of surrounding fluid

$$\rho = \rho_1 + (\rho_2 - \rho_1) V_f \quad (5)$$

$$\eta = \eta_1 + (\eta_2 - \eta_1) V_f \quad (6)$$

Therefore equations 1 to 6 form the governing equations for our two-phase numerical analysis.

## Experimental Setup

Experiments were conducted in a  $0.18 \times 0.15$  m Perspex square tank of height 0.15 m. Bubbles were generated through a 2 mm (0.002 m) diameter orifice, under a horizontal plate at a controlled rate of air injection using a peristaltic pump. A digital inclinometer is used to adjust the plate position. A schematic representation of the experimental setup as well as the actual rig is shown in the figure 1.

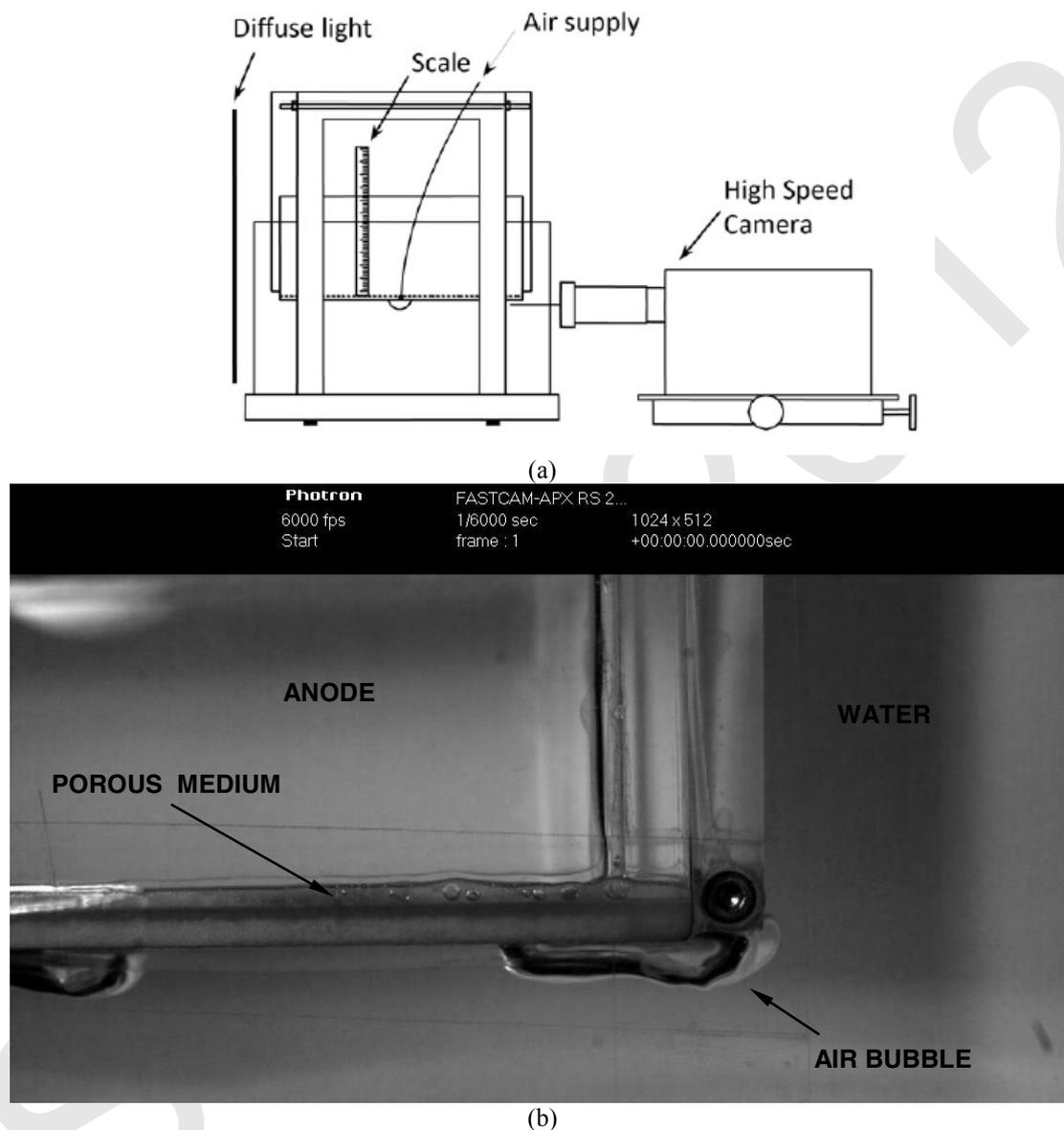


Fig. 1 (a) Schematic representation of the experimental rig and (b) the photograph using PHOTRON camera

## Results and Discussion

### Experimental Results

Different flow rates of air injections ranging from 0.06 ml/s to 0.48 ml/s were used in both experimental and numerical analyses. The shape of the bubble was studied using a high speed camera (FASTCAM-APX RS 250KC). The camera was placed on an automatic levelling shock-proof platform with precise x and y axes control. This enabled us to minimise the parallax error to a large extent.

Figure 2(a) shows the bubble formation underneath a downward facing horizontal surface. The bubble evolves from a spherical shape and gradually flattens with gravity. The bubble thickness increases rapidly, indicating a severe change in aspect ratio of the bubble. The bubble base only gets bigger without change in thickness (Das, Morsi, Brooks, Chen, & Yang, 2012). The factors that

influence the bubble forming are the gravity field, the force  $F_p$  due to the pressure inside the bubble and forces that cause the bubble to attach to the surface as shown in the figure 2(b).

$$F_1 \approx 2\pi r (\sigma \sin \theta_c \approx F_p \cos \theta_c) \quad (7)$$

$$F_2 \approx F_B \approx V(\rho_l \approx \rho_g)g \quad (8)$$

$F_1$  and  $F_2$  both act vertically upward. Thus the criterion of detachment for the bubble is not satisfied when it grows underneath a horizontal surface (perfectly horizontal). This is main reason why the bubble begins to flatten after it has reached a certain thickness due to the influence of the gravity field. It is to be noted that a significant layer of stationary air begins to form at the top part of flattened larger bubble. This is because the gas flow rate causes only lateral movement at the base.

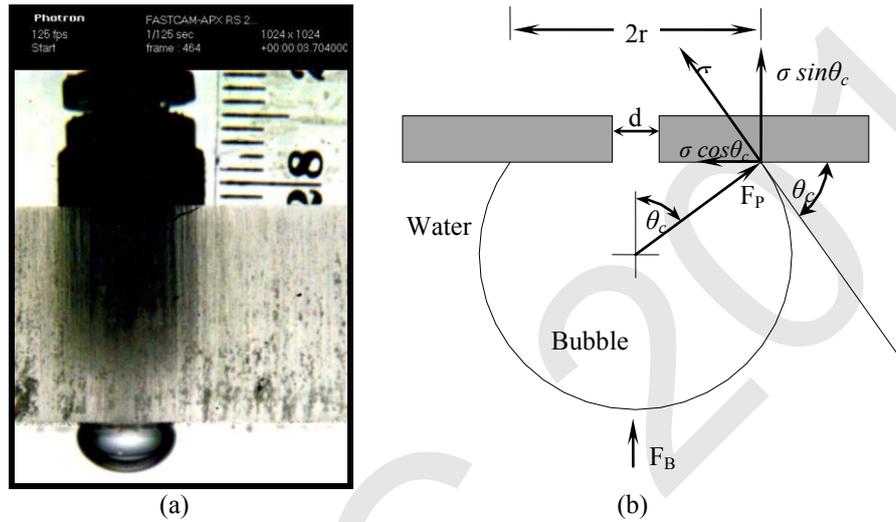


Fig. 2 Bubble formation under a flat horizontal anode

When the bubble approaches the anode corners (see figure 0) it forms a tail like structure as shown in figure 3. The bubble movements around the corner are shown at 0.015 seconds apart.

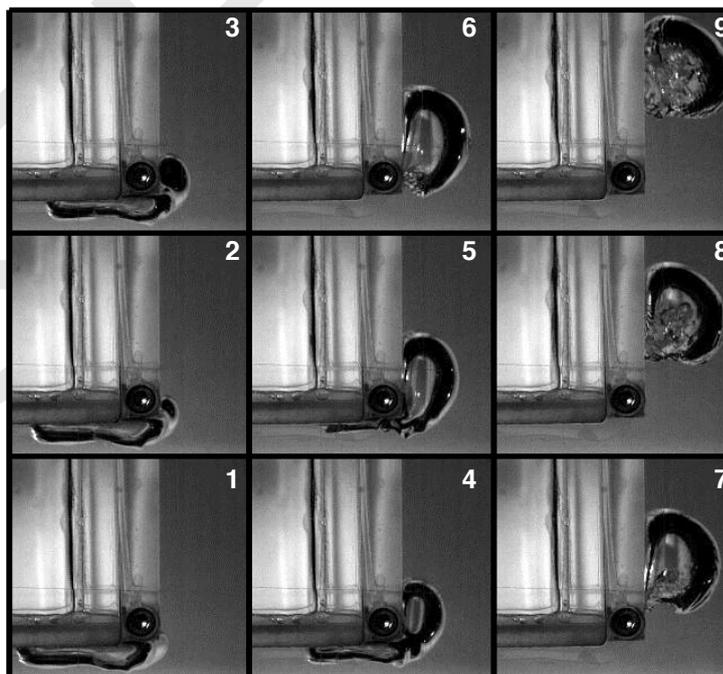


Fig. 3 Bubble movements at the anode corner

However, for inclined anode, bubble detaches and begins to slide along the path when the buoyancy exceeds the surface tension force. Figure 4 shows the sliding patterns of the bubble when generated under a surface with inclination angle of 2 degree. Both water and olive oil are used in the experiment. The figure shows the rate of air injection at 0.06 ml/s for both cases. The images are plotted at 0.01 s apart. It is apparent from the figure that the bubble gets flattened more in water than in olive oil. Different air injection rates with different inclinations ( $2^\circ$  to  $20^\circ$ ) are also considered. Because of the inclination of an orifice plate, the dynamic contact angle ( $\theta$ ) is not a single number at any instant of time of the bubble formation. The contact angle keeps on changing as bubble grows. Thus the shape of the bubble also changes depending upon flow rate and the inclination. At lower inclination, the shape changes to ellipsoid. At higher inclinations, the bubble tends to detach much earlier resulting smaller size. Figure 5 shows a comparison of bubble sizes in two different fluids (water and olive). It can be seen that bubble size in olive oil is much smaller than that of water, which is due to the influence of surface tension. Thus surface tension and the inclination angle have strong influence on the detachment and size of the bubble. At  $20^\circ$  deg inclination, detachment time decreases significantly resulting much smaller bubble in size, which is mainly attributed to the dominance buoyancy force and the non-wetting behaviour (contact-angle) of the surrounding fluid with the solid surface.

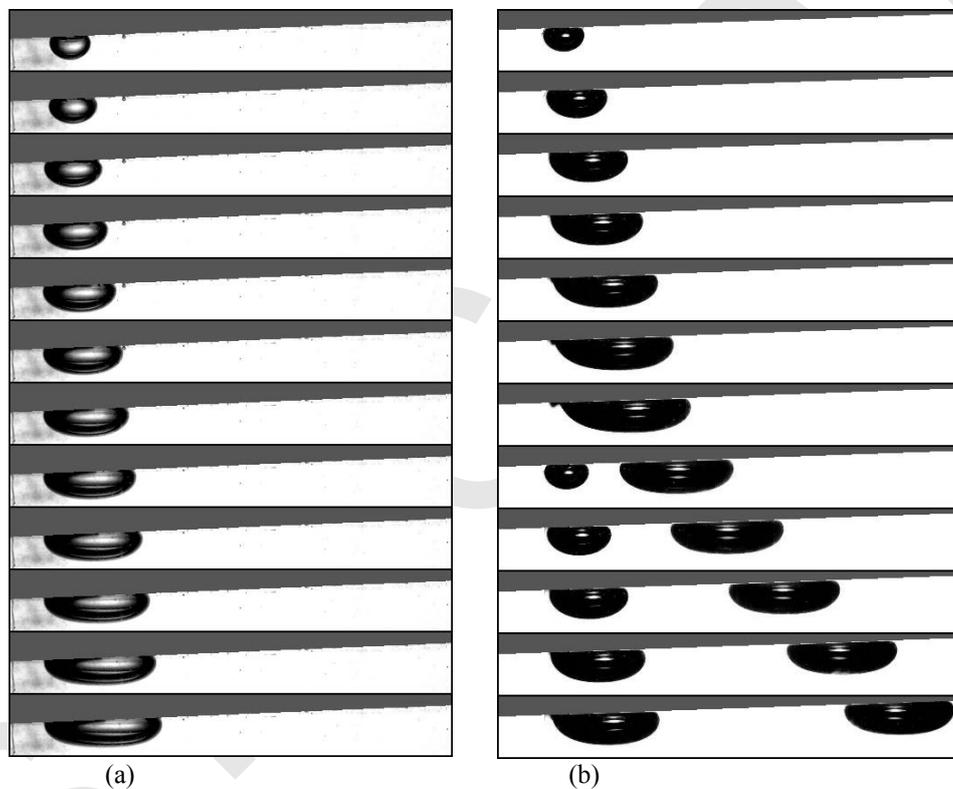


Fig. 4. Bubble formation on downward facing surface submerged in (a) water and (b) Olive oil (surface inclination = 2 deg.)

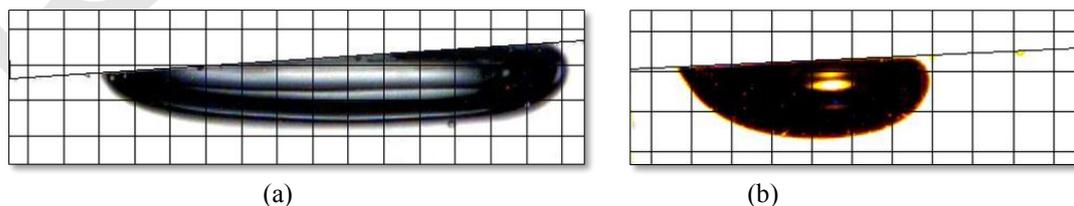


Fig. 5 Bubble formation on downward facing surface submerged in (a) water and (b) Olive oil (surface inclination = 4 deg.)

The bubble translates into an ellipsoidal shape with a circular frontal nose and elongated tail during the detachment. Several researchers (Addlesee & Cornwell, 1997; Aussillous & Quere, 2002; Perron, Kiss, & Poncsák, 2006) reported that there is a thin wetting film between the bubble and surface, which may be attributed to this non-wetting behaviour of the bubble.

## Numerical Model

The numerical simulation is carried out using Cartesian grid using triangular elements. The minimum element size, in general, 0.002 cm depending upon the size of bubbles. No slip boundary conditions are applied on all walls with a symmetric boundary condition at the left side of the domain. Gravity is applied in the entire domain, which induces the buoyancy force on the bubble. A nozzle of diameter 2 mm is used to inject gas (air) to form bubbles. The inlet of the nozzle is modified to avoid computation difficulty. Figure 6 shows a schematic representation of the computational domain for inclined anode. The phase field method typically requires an accurate initialization to avoid any overshoots or undershoots at the interface between the phases. Figure 6 represents the initialisation of phase field function at  $t = 0$ , where both phases (gas and liquid) are represented by their respective densities.

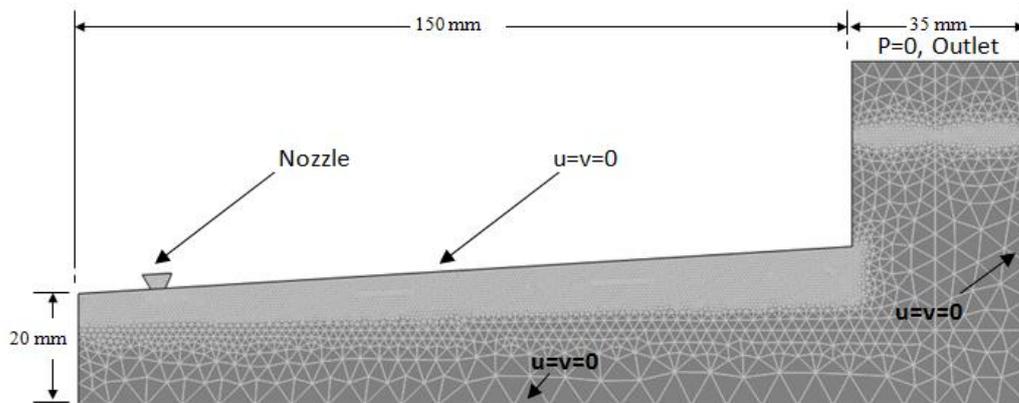


Fig. 6 Schematic representation of the computational domain

As mentioned above, the bubble nucleating under the horizontal anode surface moves toward the anode edge and escapes when it is large enough. Detachment criterion is never satisfied with pure gravitational field for bubble nucleating underneath of a horizontal field. Thus, the bubble that nucleated and/or formed near the anode edge is considerable larger and may have undergone a severe deformation before it escapes from the anode cover. The differential force that the bubble experiences due to change in shape while adhering the anode wall is a function of surface tension, the deforming contact angle and the equivalent radius.

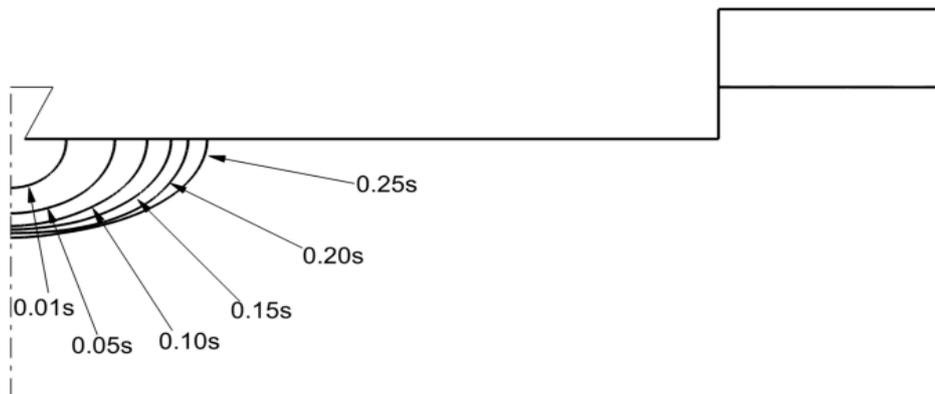


Fig. 7 The phase field function,  $\phi$  (Bubble contour), at different time steps for horizontal anode

For an inclined, the bubble evolves spherically and gradually translates along the bottom face of the anode while gradually deforming to an ellipsoidal shape. The deformation of the bubble can be attributed to a balance of the surface tension, gravity and drag forces. In general, when the bubble

begins to grow, the surface tension force tends to minimise the stretching ratio while the drag force opposes the motion due to an adverse pressure gradient. The predicted streamline plot around the bubble profile clearly illustrates the existence of adverse pressure gradient all around the bubble except at the frontal nose of the bubble. Figure 8 shows the predicted bubble growth at different time steps.

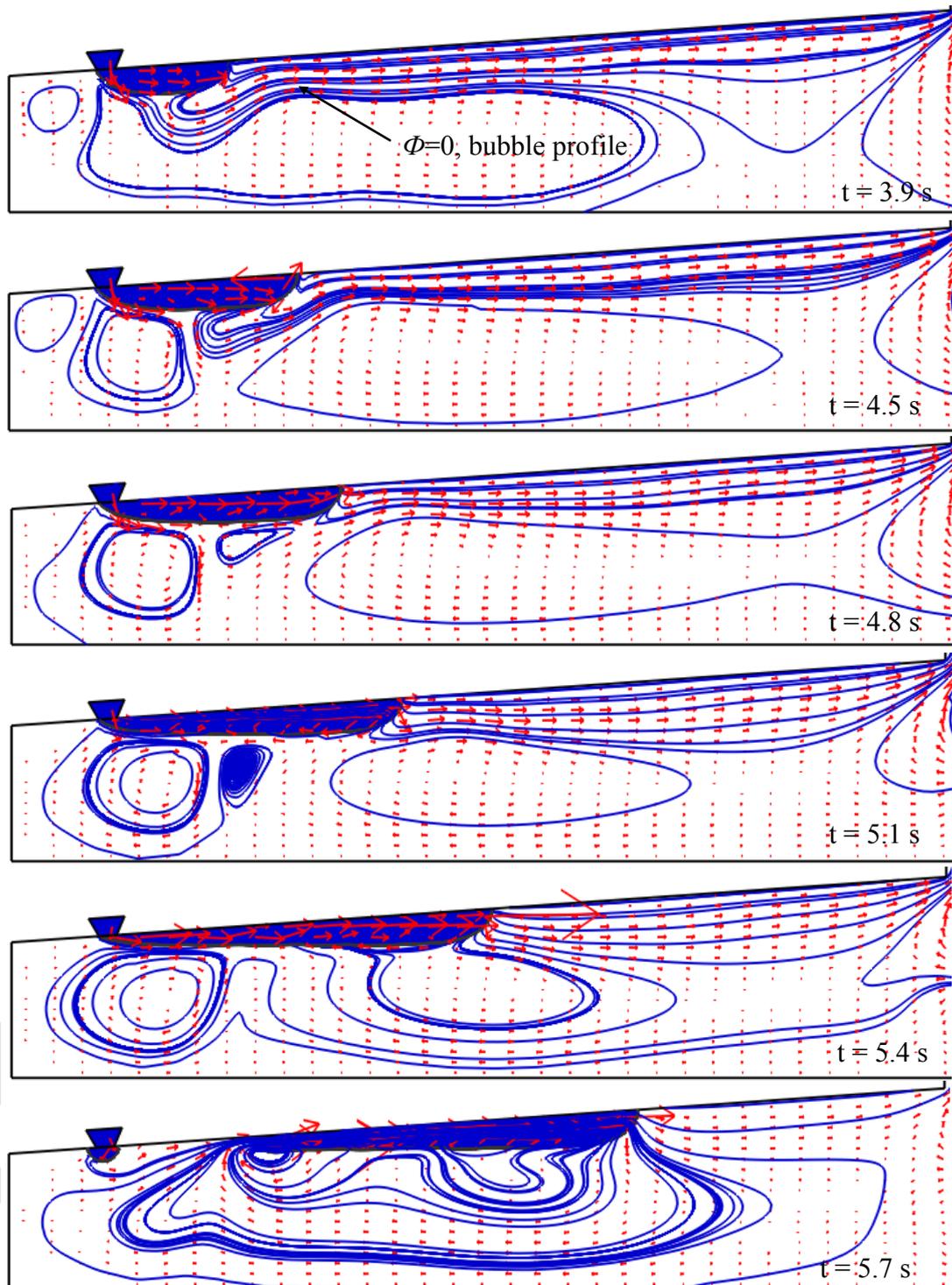


Fig. 8 Bubble sliding underneath an inclined plane at  $\Delta t = 0.3$  s.

The model predicts that a bubble changes its shape during its detachment. The gravity component parallel to the incline plane is the main cause of the bubble drifting along the incline plane while the perpendicular component flattens the shape of the bubble. Under such conditions, the thickness of the front of the bubble is bigger than that of the rear part. Fortin et al. (Fortin, Gerhardt, & Gesing, 1984) and Caboussat et al. (Caboussat et al., 2011) reported similar observations for large

bubbles under inclined planes. The bubble elongates due to the formation of the tail. The maximum displacement is predicted when the tail detaches from the orifice. The tail moves instantaneously ( $t = 5.7$  s, Fig. 8), creating a negative pressure at the trailing side of the bubble. This negative pressure is the main source of the turbulence that could be created underneath an inclined surface.

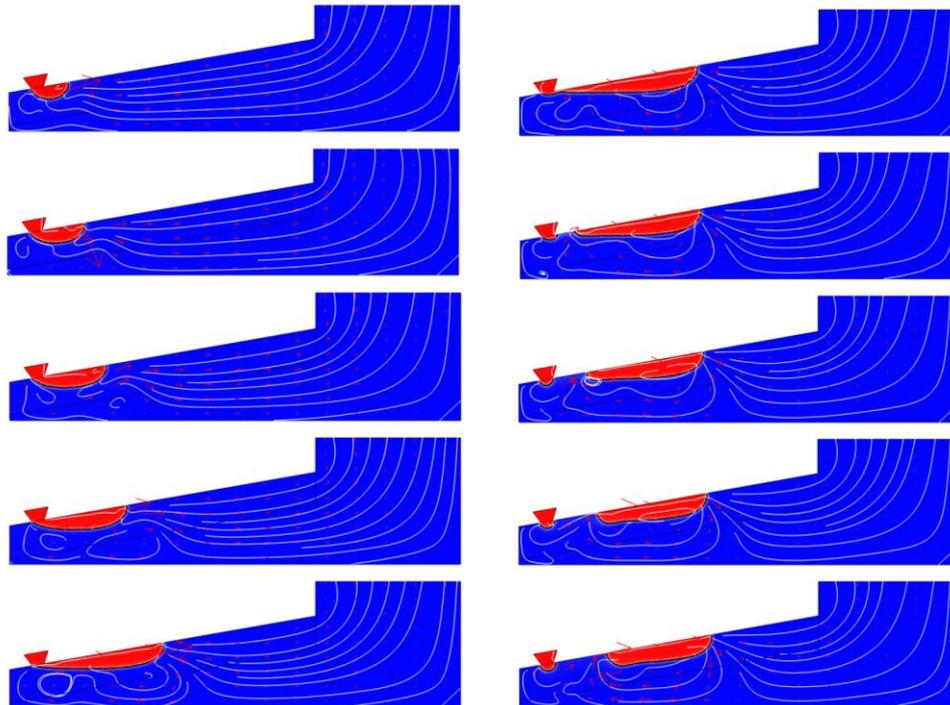


Fig. 9 Bubble formation at higher inclination ( $\alpha = 10^\circ$ )

Figure 9 shows the predicted bubble formation, detachment and sliding behaviour along the inclined path for the case,  $\alpha = 10^\circ$ . After detachment the bubble changes its shape rapidly. The change in shape after the detachment may be the main cause the onset of localised flow surrounding the bubble.

## Conclusion

A numerical scheme of phase field method has been used in to track the motion of the interface for buoyancy-driven droplets. The model uses cold model to depict the hall-hérault process. The findings here demonstrated that despite the inherent disadvantage of the phase field method of mass non-conservation, it is quite capable of tracking the bubble by implementing re-initialization with appropriate phase field variable. More importantly the technique can extended to a real application of hall-hérault process where one can think of using the porosity that impact the bubble motion (slip boundary or wet ability), convective flow due to temperature gradient and oscillatory boundary of the metal pad and the electric field which has dominant effect on the bubble flow. The predicted results of a phase field model of bubble detachment phenomena at single top-submerged orifice under constant inflow conditions were validated with experimental data obtained for an air bubble detachment under an inclined surface immersed in both water and olive oil. The influence of inclination angle on bubble shape and its detachment is studied. The results show that most of the localised phenomena are associated with bubble shapes-change during its detachment it detachment from the origin of formation.

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# TÜRKİYE’DE E-DÖNÜŞÜM SÜRECİNDE YEREL YÖNETİMLERİN ETKİSİ

Doç. Dr. Halil İbrahim AYDINLI  
[haydinli@sakarya.edu.tr](mailto:haydinli@sakarya.edu.tr)

Arş. Gör. Salih ÇİFTÇİ  
[slhciftci@gmail.com](mailto:slhciftci@gmail.com)

Uzman Nesrin Şengül AYDINLI

**Abstract:** Ekonomik anlamda sınırların ortadan kalktığı bir dünyada, bilgi ve iletişim teknolojilerinin de etkisiyle, içinde bulunduğumuz yüzyıl, küreselleşme sürecinin yoğun olarak yaşandığı bir zamana dönüşmüştür. Dolayısıyla bu süreç sosyo-ekonomik koşullar üzerinde de etkili olmaktadır. Günümüz dünyası, sanayi toplumundan bilgi toplumuna geçişin temellerinin atıldığı, değişim ve dönüşümlerin inanılmaz bir hızla yaşandığı bir dünya olmuştur. Bilgi çağının gerektirdiği kent yaşamını kolaylaştıran planlı ve programlı faaliyetlerin yürütülmesinde belediye ve yerel yönetimlere büyük görev ve sorumluluklar düşmektedir. Bu anlamda vatandaşların yerel yönetimlerden beklentileri sürekli artmaktadır. Dolayısıyla e-dönüşüm ile yerel hizmetlerde etkinlik ve verimlilik gibi kavramlar daha düzenli ve daha sağlıklı şekilde ön plana çıkabileceği gibi e-dönüşümün kentsel yaşam kalitesinin artmasına da katkısı büyük olacaktır.

**Key words:** Küreselleşme, e-devlet, e-dönüşüm, yerel yönetimler

## Giriş

Bilgi iletişim teknolojileri küreselleşmenin fiziki alt yapısını oluşturmaktadır. Bu anlamda dönüşüm sadece ekonomik anlamda değil aynı zamanda kültürel, hukuki, siyasal ve sosyal alanda da yaşanmaktadır. Ülkelerin bu yeni düzene uyum sağlayabilmesi için geliştirmekte olan teknolojiyi takip etmesi ve yeni bir yapılanmaya gitmesi gerekmektedir. E-devlet olarak adlandırılan bu yeni model, bilgi ve iletişim teknolojilerinin sosyal hayattaki yerini daha da güçlendirirken, yaşamın da vazgeçilmez öğelerinden biri haline gelmektedir. Dünyada ve Türkiye’de gerek merkezi yönetim gerekse yerel yönetimler bilgi ve iletişim teknolojilerini kullanarak, vatandaşa daha iyi, etkin, hızlı ve verimli hizmet sunarak günlük hayatı kolaylaştırmayı amaç edinmektedirler.

E-dönüşüm, “vatandaşlara daha kaliteli ve hızlı kamu hizmeti sunabilmek amacıyla; katılımcı, şeffaf, etkin ve basit iş süreçlerine sahip olmayı ilke edinmiş bir devlet yapısı oluşturacak koşulların hazırlanması” olarak tanımlanmaktadır. Vatandaşa en yakın hizmet sunma yapılanması olan yerel yönetimler, sürdürülen e-devlet çalışmalarının da merkezinde yer almaktadır. Çünkü halka hizmet arzında en yakın ve etkileşimli birim olma özelliğine sahip yerel idareler bu dönüşümün en iyi algılanabileceği yerlerdir. E-dönüşüm olgusu başarıyla yönetilip, sağlam temellere oturtulduğu takdirde yerel yönetimler özellikle belediyeler açısından büyük imkânlar sunacaktır. Yerel yönetimler bütün ülkelerde olduğu gibi ülkemizde de kamu yönetiminin önemli ve vazgeçilmez unsuru olarak, halkla en yakın ilişki içerisinde olan ve yerel halkın istek ve ihtiyaçlarını karşılamak amacıyla oluşturulan birimlerdir. Sürekli gelişen bilişim teknolojileri, yerel yönetimlerin çok yönlü hizmet verme gereksinimleri doğrultusunda yeni ufuklar açacak ve problemlere uygun çözümler sunabilecektir.

## e-Dönüşüm Türkiye Projesi

e-Dönüşüm Türkiye Projesi, AB’ye aday ülke konumunda olan Türkiye’nin e-Avrupa+ hedeflerine ulaşmak amacıyla hayata geçirilmiş bir projedir. e-Avrupa+ hedefinden önce, Avrupa Komisyonu 2000 yılının Haziran ayında, Avrupa Birliği’ni bilgi tabanlı bir ekonomiye taşımak, Araştırma-Geliştirme ve yetişmiş insan gücüne yatırım yoluyla rekabetçi yapılanmayı gerçekleştirmek ve internet’i daha ucuz, daha hızlı, daha güvenli kılarak yaygınlaştırmak üzere “e-Avrupa Eylem Planı”nı devreye sokmuştur.

Bu girişim daha sonra, AB’nin genişleme süreci de düşünülerek, aday ülkelerinde yararlanabileceği, “e-Avrupa+” adı verilen yeni ve benzer bir planla daha geniş bir çerçeveye oturtulmuştur. 23-24 Mart 2001 tarihinde Stockholm’de yapılan liderler zirvesinde, AB’ye aday ülke konumundaki ülkelerde de bilgi toplumu oluşturma yönündeki eylem planlarını içeren “e-Avrupa+” girişimi görüşülüp onaylanmıştır. Türkiye’de aday ülke olarak 15-16 Haziran 2001 tarihinde Göteborg’da düzenlenen AB zirvesinde bu girişimdeki yerini almıştır. E-Avrupa+ daha ucuz, daha hızlı ve daha güvenli internet, insan kaynağına yatırım ve internet kullanımını özendirme olmak üzere üç temel

alana yönelmektedir (Canman, Ertekin ve diğerleri, 2002: 331). Aday ülkelere yönelik olarak kapsamı ve etkisi e-Avrupa+ programında geliştirilen e-Avrupa Programının eylem planı, aslında e-Dönüşüm Türkiye girişiminin de temel eylem alanlarını oluşturmaktadır. E-Türkiye ile Türkiye'de bilgi toplumunu oluşturmak ve bunu da Avrupa Birliği'nde bu yöndeki çalışmalarla eşgüdümü sağlayacak kurumsal yapılanmaları da kapsayacak biçimde yapılması hedeflenmektedir (İkinci Bilişim Şurası, 2004).

E-Dönüşüm Türkiye projesine ilk defa 58'nci Hükümet Programında yer verilmiş, projenin koordinasyonu, izlenmesi, değerlendirilmesi ve yönlendirilmesi ile ilgili olarak DPT Müsteşarlığı görevlendirilmiştir. Bu çerçevede ülke çapında gerçekleştirilecek e-Türkiye dönüşümünün kurumlar arası eşgüdümünün sağlanması, stratejilerin belirlenmesi amacıyla DPT bünyesinde Bilgi Toplumu Dairesi Başkanlığı teşkilatlandırılmıştır. Ayrıca, 27 Şubat 2003 tarihinde yayımlanan 2003/12 sayılı Başbakanlık Genelgesi ile E-Dönüşüm Türkiye Projesi'nin amaçları, kurumsal yapısı ve uygulama esasları belirlenmiştir. 2003/12 Sayılı Başbakanlık Genelgesi'nde belirtildiği üzere, e-Dönüşüm Türkiye Projesi'nin başlıca hedefi; vatandaşlara daha kaliteli ve hızlı kamu hizmeti sunabilmek amacıyla; katılımcı, şeffaf, etkin ve basit iş süreçlerine sahip olmayı ilke edinmiş bir devlet yapısı oluşturacak koşulların hazırlanması olarak belirlenmiştir. E-Türkiye Projesini gerçekleştirmek amacıyla oluşturulan on üç çalışma gurubunun yaptığı çalışmalar neticesinde 04 Aralık 2003 tarih ve 2003/48 sayılı Başbakanlık Genelgesiyle E-Dönüşüm Türkiye Projesi KDEP (Kısa Dönem Eylem Planı) uygulamaya konmuştur. Aynı zamanda bir devlet bakanı ve başbakan yardımcısının başkanlığında da E-Dönüşüm Türkiye İcra Kurulu oluşturulmuştur ([http://www.bilgitoplumu.gov.tr/Documents/1/Mevzuatlar/031203\\_2003-48SayiliGenelge.pdf](http://www.bilgitoplumu.gov.tr/Documents/1/Mevzuatlar/031203_2003-48SayiliGenelge.pdf)). 2012 yılında Kalkınma Bakanlığı'nın kurulmasıyla Devlet Planlama Teşkilatı'nın da kaldırılmasıyla bu projenin yönlendirilmesi görevi Kalkınma Bakanlığı'na geçmiştir.

Bu projeye; Avrupa Birliği müktesebatına uygun politikaları ve mevzuatın oluşturulması amaçlanmıştır. Ayrıca, vatandaşın karar alma süreçlerine katılımını sağlayacak mekanizmaların geliştirilmesi, kamu yönetiminin, saydam ve hesap verebilir hale getirilmesine katkıda bulunulması hedeflenmiştir. Yine, kamu hizmetlerinin sunumunda, enformasyon teknolojilerinden yararlanılarak iyi yönetim ilkelerinin hayata geçirilmesine yönelik çalışmalar yapılması vurgulanmıştır. Enformasyon teknolojilerinin kullanımının yaygınlaştırılması, kaynak israfını azaltmak amacıyla, kamunun mükerrer yatırım projelerinin bütünleştirilmesi, izlenmesi, değerlendirilmesi ve yatırımcı kamu kuruluşları arasında gerekli koordinasyonun sağlanması, sektördeki özel sektör faaliyetlerine yukarıdaki ilkeler ışığında yol gösterilmesi amaçlandığı belirtilmektedir (<http://www.bilgitoplumu.gov.tr>)

## Türkiye'de e-Dönüşüm Sürecinde e-Belediyecilik

e-dönüşüm, "vatandaşlara daha kaliteli ve hızlı kamu hizmeti sunabilmek amacıyla; katılımcı, şeffaf, etkin ve basit iş süreçlerine sahip olmayı ilke edinmiş bir devlet yapısı oluşturacak koşulların hazırlanması" olarak tanımlanmaktadır (2003/12 Başbakanlık Genelgesi). Vatandaşa en yakın hizmet sunma yapılanması olan yerel yönetimler, sürdürülen e-devlet çalışmalarının da merkezinde yer almalıdır. Çünkü halka hizmet arzında en yakın ve etkileşimli birim olma özelliğine sahip yerel idareler bu dönüşümün en iyi algılanabileceği yerlerdir. e-dönüşüm olgusu başarıyla yönetilip, sağlam temellere oturtulduğu takdirde yerel yönetimler özellikle belediyeler açısından büyük imkânlar sunacaktır.

Günümüzde, başta internet olmak üzere diğer elektronik unsurlar ve hizmetler; pahalı alt yapı yatırımları gerektirdiği için, yerel yönetimlerde devlet düzeyine göre daha yavaş gelişmekte ve yerleşmektedir. Yerel yönetimler bütün ülkelerde olduğu gibi Türkiye'de de kamu yönetiminin önemli ve vazgeçilmez unsuru olarak, vatandaşla en yakın ilişki içerisinde olan ve yerel halkın istek ve ihtiyaçlarını karşılamak amacıyla oluşturulan birimlerdir.

Ülkemizde nüfusun büyük bir kısmının kentlerde yaşamaya başlamasıyla kentsel ihtiyaçlar hızla artmakta ve çeşitlenmektedir. Buna bağlı olarak merkezi hükümetten yerel yönetimlere daha fazla kaynak aktarımı zorunlu hale gelmekte ve yerel yönetimlere yetki aktarımı her alanda hız kazanmaya başlamaktadır. Yerel yönetimlerin tanım olarak; belli bir coğrafi alanda yaşayan bireylerin ortak ihtiyaçlarının giderilmesi amacıyla oluşturulmuş, karar organları yerel toplulukça seçimle işbaşına gelen, yasalarla belirlenmiş görev ve yetkilere, özel gelirlere, bütçeye ve personele sahip, merkezi yönetim ile ilişkilerinde özerkliğe sahip kamu tüzel kişileri (Aksoy, 2006).

Bu noktada yerel yönetimlerin "e-" dönüşümünü gerçekleştirebilmeleri için bilgi teknolojileri altyapılarını güçlendirmelidirler. Yerel yönetim sistemi içinde en fonksiyonel ve vatandaşla en yakın yerel yönetim birimi belediyelerdir. e-dönüşüm projelerinde en önemli unsur olan internet, tüm yerel yönetim birimleri bakımından önem taşımakla birlikte daha çok belediyelerde ön plana çıkmaktadır. Çünkü belediyeler, kentte yaşayan vatandaşların öncelik taşıyan ihtiyaçlarını karşılayan ve yerel kamu hizmetlerinin vatandaşla sunumunda önemli roller üstlenen birimlerdir.

Türkiye'de anayasal olarak merkezden ve yerinden yönetim ilkelerine göre bir yapılanma söz konusudur. Merkezi yönetim ile yerel yönetimlerin "e-" yapılanmaya yönelik girişimleri birbirinden bağımsız düşünülmemelidir. Dolayısıyla merkezi yönetim dışında yerel yönetimlerde de e-devlet uygulamalarının yaygınlaştırılması gerekmektedir.

Devlet birimlerinde e-devlet yapılanması, vatandaşın işlemlerini kolaylaştırmakla beraber, daha çok kurumun kendisine fayda sağlamaktadır. Belediyeler bir yerel yönetim birimi olduğu için ve yerel yönetimlerin büyük bir kısmını temsil ettiğinden, yerel yönetim denilince akla ilk çağrışım yapan kavram "belediye"dir. Belediyelerde ise durum daha farklıdır. Her türlü yenilik, gelişim ve "e-" yapılanma, vatandaşla doğrudan hizmet olarak ulaşmaktadır. Belediyeler, vatandaşla kaliteli hizmet verebildikleri sürece "başarılı" kabul edilmektedir. Bilgi ve iletişim teknolojileri kullanımı

yani e-devlet yapılanması bu başarının temel faktörüdür. E-devlet yapılanmasının yerel düzeyde yansımaları e-belediye hizmetiyle kendini göstermektedir.

E-belediye, belediye yönetimi ile yerel yönetim hizmet ve faaliyetlerinde enformasyon teknolojilerinin kullanımı, vatandaş ve işletmelere internet üzerinden etkin bir biçimde hizmet sunumu, kurum içi birimlerin bilgisayar ağları ile entegrasyonu ve ilgili dış birimlerle ağ üzerinden iletişimin sağlanmasıdır (Erdal, 2002: 14). E-belediye, temel olarak bilgi ve iletişim teknolojilerinin kullanılması yoluyla daha şeffaf, daha etkin ve verimli, vatandaşa daha yakın ve onun katılımına daha açık bir yapılanmayı ifade eder (TASAM, 2006: 10). E-Belediye hizmeti, belediyelerin görevlerini yerine getirirken internet teknolojileri yardımıyla yaptığı hizmetleri halkın ayağına götürmesi demektir (Çoruh, 2009: 3). E-Belediyeler, E-devlet'e giden yolda önemli ve tamamlayıcı bir parçadır. E-Belediye projelerinde amaç, internet sayesinde belediyenin hizmet ve faaliyetleri hakkındaki tüm bilgilerin yerel halkın kullanımına sunulması yoluyla belediye – yerel halk arasında karşılıklı iletişimi sağlamak ve yerel demokrasinin geliştirilmesidir.

E-Belediye hizmetlerin sadece bilgisayar ortamında, teknolojik aygıtların kullanılarak gerçekleştirilmesi değildir. "e" kavramı ile vurgulanmak istenen olgu yalnızca elektronik ya da bilgi ve iletişim teknolojisi değil, bu alt yapının toplumun her kesimi tarafından yaygın olarak kullanımı sonucu sosyal, ekonomik ve kültürel alanda yaşanacak dönüşümdür (Odendaal, 2003: 2). Bu anlamda e-belediye, kente ilişkin verilerin güncel bilişim teknolojileri destekli çalışmalarla yönetilerek bu verilerden kent ve toplum yararına çeşitli bilgiler üretilmesi ve etkin bir biçimde vatandaşın hizmetine sunulması (TBD, 2004: 11) olarak ifade edilebilir.

Organizasyon yapısını ve iş süreçlerini diğer kamu kuruluşları ile entegre bir şekilde dijital tabanlı olarak düzenlemiş bir yerel yönetim; daha demokratik ve katılımcı bir anlayışla etkin, verimli ve hızlı hizmet üretme kabiliyetine erişecektir. Şeffaflaşma sayesinde halkın yönetime duyduğu güven artacak, kaynakların daha isabetli ve yerinde kullanımı sağlanmış olacaktır. Dolayısı ile basitleşen ve hızlanan karar alma süreçleri yöneticilere daha isabetli kararlar alıp uygulama fırsatı verecektir (Apan, 2004: 4).

## e-Belediyeciliğin Faydaları ve Kazanımları

E-dönüşümün önemli ve tamamlayıcı bir parçası olan e-belediye projesi çağımızın vazgeçilmez teknolojisi olan internetin yerel halkın kullanımına sunulmasını öngörmekte ve bu yolla belediye – yerel halk arasında karşılıklı iletişim ve bilgi alışverişi yolu ile kaliteli hizmet sunumu ve yerel demokrasinin geliştirilmesini hedeflemektedir (Yıldırım ve Öner, 2006). Yerel yönetimler, halka en yakın yönetim birimleri olmaları nedeniyle hem yönetsel (vatandaşlara bilgi sağlama ve hizmet götürme) hem de siyasi (bir demokrasi okulu olma) bir takım işlevleri yerine getirmek durumundadırlar (Yıldız, 2001: 239). Yani günümüzde yerel yönetimlerin elektronik ortamda hizmet verebilmelerinin yönetsel ve siyasi boyutu da bulunmaktadır. Bunlar yerel yönetimlerde siyasi olarak internet yolu ile hizmetlere katılıma imkân sağlanması, şeffaflık, hesap verebilirlik gibi alanlarda daha etkin olabilme, yönetsel olarak ise, daha çok belediyelerde web sayfası oluşturma faaliyeti olarak kendini göstermektedir. Esas olarak, e-belediye projelerinde amaç, internet sayesinde belediyenin hizmet ve faaliyetleri hakkındaki tüm bilgilerin yerel halkın kullanımına sunulması yoluyla belediye – vatandaş arasında karşılıklı iletişimi ve yerel demokrasinin geliştirilmesini sağlamak olmalıdır. Siyasi alanda e-belediyelerin amacı, internet yardımı ile katılım, şeffaflık, hesap verebilirlik gibi alanlarda daha iyi bir performans sergilemektir. Yönetsel alanda ise, e-belediyecilik daha çok web sayfası oluşturma faaliyeti olarak ortaya çıkmaktadır. Web sayfası oluşturmak e-belediye uygulamasının sadece bir yönüdür. Ancak şeffaf, katılımcı, hesap verebilir, vatandaş odaklı, etkin ve verimli yönetim yapısı; e-belediye uygulamaların odak noktası haline gelmelidir. Buradan hareketle hizmet üretme sürecinin yönetimine ilişkin olarak e-belediye uygulaması, yönetim süreçlerinin iyileştirilmesi, hızlandırılması ve maliyetlerin düşürülmesine yönelik olmalıdır (Genco, 2010: 7-8).

Bu çerçevede e-belediyeden beklenen faydalar;

- Şeffaf ve hesap verebilir bir belediye yönetimi sağlanması,
- Halkın talep ve şikâyetlerine kısa sürede yanıt verebilen bir belediye yönetimi oluşturması,
- Belediye faaliyetlerinin sürekli izlenebilmesi,
- Farklı semt ve mahallelerde yaşayan yerel halka eşit mesafede olma ve eşit düzeyde hizmet götürme,
- Yerel halkın gereksinimlerine uygun olarak hizmetlerin düzenlenmesi ve sunulması,
- Yerel hizmetlerde maliyetlerin düşürülmesi,
- Yerel hizmetlere 7/24 saatte ulaşılabilmesi,
- Belediye hizmetleri ve yönetiminin kararlarının denetlenmesi,
- Yerel halkın belediye faaliyetlerine ve demokratik süreçlere daha aktif bir biçimde katılabilmesi,
- Rüşvet ve yolsuzlukların önüne geçilmesi,
- Merkezi yönetimle yerel yönetimler arasında etkili bir ağ yapısının oluşturulması ve bilgilerin karşılıklı olarak paylaşılması,
- İnternet vasıtasıyla bürokratik işlemlerin azaltılması,

olarak belirtilmiştir (Genco, 2010: 9).

e-belediyecilik, ülkemizin sosyo-ekonomik gelişmesine önemli derece etki edecek ve ülke kalkınmasına ivme kazandıracak önemli bir proje olarak görülmektedir. Çünkü bu proje ile katılımcılık temelinde etkin bir anlayışın yerleştirilmesi esas alındığı belirtilmektedir (Öner ve Uğur, 2004: 8).

e-belediye uygulamaları ile kamusal ve toplumsal yaşamda öngörülen gelişmeler kısaca şöyle sıralanmaktadır (Bulut, 2003: 338)

e-belediye uygulamaları ile;

- Kırtasiyecilik ve bürokrasi azalacak,
- Kaynaklar daha etkin ve verimli kullanılacak,
- Vatandaş talep ettiği hizmete daha kısa sürede ulaşacak,
- Yöneticilerin karar alma süreçlerine yaptığı katkıyla, güncel ve doğru bilgilerin ışığında hızlı ve etkin karar alınacak,
- Yolsuzluklar azalacak,
- Bilgi paylaşımı ve erişilebilirlik sayesinde halkın katılımı artacak,
- Demokrasinin işlenmesine katkıda bulunarak, yönetimi güçlendirecek,
- Hizmetler daha etkin ve verimli olarak sunulacak,
- Kamu ve özel sektör kuruluşları ve diğer aktörler arasındaki iletişim ağlarının gelişmesi neticesinde; iş tekrarları ve koordinesizlik sonucu oluşan mali kayıplar önlenecek,
- Özel sektörle iş birliği artacak, uzmanlık gerektiren işlerin daha kaliteli ve ucuza yapılması veya alınması kolaylaşacak,
- Belediyeler kendisini devamlı yenileyebilen dinamik sistem yapısı sayesinde, oluşan değişimlere hemen adapte olabilecek ve değişim maliyetinden kurtulacak,
- Ani kriz ve dalgalanmalara hızlı ve doğru tepki verilebilecektir.

e-belediye ile belediyelerin halka, halkın da belediye hizmetlerine etkin ve kolay bir şekilde ulaşması mümkün olabilecektir. Bu yolla, halkın belediyelerle olan işlemlerinde pek çok bürokratik engel ortadan kaldırılacak, bunun sonucu olarak da zaman ve emekten tasarruf edilmiş olacaktır. e-belediye uygulaması ile şeffaflık sağlanacak, hata ve riskler minimum seviyeye indirilecektir. Belediye işlemlerinin azaltılması ve hızlı işlem yapılabilmesi kolaylaşacaktır. Belediyelerde çağın gerektirdiği teknolojik altyapının kullanılması ile klasik belediyeçilik anlayışının dışına çıkılarak sorunlar ortaya çıktığı anda çözümlenebilecektir.

Yerel yönetimler sahip oldukları halka yakınlık ve küçük yapılanmış dinamik organizasyon yapıları nedeniyle e-dönüşüm projelerinin hayata geçirilmesi bakımından avantajlı bir konuma sahiptir. e-dönüşüm modelinin vatandaşların katılımıyla anlam kazanacağı yaklaşımı, yerel yönetimlerin adem-i merkeziyetçi koordinasyonunu olanaklı kılan yapısı ve doğrudan yurttaşların ihtiyaç ve beklentilerine yönelik hizmet verme misyonu ile uyuyacağı belirtilmektedir (Uçkan, 2003: 295).

**Tablo 1.** Klasik yerel yönetim (belediye) ile e-yerel yönetim (e-belediye) anlayışının karşılaştırılması (Henden ve Henden, 2005: 56)

| <b>Klasik Yerel Yönetim (Belediye) Anlayışı</b>   | <b>E-Yerel Yönetim (E-Belediye) Anlayışı</b>  |
|---|---|
| Paylaşılmayan idari karar almalar   | Alınan kararların elektronik ortamda paylaşımı  |
| Uzun bürokratik iş akışı  | Hızlı ve seri elektronik süreç  |
| Vatandaşa ilişkin kararların, konuya dair fazla bilgi toplanmasına gerek görülmeden, yöneticiler tarafından verilmesi | Yerel halkın dilek ve önerilerinin anket, şikâyet, elektronik posta, beyaz masa vb. yöntemlerle toplanarak değerlendirilmesi ve hizmet sunumu |
| Yönetim-Vatandaş ilişkisi   | Hizmet Sunan-Müşteri ilişkisi   |
| Yetkili birimlere başvuruda süreç zorluğu   | Erişilebilirliğin ve sürekli gelişmenin ilke edinilmesi   |
| Diğer kamu kurumlarıyla olan ilişkilerde uzun bürokratik süreç  | Kurumlar arası entegrasyon, eşgüdüm ve etkinlik   |
| Bürokratik denetleme  | Bireysel katılımcılık ve performans ölçümü  |

e-belediye uygulaması ile belediye adeta vatandaşın evine, ofisine, arabasına vb. taşınacaktır. Bu anlamda sosyal hayatın her alanında vatandaş belediyeye ulaşabilecektir. Dolayısıyla bu uygulamadan vatandaşların kazanımları artacaktır. Özellikle vatandaşların yöreye ait olma duygusu (aidiyet) gelişecek, bu durum beraberinde demokratik bilinç, çözüme ortak olma gibi siyasal, toplumsal, hukuksal alanda olumlu katkılar getirecektir.

e-belediyeçilik uygulaması ile belediyelerde çağın gerektirdiği teknolojik altyapının kullanılması ile klasik belediyeçilik anlayışının dışına çıkılarak sorunlar çözümlenebilmektedir. Aynı zamanda şeffaflık sağlanacak hata ve riskler minimum seviyeye indirilecektir. Belediye işlemlerinin azaltılması ve hızlı işlem yapılabilmesi ancak bu uygulama ile mümkün olacağı belirtilmektedir (Fıstıkçıoğlu, 2007: 51).

E-belediye'nin vatandaşlara kazanımları en genel biçimiyle şu şekilde belirtilebilir:

- Kaliteli hizmetlerden yararlanarak zamandan tasarruf etmiş olmaları,
- Belediye ile ilgili tüm işlemlerini belediyeye gelmeden halletmeleri,
- Şikâyet ve dileklerini iletebilmeleri ve bu başvurularını kolaylıkla takip edebilmeleri,

- Her türlü ödemelerini (vergi, harç, vb.) elektronik ortamda yapabilmeleri,
- Belediye sınırları içerisindeki tüm alanlarda imar durumlarını sorgulayabilmeleri,
- Günlük ihtiyaçları için gerek duyabilecekleri tüm hizmetlere erişebilme,
- Beyan ve bildirimlerini yapabilme,
- Yönetmeliklere katılarak yönetim kararlarına katkıda bulunabilme,
- Belediye etkinlikleri ve bütçeleri ile ilgili ayrıntılı bilgi edinebilme,
- Belediye başkanına veya başka bir görevliye e-posta göndererek randevu talep edebilme,
- Belediyenin çalışmaları hakkında önerilerde bulunma,
- Mahallesinde yapılmasını istediği işlerin öncelik sırası hakkında fikrini söyleyebilme,
- Belediyenin bütün ihale ilanlarını ve sonuçlarını takip edebilme,
- E-Belediyecilik hizmetlerinden olan Kent Bilgi Sistemi ile altyapı, yapılaşma, trafik yönetimi, tapu ve kadastro gibi bilgilerin merkezi bir bilgisayar ortamında toplanması ve ortak kullanıma sunulması ile yerel vatandaşların kentsel yaşam kalitesi artırılmıştır. Böylece vatandaşlar belediyecilik hizmetlerinden daha çabuk ve kaliteli olarak faydalanacaktır. Kentsel yaşamda ise kaçak yapılaşmayı önlemek kolaylaşacak ve kent trafiği daha kolay yönetilebilecektir (Fıstıkçıoğlu, 2007: 52).

E-belediyecilik uygulamalarının önemli bir boyutu ise vatandaşın aldığı hizmetin kalitesi ve süresi anlamında belediyeye geri dönüş sağlanacaktır.

## Sonuç ve Değerlendirme

Kent halkının çeşitlenen ihtiyaçlarını etkin ve verimlilik esaslarında, bilişim teknolojilerinden azami faydalanarak çözüme çalışmaları e-belediyecilik anlayışının gelişmesiyle sonuçlanmıştır.

E-dönüşüm sürecinde belediyelerde elektronikleşme süreci beş aşamadan oluşmaktadır.

- Bilgisayarlaşma
- Otomasyon
- İnternet kullanımı
- WEB sitesi kurma
- Yönetimi internete taşıma

Türkiye’de belediyelerin pek çoğu dördüncü aşamayı gerçekleştirmiştir. Ancak yönetimi internete taşıma aşamasında pek istekli değildirler. E-belediyecilik; tek yönlü bilgi akışıyla, belediye hizmet ve çalışmalarıyla ilgili vatandaş bilgilendirmekle sınırlı kalmaktadır. Bu anlamda e-belediyecilik genel anlamda bir “tanıtma broşürü” olarak görülmektedir. e-belediyecilik, sadece internet sayfası açmak değildir. Yönetimsel, toplumsal ve bilgilendirme amaçlı tüm süreçlerin zaman ve mekân kısıtlaması olmadan, hızlı ve etkin bir biçimde elektronik ortamda gerçekleşebilmesi demektir.

e-belediye, “başkandan mesaj” değil, iş ve hizmet üretme yöntemlerinin teknolojik imkânlar kullanılarak yeniden yapılandırılması ve vatandaşa sunulması olarak değerlendirilmelidir. e-dönüşüm sürecinde e-belediyeciliğin başarılı olabilmesi esas olarak bürokratik anlayışla da ilgilidir.

Bürokrasi kendini değiştirmeyi amaçlayan bu süreci onaylar gibi görünse de aslında icraat safhasında daha önceki dönemlerde olduğu gibi tutucu ve ihtiyatlıdır. Dolayısıyla etkin ve verimli bir e-dönüşüm için “e-bürokrasi” anlayışı gereklidir.

Yerel yönetimlerin e-dönüşüme gerçek manada katkısı bu noktada ortaya çıkacaktır. Halkı daha yakından kavrama ve etkileme gücüne sahip olan belediyelerin vatandaşlar üzerinde yaratacağı etkileşim ile e-dönüşümün, toplumsal bir talep olarak bürokrasinin önünde yer alması sağlanabilir.

e-belediyecilik uygulamalarının başarısı genel kamu bürokrasisinin değişimi için de bir fırsat olarak görülmelidir. Çünkü e-belediye hizmet sunma aşamasında hızlı ve etkili olabilirse, bu hizmetlerden yararlanan vatandaşlar, kamu bürokrasisini de bu doğrultuda şekillendirmeye yönelik isteklerde bulunacaklardır. Neticesinde yerel ölçekte başarıyla tamamlanacak e-belediye dönüşümlerinin tüm toplumsal yapıyı değiştirebilmesi de mümkündür.

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## USE OF INDIGENOUS BACTERIA SELECTED AT THE RHIZOSPHERE OF POTATO IN BIOLOGICAL CONTROL

SamiaMezaache-Aichour, Nadia Sayah, Mohamed Mihoub Zerroug, Nora Haichour and Abdelhadi Guechi  
Laboratory of Applied Microbiology, Faculty S.N.V. University Ferhat Abbas 1

ALGERIA

geuchibio@yahoo.fr

mezaic2002@yahoo.fr

**Abstract** The soil-borne pathogens of plants that cause root rot, crown, ring rot and seedling blight are the major factors limiting crop yields and fiber plants. Resistant varieties of plants are not available for many pathogens and chemical control is often not sufficiently effective in the soil. Moreover, a reduction of pesticide use is considered to reduce the potential for environmental pollution. Improved properties suppressive soil will limit the development of diseases, is of great importance to ensure agricultural sustainability and the development of organic farming systems. The aim of our work fits into the context of sustainable development and ecosystem preservation, by the introduction of biological control agents in order to limit the use of chemical inputs in agriculture. This work is done by selection and isolation of indigenous bacteria from the soil of potato crops, can hinder the development of pathogenic fungi by their adversarial nature. The preliminary screening allowed us to select a group of microorganisms capable of reducing in vitro growth of phytopathogens such as soil fungi. This work allowed us to isolate bacteria belonging to the genera *Bacillus* and *Pseudomonas*. These bacterial populations have inhibited fungal growth by a percentage ranging from 0% to 92%.

**Key words:** biological control, antagonism, soil borne pathogens.

### Introduction

The soil-borne pathogens that cause plant rot roots, crowns, wilting and damping off are the main factors that limit crop yields, fiber, and ornamental plants. Most telluric pathogens are difficult to control with conventional strategies such as use, host resistant cultivars and synthetic fungicides. The absence of reliable chemical controls, the development of resistance to fungicides and the degradation of host resistance by the pathogen populations are major factors that highlight efforts to develop alternative control measures (Haas and Défago, 2005).

The search for alternative strategies was also stimulated by concerns public on the harmful effects of fumigants ground such as methyl bromide on the environment and human health (Léon *et al.*, 2009).

Suppressive soils are probably the best natural examples in which the indigenous microflora effectively protects plants against pathogen. Initially removing soil became apparent because the incidence or severity of the disease is lower in comparison with infested soil. Suppressive soils have been described for many soil-borne pathogens, such as: *Gaeumannomyces graminis* var. *tritici*, *Fusarium oxysporum*, *Aphanomyces euteiches*, *Heterodera avenae*, *H. schachtii*, *Meloidogyne* spp. *Criconebella xenoplax*, *Thielaviopsis basicola*, *Phytophthora cinnamomi*, *Phytophthora infestans*, *Pythium splendens*, *P. ultimum*, *Rhizoctonia solani*, *Streptomyces scabies*, *Plasmodiophora brassicae* and *Ralstonia solanacearum* (Haas and Défago, 2005).

### Materials and Method

#### Fungal strains

Four fungal strains were used in this study, *Fusarium solani* (LMA), *Phytophthora infestans* (Pr. Larous), *Fusarium oxysporum* f. sp. *albedinis* (INRA, Alger) and *Fusarium solani* var. *coeruleum* (Institut Pasteur Paris, France).

The soil samples were obtained from potato fields in three regions of Sétif, at which samples are taken randomly. The first and third samplings were conducted in a soil that received culture of potatoes harvested for almost a month, at a depth of 10 to 15 cm. The second was made in April of the same year, but in a potatoes culture. Sampling was performed in separate strata of soil: rhizosphere soil, spermosphere (soil) and soil adhering strongly to potatoes tubers. The samples were stored in sterile plastic bags, then reported the laboratory. After drying in an oven at 28°C for 24 hours, the soil is subject to sieving to have quite fine soil grains (sieve mesh of 1.5 mm). Finally a dilution series were made.

Trapping of microorganism described by Tivoli *et al.* (1983), inspired by Lansade work (1950), is to spread a portion of the earth to be tested on the wafer half-tubers and freshly severed, after incubation, the level of soil contamination and the nature of microorganisms were determined.

#### Analysis of bacterial microflora

The primary screening of bacteria with antifungal activity is carried out according Léon *et al.* (2009).

Analyses of the bacterial microflora are made by the method of suspensions dilutions (Tamietti and Pramotton, 1990). 30g of each soil sample was suspended in 75ml sterile saline water (Tivoli *et al.*, 1990). After stirring (for 30 minutes) and a settling period (for 15 min), a series of suspension 1/10<sup>th</sup> dilutions is made from these supernatants (Tamietti and Pramotton, 1990).

From the previous dilutions, 0.1 ml was plated on PDA in dual culture with fungal disc (reference strains studied). Plates were incubated at a temperature of 28C° for 15 days (Aliye *et al.*, 2008). Bacteria which inhibited fungal growth were selected to be purified.

Bacterial strains with fungal inhibition were purified by a series of successive transfer of the isolated colony on Nutrient Agar in two to 5 times (Jalal *et al.*, 2006).

Test of antagonism:

The same test was used as that carried out for the isolation except, we used pure bacterial strains were incubated until the full growth of the control without bacteria (Léon *et al.*, 2009).

## Results

The screening strategy used was to isolate natural antagonistic cultivable bacteria. The primary screening allowed us to select a group of microorganisms which can survive in the presence of other phytopathogenic microorganisms. The Exploration of the biodiversity in microorganisms from potatoes field soils has highlighted two categories of bacteria with antagonistic capacity. We focused our study on populations of the most common bacterial genera, such as Gram-positive spore-forming belonging to the genus *Bacillus* and Gram negative belonging to the genus *Pseudomonas*.

The antagonistic test performed by dual culture between the bacterial isolates and the fungal strains studied (Fsc, Foa and Pi), showed an inhibitory action between these microorganisms. The inhibition varied between 0 and 92.30%, depending on the isolate and pathogen considered (Table I). 14 antagonistic strains that have been selected *in vitro* have revealed an antagonistic proved effect. In fact, three isolates showed an interesting activity against the three phytopathogenic isolates studied.

Some isolates are antagonistic against the three fungi studied, the high activity was obtained with isolate 20b, and the lowest one was obtained with isolates 17b and 24b. Whereas, some are antagonistic against two fungi and finally four isolates are antagonists to one fungus (Table I). These strains belong to Gram-positive and Gram-negative. Among the studied Gram positive strains, 4.16% inhibit the growth of *Fusarium solani* var. *coeruleum* 6.25% inhibit the growth of *Fusarium oxysporum* f. sp. *albedinis* while 4.16% inhibit *Phytophthora infestans*. Whereas in bacteria Gram-negative, 16.66% inhibit the growth of *Fusarium solani* var. *coeruleum*, 14.58% inhibit the growth of *Fusarium oxysporum* f. sp. *albedinis* and 10.41% inhibit *Phytophthora infestans*. Of the 7 strains of inhibitory Gram-negative bacteria, which colonize the rhizosphere, a single strain inhibits three phytopathogenic fungi.

## Discussion

Our result are similar to those of Léon *et al.* (2009) reported that among 80 isolates with antifungal activity greater than 40%, and 150 microorganisms selected from isolated, six showed antagonistic activity against the phytopathogenic fungi studied (Ascomycetes, Deuteromycetes and Oomycetes).

The obtained results are also similar to those of Nion and Toyota (2008) They isolated 270 strains from the five isolates of *Burkholderia* with proved antagonistic effect against *Ralstonia solanacearum* and those of Kamilova *et al.* (2005), who selected 16 isolates of fluorescent *Pseudomonas* colonising the rhizosphere of tomato, among which a single isolate effectively inhibit four of the five tested fungi.

**Table I:** Percentage of fungal inhibition.

| Zones | Souches         | Rate of inhibition |       |           |
|-------|-----------------|--------------------|-------|-----------|
|       |                 | Mitosporic fungi   |       | Oomycetes |
|       |                 | Fsc                | Foa   | Pi        |
| 1     | 2 <sup>a</sup>  | 37.5               | 53.48 | Nd        |
|       | 5 <sup>a</sup>  | 34.72              | 76.74 | Nd        |
|       | 9 <sup>a</sup>  | 6.94               | 6.97  | Nd        |
|       | 8 <sup>b</sup>  | 0                  | 53.84 | Nd        |
|       | 1 <sup>b</sup>  | 6.25               | 37.5  | 0         |
| 2     | 16 <sup>b</sup> | 41.25              | 42.5  | 0         |
|       | 17 <sup>b</sup> | 85                 | 1.25  | 30        |
|       | 18 <sup>b</sup> | 46.25              | Nd    | 34.21     |
|       | 20 <sup>b</sup> | 82.5               | 92.30 | 63.15     |
|       | 22 <sup>b</sup> | 52.5               | 43.75 | 0         |
|       | 24 <sup>b</sup> | 32.5               | 32.5  | 2.5       |
|       | 2 <sup>c</sup>  | Nd                 | Nd    | 35.75     |
|       | 6 <sup>c</sup>  | Nd                 | Nd    | 86.25     |
|       | 7 <sup>c</sup>  | Nd                 | Nd    | 7.5       |

Zone 1: spermosphere ; Zone 2: rhizosphere ; a, b et c : 1<sup>st</sup> 2<sup>nd</sup> and 3<sup>rd</sup> sample ; Fsc: *Fusarium solani* var. *coeruleum* ; Foa : *Fusarium oxysporum* f. sp. *albedinis* ; PI : *Phytophthora infestans* ; Nd: not determined.

## Conclusions

Our results are consistent with the hypothesis, that the group microorganisms isolated, would be responsible for the general suppression in the soil (Adesina *et al.*, 2007; Léon *et al.*, 2009).

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## USE OF SOCIAL NETWORKING SITE IN POST READING ACTIVITIES: IMPLICATIONS FOR PRACTICE AND FUTURE RESEARCH

Norlidah Alias\*, Saedah Siraj, Chin Yen Looi, Limalini Raveendran, Bhavaani Elamtho Thevar, Dorothy DeWitt and Mohammad Attaran

Faculty of Education, University of Malaya 50603 Kuala Lumpur, Malaysia // Tel.: 06 03 79673895 // Fax: 06 03 79565506 // drnorlidah@um.edu.my \* norlidah2007@yahoo.com // saedah@um.edu.my // yenlooi@hotmail.com // miss.linnie@hotmail.com // sneha\_147@hotmail.com // dorothy@um.edu.my // attaran@um.edu.my

### ABSTRACT

In an English Language classroom, a reading lesson consists of three main parts: pre-reading, while-reading and post-reading. The pre-reading stage intends to prepare the students for the reading experience. The while-reading stage is mostly concerned with comprehension as comprehension is the ultimate goal of reading. The post-reading activities provide students the opportunities to synthesize and reflect on the text they read and evaluate their own understanding of the content. Post reading activities are designed for students to externalize their understanding of the text. Post-reading activities can also encourage extended / extensive reading as they allow learners to conduct further research related to the topics. Although the post-reading stage is important to give learners the opportunity to apply the knowledge they have gained, it is often a neglected part of a reading lesson. This paper will examine experts' opinions towards post-reading activities and their attitudes towards implementing Web 2.0 technologies in post-reading activities. It will also examine the criteria of using Web 2.0 technologies, particularly social networking sites, in post-reading activities. By understanding the variables involved in using effective social networking websites, this paper will mainly benefit teachers as they will be informed of the challenges and possibilities in the integration of Web 2.0 technologies in English language teaching and learning.

*Keywords:* Post-reading, Extended / extensive reading, Web 2.0 technologies, Social networking sites

## USING GAME CONCEPT IN INTRODUCTORY PROGRAMMING COURSES: SCRATCH EXAMPLE

**Zülfü GENÇ**

Computer and Instructional Technology Department, University of Firat, Elazığ, TURKEY

[zulfugenc@gmail.com](mailto:zulfugenc@gmail.com)

**Zafer CÖMERT**

Computer Engineering, Bitlis Eren University, Bitlis, TURKEY

Programming is a fundamental aspect of computer literacy as it helps the student understand and control how the computer processes information. In introductory computer programming courses, students are required to develop problem solving and critical thinking skills, and solve programming problems. However, teaching styles in introductory computer programming courses may not always match the learning styles of some novice programmers. The learning styles of students are a significant factor affecting the achievement of students enrolled in an introductory programming course. Many instructors have tried to use game programming concept as a way of teaching computer programming to novices. This study examined the integration of a game based programming environment as a new technology in a first level programming course and investigated the perceptions of students about the use of game based environment called as Scratch in their programming course in terms of its effects on their perceived motivation, perceived usefulness and perceived ease of use. The participants were 96 sophomore students taking Programming Languages - I course at Computer Education and Instructional Technology department in University of Firat, Turkey. The results revealed that game based instruction has a great potential in facilitating student's problem-solving ability and improving programming achievement.

**Keywords:** learning programming, scratch, game

# ÜÇ KATLI ÇELİK YAPI SİSTEMİNİN YAPI TANILAMA TEKNİKLERİ KULLANILARAK DİNAMİK KARAKTERİSTİKLERİNİN BELİRLENMESİ

Yüşa Gökhan DURGUN, Muharrem AKTAŞ  
Sakarya Üniversitesi İnşaat Mühendisliği Bölümü  
Türkiye  
ydurgun@sakarya.edu.tr  
muharrema@sakarya.edu.tr

**Özet:** Mühendislik yapıları, yapı ömrü boyunca patlama, deprem, rüzgar v. b. kuvvetlerine maruz kalmaktadır. Yapıya etkiyen bu kuvvetler altında yapının davranışının nasıl olduğunu saptamak, mevcut durumu belirlemek ve varsa hasar oluşumu anlayabilmek yapı tanılama teknikleriyle gözlemlenebilmektedir. Kullanılan bu teknikler sayesinde yapının dinamik karakteristiklerine bağlı olarak durum değerlendirmesi yapılmaktadır.

Bu çalışmada küçük ölçekte hazırlanmış üç katlı çelik yapı tek eksenli sarsma tablası üzerine yerleştirilmiştir. Ardından deneysel model üzerinde kat seviyesinde ve tabla düzlemine yerleştirilen ivme ölçerlerle kayıtlar alınmıştır. Daha sonra alınan kayıtlar filtrelenmiş ve kalibre edilmiştir. Gerekli düzenlemeler yapılan kayıtlar kullanılarak modal parametreler( doğal frekanslar, sönüm oranı, mod şekilleri ) belirlenmiştir. Alınan kayıtlar güç motorundan tablaya iletilen farklı frekans değerleri için de gözlemlenmiştir. Yapının deneysel olarak belirlenmiş dinamik karakteristikleri nümerik olarak ta SAP2000 programıyla doğrulanmış ve böylece deneysel verilerle nümerik veriler arasındaki ilişki belirlenmeye çalışılmıştır.

**Anahtar Kelimeler:** Yapı tanılama teknikleri, tek eksenli sarsma tablası, çelik yapı, kayıt filtreleme, modal parametreler, sayısal ve deneysel model.

## Giriş

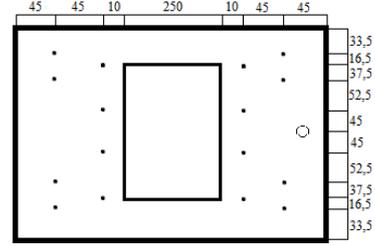
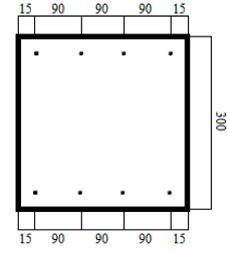
Neden yapı tanı tekniklerine ihtiyaç var? Bu anlamda, inşaat mühendisliği sektöründe çok fazla kullanım alanı olan SAP2000 programı kullanılarak yapıların dinamik karakterlerinin belirlenmesi amaçlanmıştır. Ancak nümerik analizlerde yaklaşık yöntemler olduğu için kurulan sonlu eleman modeli gerçek bir deneyle test edilerek kontrol edilmelidir. Bu çalışmada 3 katlı çelik yapı önce deneye tabi tutulmuş, daha sonra SAP2000’de modellenmiştir. Sonlu eleman modellemesinde geometrik kusurlar ihmal edildiğinden ve birleşim noktaları daha rijit olduğundan, modelin rijitliği tanımlanırken sadece malzeme elastisite modülü kullanılmamıştır. Malzeme rijitliği temsil edecek olan elastisite modülü aynı malzeme ve aynı birleşimlerden oluşan ve teorik olarak periyodu bilinen başka bir model kurularak tespit edilmiştir.

## Test Modeli

Test modeli 3 katlı bir çelik yapı olup her bir kat 300×300×8 mm boyutlarında çelik levha ile temsil edilmiştir. Kolonlar için sekiz adet 5 mm çapında çelik gijonlar kullanılmış olup, katlar kolonlara somunlarla sıkıştırılarak bağlanmıştır. Oluşturulan test modelinde katlar arası yükseklik 250 mm seçilmiştir. Hazırlanan test modeli Şekil 1a’da verilmiştir. Deney sırasında yapısal modelin kat yer değiştirme kayıtlarının ölçümü için kat seviyelerine tek eksenli ivme ölçerler yerleştirilmiştir. Test modeli deney düzeneğine rijit bir tabla aracılığıyla bağlanmıştır (Şekil 1).



a) Sarsma Tablası ve Test Modeli



b) Kat plakası ve tabla boyutları (mm)

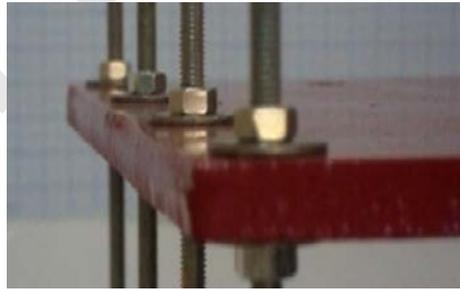
**Şekil 1: Test Düzenegi**

## Deney Düzenegi ve Deneyin Yapılması

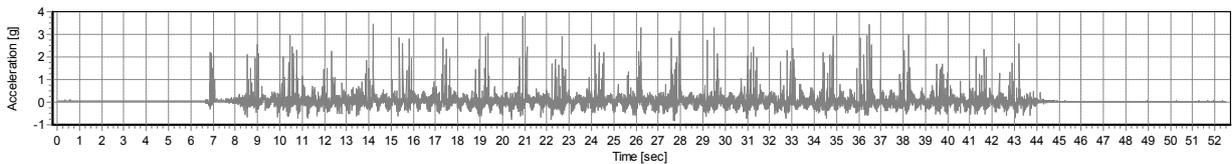
Testler tek eksenli sinüsoidal kuvvet uygulayan sarsma tablasında gerçekleştirilmiştir. Tablaya uygulanan kuvvet AC hız kontrol ünitesi aracılığıyla 1-200 Hz aralığında farklı frekanslarla kontrol edilmektedir. Uygulanan kuvvet sarsma tablası üzerine yerleştirilmiş AC elektrik motorunun, eksantritesi ayarlanabilir krank şafta bağlı rotun tahrik edilmesi ile tablaya aktarılmaktadır (Kutaniş,2007). Elde edilen kayıtlar veri toplama ünitesi ve LabVIEW yazılımı kullanılarak bilgisayardan kontrol edilmektedir. Test numunesinin katlarına ivme ölçerler yerleştirilmiştir. Sarsma tablası üzerine montajı yapılmış deney modeline, dijital motor hız kontrol ünitesine 20-25 Hz frekanslarında kuvvetler uygulanmıştır. Ayrıca yapının tepe noktasından, kullanılan ivme ölçerler paralelinde yapı modeli serbest titreşime maruz bırakılmıştır.

## Kayıt İşleme

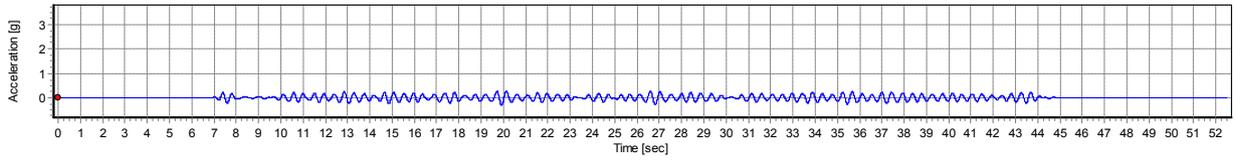
Elde edilen veriler kayıt işleme teknikleri kullanılarak düzeltilmiş ve yapının modal periyodları gözlemlenmiştir. Kayıtların düzeltilmesi ve filtrelenmesi için Seismosignal programı kullanılmıştır. MATLAB kodları kullanılarak periyodlar hesaplanmıştır. Kayıtların doğru işlenebilmesi amacıyla yapı modelinin en üst kat seviyesindeki yatay deplasman Şekil 2’de gösterildiği gibi dijital kamera kayıtlarıyla ölçülmüş, kamera kayıtlarından elde edilen deplasman değerleri filtreleme sonrası elde edilen deplasman değerleriyle kıyaslanmıştır. Filtreleme işleminde 20 Hz’ lik yüklemeye için 3.kat maksimum deplasmanı 3.2 cm , 25 Hz’ lik yüklemeye ise 5.2 cm olduğu gözlemlenmiştir. Böylece filtreleme işlemindeki hatalar en aza indirilmeye çalışılmıştır.


**Şekil 2: Kat deplasman kaydı**

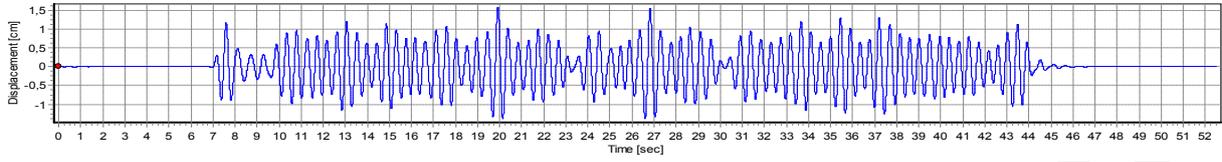
Test sonrası elde edilen ham ve düzeltilmiş kayıtlar Şekil 3’te verilmiştir.



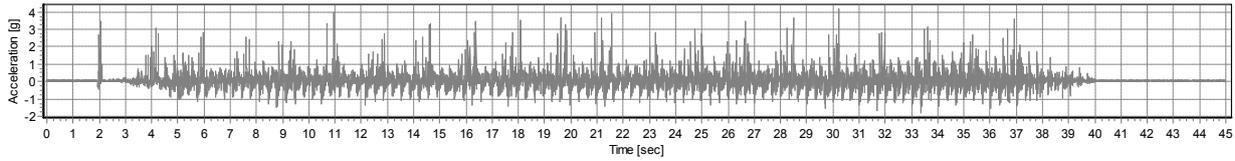
i) Filtrenmemiş tabla ivme kaydı



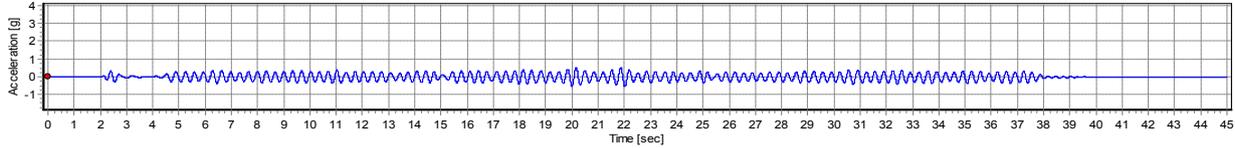
ii) Filtrelenmiş tabla ivme kaydı



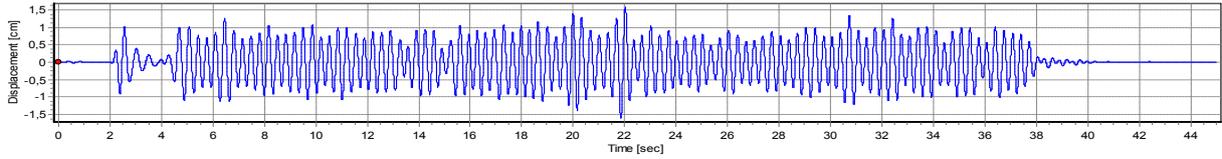
iii) Filtrelenmiş deplasman kaydı

**a) 20 Hz yükleme protokolü altında taban plakada alınan kayıtlar**


i) Filtrelenmemiş tabla ivme kaydı



ii) Filtrelenmiş tabla ivme kaydı

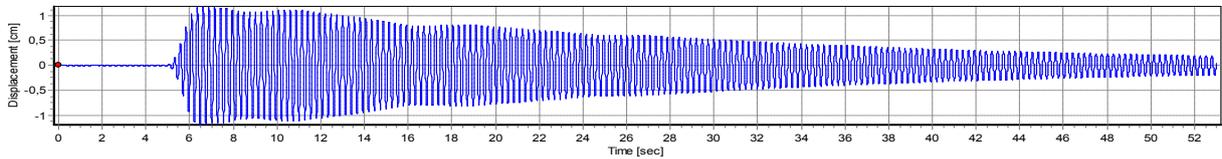


iii) Filtrelenmiş deplasman kaydı

**b) 25 Hz yükleme protokolü altında taban plakada alınan kayıtlar**
**Şekil 3: 20 Hz ve 25 Hz yükleme protokolü altında taban plaka kayıtları (Seismosignal)**

## Yapısal Sönümün Belirlenmesi

Yapısal sönüm, yapının serbest titreşimi sırasında alınan ivme kayıtlarının kullanılmasıyla elde edilmiştir. Bunun için logaritmik azalım yöntemi kullanılmıştır. Birbirine komşu veya birbirinden  $j$  uzaklıktaki maksimumlar kullanılarak sönüm oranı hesaplanabilir. Yapının hesaba katılan serbest titreşim maksimum genliği 0.439 cm iken 14 devir sonra bu değerde %14.15 azalma gözlemlenmiştir.

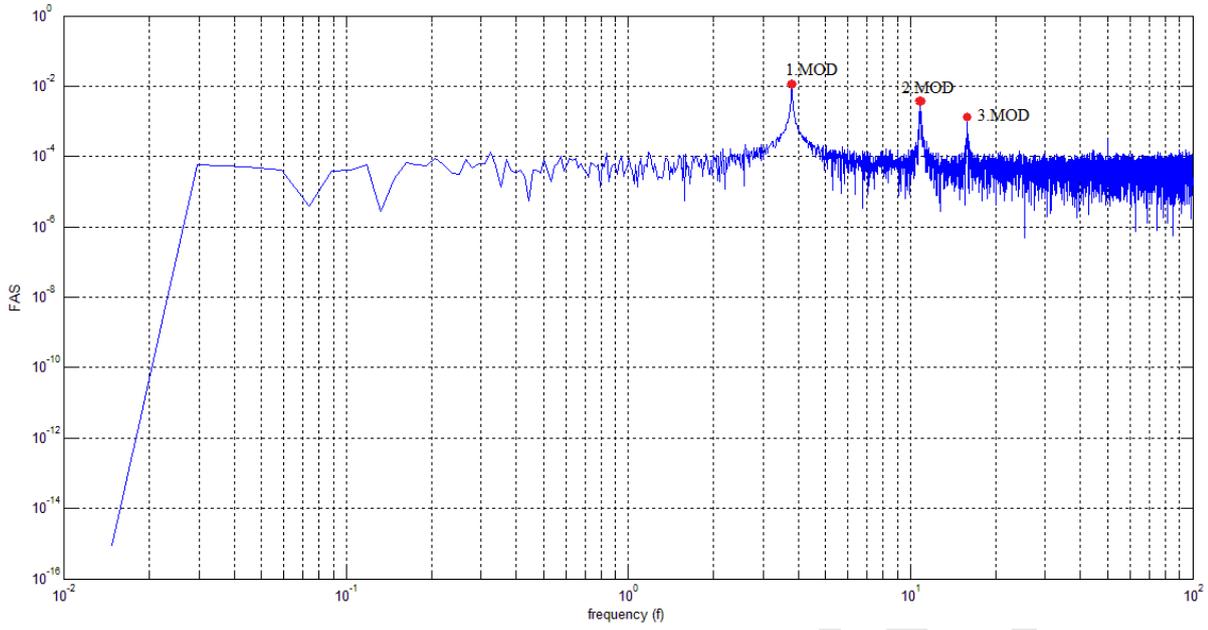

**Şekil 4: Serbest titreşim deplasman grafiği (Seismosignal)**

Oluşturulan test modelinde  $\xi$ , sönüm oranının küçük olacağı kabulü ile yapı dinamiği teorisinde kullanılan logaritmik azalım, aşağıdaki denklemde  $\delta$  hesaplanarak sönüm oranı belirlenmiştir (Chopra,2007).

$$\delta = \frac{1}{j} \ln \left( \frac{u_1}{u_{j+1}} \right) \approx 2\pi\xi \quad (1)$$

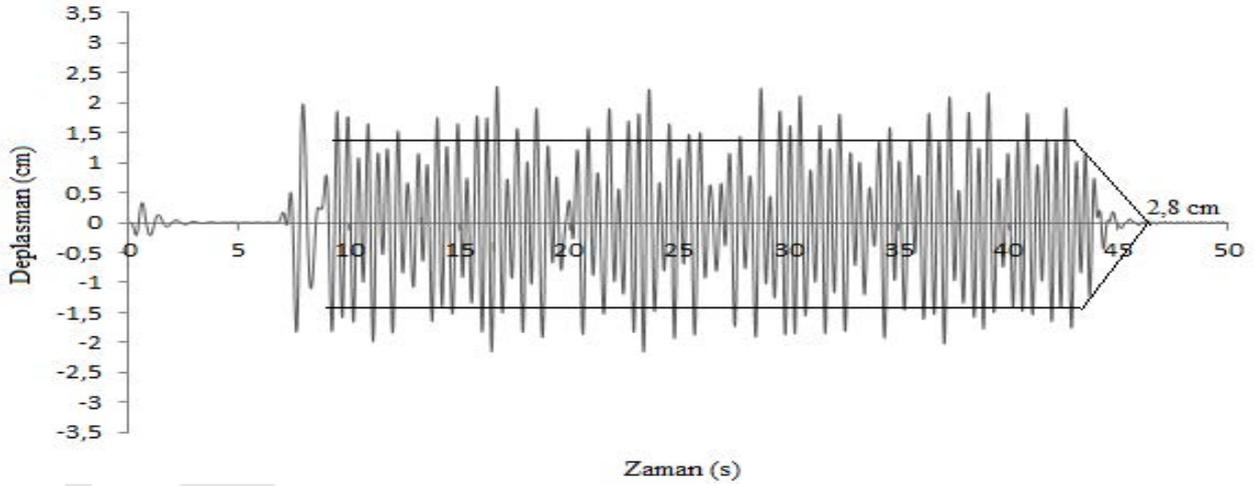
Denklem 1'de  $j$  hareketin genliğinin  $u_1$  den  $u_{j+1}$  e azalması için gereken çevrim sayısını göstermektedir. Bu denklem kullanılarak sönüm oranı % 2.25 olarak hesaplanmıştır. Test modeline ait modal periyodlar MATLAB programında fast fourier transform (FFT) yapılarak Şekil 5'teki gibi elde edilmiştir. Grafikten elde edilen bilgilere göre periyodlar sırasıyla

0.264 s, 0.094 s ve 0.065 s olarak belirlenmiştir. FFT sonrası elde edilen bu değerler yapının doğal frekansları hakkında bilgiler vermektedir (Türer, A ve Boz, B.,2005).

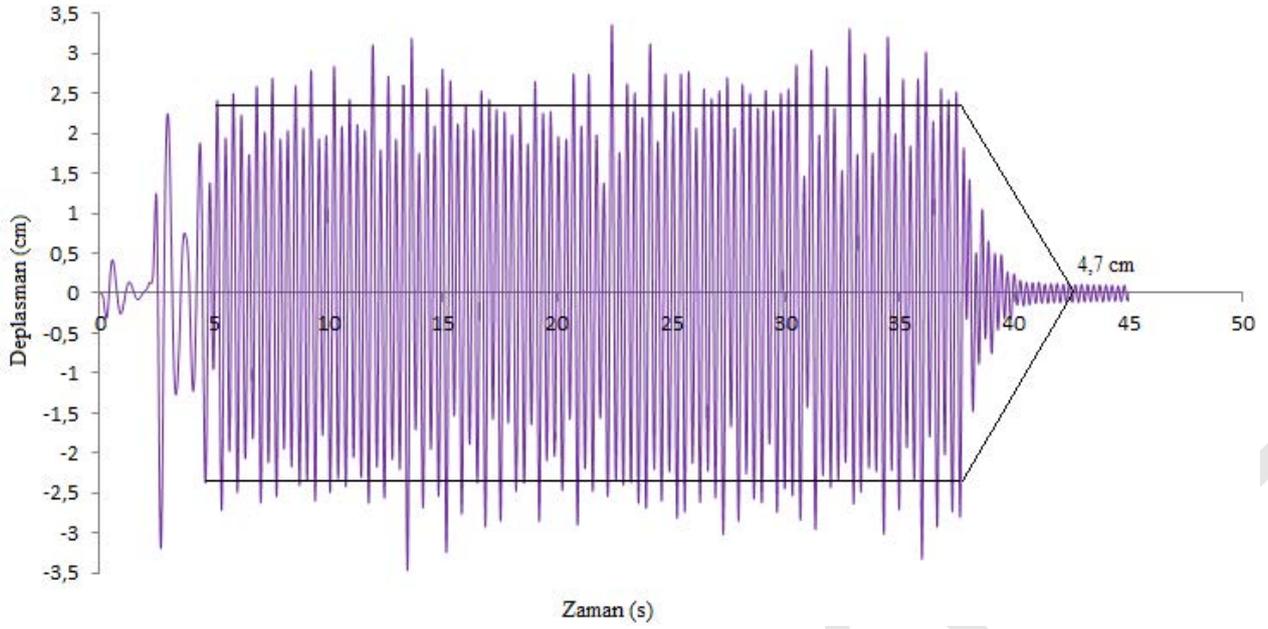


Şekil 5: FFT grafiği (MATLAB)

Deney sırasında ivme ölçerler ile kayıtları alınan verilerin filtrelenme işlemi sonrasında deplasman kayıtları oluşturulmuştur (Şekil 6 ve Şekil 7).



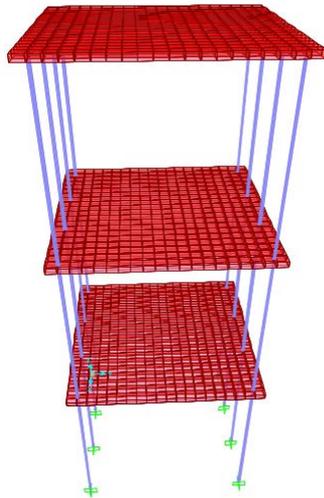
Şekil 6: 20 Hz 3.kat ivme ölçerden bulunan deplasman



Şekil 7: 25 Hz 3.kat ivme ölçerden bulunan deplasman

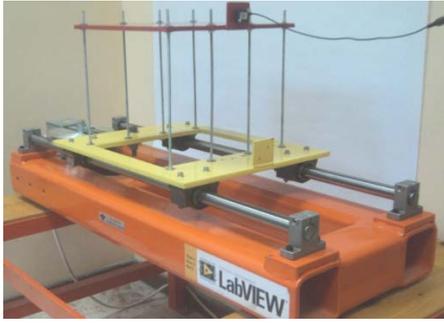
### Sonlu eleman modeli

Deney sırasında kullanılan yapının sonlu eleman modeli SAP2000 programı kullanılarak oluşturulmuştur (Şekil 8). Yapının deprem yükleri altında, kat döşemelerinin, kendi düzlemleri içinde rijit cisim hareketi yaptıklarının belirtilmesi gerekir (Özmen ve diğ., 2009). Bu nedenle oluşturulan sonlu eleman modelinin her katındaki düğüm noktalarının aynı yöndeki deplasmanlarının eşit olması kabulünden doğan rijit diyafram özelliği tanımlanmıştır. Sonlu eleman metodolojisinde elemanlar için ağ örgüsü oluşturulmalıdır (Chandrupatla, T.R. and Belegundu A.D., 1997). Yapının sonlu eleman modeli için oluşturulmuş Şekil 8’de uygun boyutlarda mesh özelliği tanımlanmıştır.

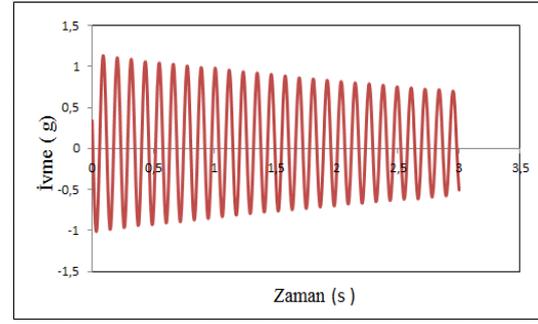


Şekil 8: Yapının sonlu eleman modeli (SAP2000)

Sonlu eleman modelinde kullanılan çelik malzemenin elastik modülü hesabında, malzemenin mekanik deneyler altındaki davranışının yanı sıra, test numunesinin hazırlanması aşamasında somunlarla yapılan birleşimde olası mümkün rijitlik azalmasını dikkate almak için elastik modül tek katlı çelik model serbest titreşime tabi tutularak hesaplanmıştır (Şekil 9a). Tek katlı yapının kat seviyesindeki serbest titreşim değerleri kaydedilmiştir (Şekil 9b).



a) Tek katlı deney modeli



b) Serbest titreşim ivme kaydı (LabVIEW)

**Şekil 9:** Serbest titreşim deneyi

Yapının serbest titreşim ivme kaydından elde edilen bilgiler ışığında tek katlı çerçevenin doğal periyodu 0.114 s olarak hesaplanmıştır. Tek katlı bir çerçeve için periyod denklemi aşağıdaki gibidir (Chopra,2007).

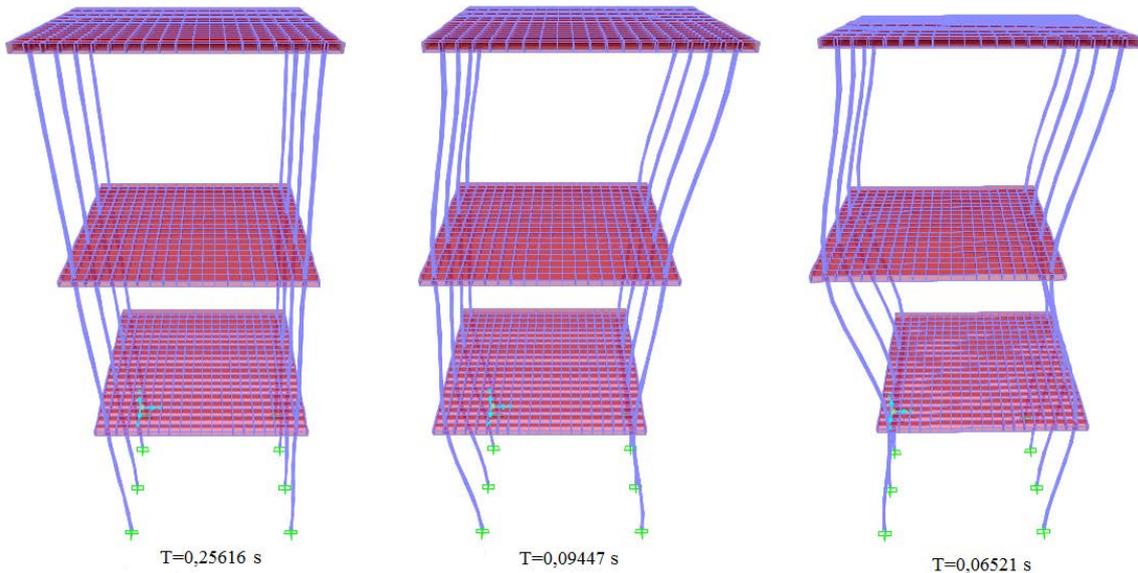
$$T = 2\pi \sqrt{\frac{m}{\sum \frac{12EI}{H^3}}} \quad (2)$$

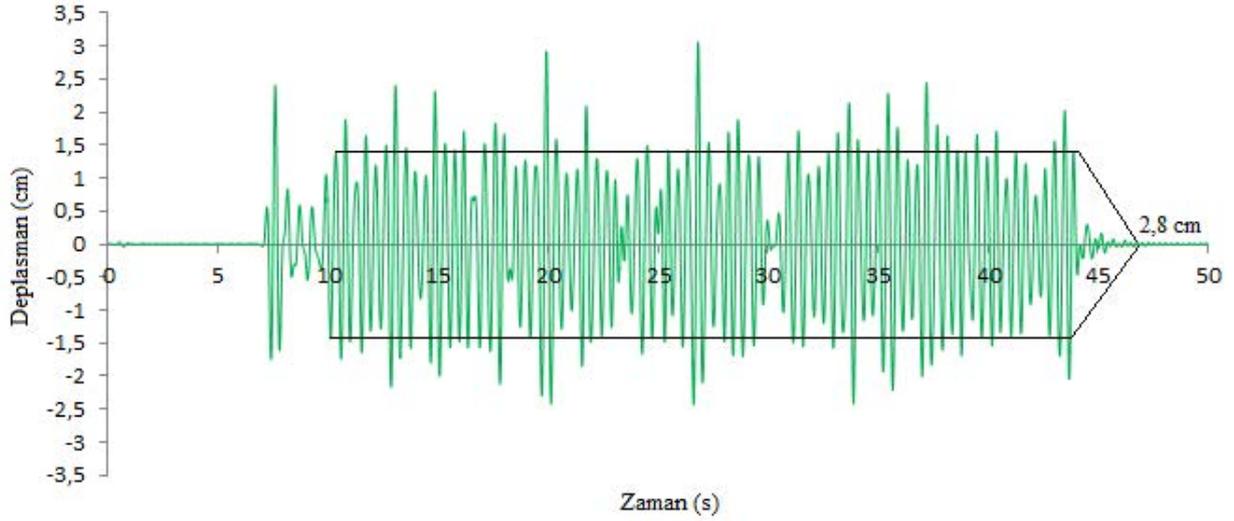
Denklemden, kütle (m), atalet momenti (I), kat yüksekliği (H) değerleri kullanılarak elastisite modülü (E) hesaplanmıştır. Buna göre sonlu elemanlar programında kullanılan malzeme mekanik özellikleri tablo 1’de özetlenmiştir.

**Tablo 1 :** Malzeme Özellikleri

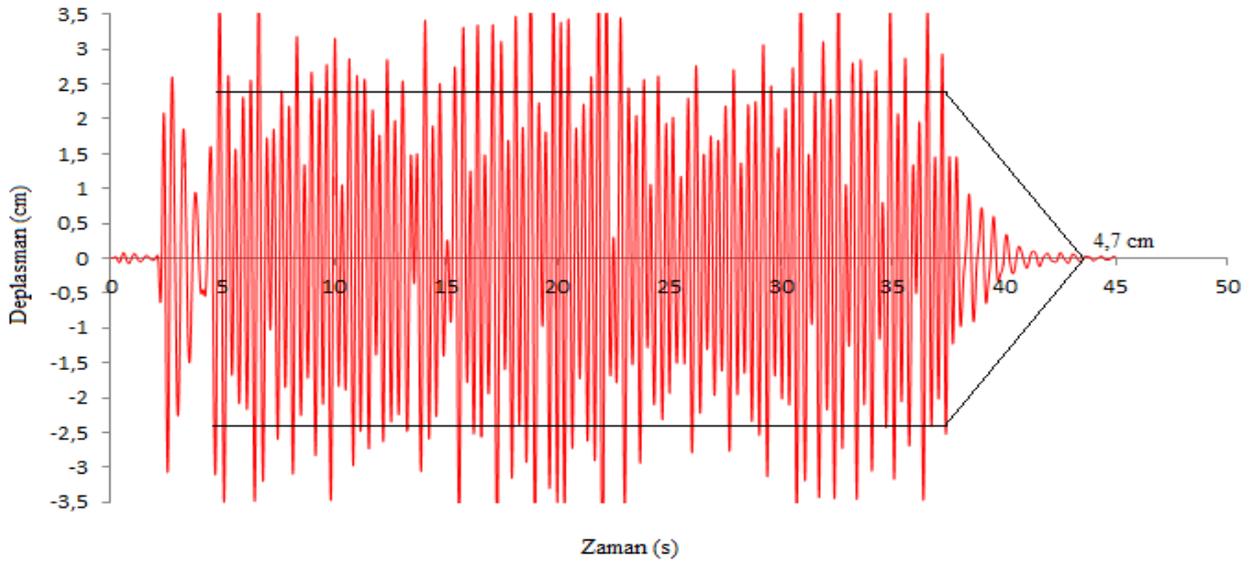
|             | Elastisite Modülü (MPa) | Poisson Oranı | Öz kütle (kg/m <sup>3</sup> ) |
|-------------|-------------------------|---------------|-------------------------------|
| Çelik Levha | 210000                  | 0.3           | 7849                          |
| Çelik Gijon | 115700                  |               | 7073                          |

Hazırlanan sonlu eleman modeline zaman-tanım alanında analiz yapılmıştır. Analizde testte kullanılan 20 Hz ve 25 Hz’lik yükleme protokolleri kullanılmıştır. Analiz sonucunda elde edilen mod şekilleri şekil 10’da verilmiştir. Elde edilen her bir mod , sonlu eleman programının hesapladığı 12 adet mod arasından , uygulanan yükleme yönüne göre seçilmiş modlardır. Ayrıca her bir yükleme protokolü için elde edilen deplasmanlar zaman-tanım alanında Şekil 11 ve Şekil 12’de ayrı ayrı gösterilmiştir.


**Şekil 10:** Yapı periyodlarının sonlu eleman modeliyle gösterimi (SAP2000)



Şekil 11: 20 Hz 3.kat deplasmanı



Şekil 12: 25 Hz 3.kat deplasmanı

Sonlu eleman modelleme aşamalarının doğruluğunu kanıtlamak amacıyla deneylerden elde edilen modal periyod ve ortalama deplasman değerleri kıyaslanmıştır. Tablo 2’de zaman-tanım alanında hesaplanan deplasmanın ortalama değerleri verilmiştir. Bu değerler incelendiğinde sonlu eleman analizinde elde edilen değerler %12.5’e varan farkla test değerlerinden daha az hesaplanmıştır. Bu fark test aşamasında kayıt alırken ivme ölçerlerin güç kaynağına yakın olmasından kaynaklanan ölçüm hataları olabileceği gibi test yapılan binada kayıt sırasında var olan hareketli yükler ve ortam gürültüsünden de kaynaklanabilir. Ancak periyodlara bakıldığında bu fark %3’e düşmektedir (Tablo3).

Tablo 2: Ortalama deplasman değerleri kıyaslanması

| Yükleme protokolleri | Ortalama Deplasman (cm) |                        | Fark (%) |
|----------------------|-------------------------|------------------------|----------|
|                      | Sonlu elemanlar modeli  | Test Modeli (Gözlenen) |          |
| 20 Hz                | 2.8                     | 3.2                    | 12.5     |
| 25 Hz                | 4.7                     | 5.2                    | 9.6      |

Tablo 3: Modal periyod değerlerinin kıyaslanması

| Yükleme yönündeki modlar | Modal periyodlar (s) |                      | Fark (%) |
|--------------------------|----------------------|----------------------|----------|
|                          | Sonlu eleman modeli  | Test Modeli (MATLAB) |          |
| 1.Mod                    | 0.256                | 0.264                | 3        |
| 2.Mod                    | 0.094                | 0,094                | 0        |
| 3.Mod                    | 0.065                | 0,065                | 0        |

## Sonuçlar

Sonlu eleman analizi kullanılarak yapıların dinamik davranışlarıyla ilgili bilgiler elde edilmektedir. Fakat sonlu eleman modelleme aşamalarında, gerçekte var olan kusurların hesaplara yansıtılması amacıyla, rijitlik hesabında kullanılacak olan elastisite modülü aynı malzemelerden yapılmış tek katlı bir çerçeve modeli ile belirlenmelidir. Böylece gerçek malzeme özelliklerini belirleyerek sonlu eleman modeli kurulabilir. Sonlu eleman analizi sonuçları, yapıların modal periyodlarını çok yakın mertebelerde yakalarken, deplasmanların hesaplanmasında farklılık gösterebilmektedir. Ancak bu farklılıklar sonlu eleman metodolojisinde kabul edilebilir düzeydedir.

## Teşekkür

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# ÜNİFORM DONATI KOROZYONUNUN BİNALARIN DEPREM DAVRANIŞINA ETKİLERİ

Seda Coşkan\* , İsa Yüksel

Bülent Ecevit Üniversitesi, Zonguldak Meslek Yüksekokulu,  
İnşaat Teknolojisi Bölümü/ZONGULDAK  
sedacoskan@gmail.com

Bursa Teknik Üniversitesi, Doğa Bilimleri, Mimarlık ve Mühendislik Fakültesi,  
İnşaat Mühendisliği Bölümü/BURSA  
[yukselisa@yahoo.com](mailto:yukselisa@yahoo.com)

**Özet** Betonarme yapılarda, yıpratıcı çevresel etkiler veya beton bileşiminden kaynaklanan çeşitli nedenlerle donatı korozyonu oluşabilmektedir. Donatı korozyonu ile birlikte, örtü beton çatlayıp donatı paslanmakta ve kesit kaybı oluşmaktadır. Ayrıca, donatı ile beton arasında aderans kaybı meydana gelmekte ve donatı mekanik özellikleri de korozyondan etkilenebilmektedir. Önemli bir deprem kuşağında yer alan Türkiye’de tüm bu sonuçlar, binaların deprem davranışını olumsuz yönde etkilemektedir.

Bu çalışmanın amacı, üniform korozyonun betonarme binaların deprem davranışına olan etkilerini araştırmaktır. Bu amaçla, yıpratıcı çevresel etkilere maruz referans bir binada farklı korozyon senaryoları altında deprem davranışının değişimi incelenmiştir. Yönetmeliklere göre tasarlanmış binanın tasarım depremi etkisi altında her bir korozyon senaryosu için SAP2000 programı ile statik itme analizleri yapılmıştır. Elde edilen veriler ışığında çeşitli grafik ve çizelgeler oluşturularak, binanın farklı üniform korozyon durumları için deprem davranışı ortaya konulmuştur. Korozyonsuz ve farklı seviyelerde ve farklı şekillerde korozyonlu durumlara ait sonuçlar referans durum ve birbirleriyle karşılaştırılmıştır. Her bir senaryoda, donatıdaki çap kaybı, donatı-beton arasındaki aderans kaybı, donatı çeliği mekanik özelliklerindeki değişim literatürden alınan bağıntılarla hesaplanmıştır. Korozyonun bina üzerindeki yaygınlığı, etki süresi, yeri ve hızı araştırmanın değişkenleri olarak alınmıştır. Yapılan karşılaştırmalar sonucunda korozyonun binanın davranışını olumsuz yönde etkilediği, korozyonun yeri ve hızına bağlı olarak yapısal hasarın arttığı görülmüştür.

**Anahtar kelimeler:** Betonarme bina, Davranış, Deprem, İtme analizi, Korozyon.

# EFFECT OF UNIFORM REBAR CORROSION ON THE EARTHQUAKE BEHAVIOR OF BUILDINGS

Seda Coşkan\* , İsa Yüksel

Bülent Ecevit University, Zonguldak Vocational School,  
Department of Construction Technology/ZONGULDAK  
sedacoskan@gmail.com

Bursa Technical University, Nature Sciences, Architecture and Engineering Faculty  
Department of Civil Engineering/BURSA  
yükselisa@yahoo.com

**Abstract** Rebar corrosion could be occurred due to aggressive environmental agents or composition of concrete in reinforced concrete (RC) structures. Concrete cover has cracked; diameter of reinforcement steel bar has reduced with corrosion of steel bar. Also bond loss between concrete-rebar interfaces, change of mechanical properties of reinforcement steel have been affected from corrosion. These results have adversely affected the earthquake behavior of buildings in Turkey which is located in a major earthquake zone.

The goal of this study is to investigate the effect of uniform rebar corrosion to earthquake behavior of RC buildings. For this purpose, the variation of earthquake behavior is investigated in a reference building which is exposed to aggressive environmental actions under different corrosion scenarios. Static nonlinear pushover analysis is performed for each scenario of the building after the completion of design according to current regulations. The earthquake behavior of the building was exhibited with various graphics and charts according to the results of the analysis for every different uniform corrosion scenario. The results of analysis are compared with reference that the state of no corrosion. Loss in diameter of rebar, loss in bond strength, changes in engineering properties of reinforcement steel are determined by equations presented in literature for each scenario. Extensiveness of corrosion on the building, time of propagation, place and rate of corrosion are handled variables of the investigation. The results shows that rebar corrosion has adverse effects on the structural behavior, structural damage has increased due to type of the corroded elements.

**Keywords:** Reinforced Concrete Building, Behavior, Earthquake, Pushover Analysis, Corrosion.

# VALIDITY CRITERIA OF OEDOMETRIC AND TRIAXIAL TEST RESULTS

**Khemissa Mohamed**

Geomaterials Development Laboratory, Civil Engineering Department,  
Faculty of Technology, M'sila University, P.O. Box 166 Ichbilia 28000 M'sila, Algeria  
Corresponding Author: khemissa@univ-msila.dz

**Abstract:** Oedometric and triaxial tests are very much used in soil mechanics. However, in spite of their frequency in the world, these tests present some limitations related to remolding due to sampling process and to implemented experimental procedures. These limitations contribute to decreasing the resistance and deformability mechanical properties of soils, which condition their limit and critical states behavior. This paper proposes four validity criteria of oedometric and triaxial test results (compressibility criterion based on oedometric test results; consolidation, resistance and rigidity criteria based on triaxial test results) to appreciate the disturbance of test specimens. Impact of the sample disturbance on yield envelope of clayey soils according to these validity criteria is then analyzed.

**Key words:** Clay, oedometer, triaxial, validity criterion, disturbance, limit state, critical state.

## Introduction

Experimental study of the behavior of soft clays is frequently carried out by means of conventional oedometric tests with incremental loading and of standard triaxial tests according to various stress or strain paths. The considerable success of these tests, in which the effective stress or strain paths followed are known, is due to the fact that they make it possible to rather correctly describe the behavior of soils and that they are carried out on specimens to which the principles of continuum mechanics can well apply. They have also significant advantages such as a good definition of spatial and temporal boundary conditions, a strict control of drainage conditions and a rather precise identification of mechanical properties of soils. Oedometric and triaxial tests present however some limitations related to remolding due to sampling process and to experimental procedures described in standards and in other texts of reference, which make that the interpretation of test results requires certain prudence.

This paper proposes four validity criteria of oedometric and triaxial test results. It aims to appreciating the sample disturbance and its influence on the limit and critical states behavior of clayey soils and to report which we can draw from the experimental data available on Guiche clay (Adour valley, France). Table 1 gives the range of variation of geotechnical characteristics of this natural clay and their mean values.

**Table 1.** Geotechnical characteristics of Guiche clay (Adour valley, France)

| Parameters                | Symbols                       | Range of variation | Mean values |
|---------------------------|-------------------------------|--------------------|-------------|
| Wet unit weight           | $\gamma$ (kN/m <sup>3</sup> ) | 14.8 – 18.0        | 16.3        |
| Moisture content          | w (%)                         | 46 – 85            | 55          |
| Liquid limit              | w <sub>L</sub> (%)            | 48 – 98            | 68          |
| Plasticity index          | I <sub>p</sub> (%)            | 26 – 61            | 49          |
| Consistency index         | I <sub>c</sub> (%)            | 10 – 40            | 28          |
| Content of organic matter | C <sub>OM</sub> (%)           | -                  | 4.3         |
| In-situ void ratio        | e <sub>o</sub>                | 1.39 – 1.87        | 1.62        |
| Compression index         | C <sub>c</sub>                | 0.46 – 0.99        | 0.74        |
| Swelling index            | C <sub>s</sub>                | 0.05 – 0.13        | 0.08        |
| Preconsolidation pressure | $\sigma'_p$ (kPa)             | 40 – 90            | 70          |

This natural clay is described as a slightly organic and high plastic silty soft clay (fO-At according to French classification for soils or CH according to Unified System Classification for Soils). Experimental procedures implemented in study of the behavior of this natural soft clay, the test program realized and the detailed results obtained are in publications of Khemissa et al. (1993, 1997). Also, only the test results that appear to be interesting are described hereafter.

## Validity of oedometric test results: *Compressibility criterion*

The compressibility and consolidation characteristics of Guiche soft clay (Adour valley, France) were determined starting from conventional oedometric test results. The tests were performed in accordance with oedometric testing methods in the Laboratoires des Ponts et Chaussées (LPC) in France (Magnan et al., 1985; Ducasse et al., 1986). An analysis of the variability of oedometric test results carried out on a homogeneous series of specimens of this same clay confirmed the cogency of these testing methods (Khemissa and Magnan, 2000).

The compressibility criterion, adopted as a remolding criterion by the LPC testing methods, is defined to validate the oedometric test results starting from conventional oedometric compressibility tests. It is translated, for a disturbed specimen, by values of the preconsolidation pressure  $\sigma'_p$  rather weak and lower than values of the effective overburden pressure  $\sigma'_{vo}$  i.e. by overconsolidation ratio  $OCR = \sigma'_p / \sigma'_{vo} < 1$ . It also translated by values of the compression and swelling indexes,  $C_c$  and  $C_s$ , weaker for a disturbed specimen than for an undisturbed specimen. This criterion is schematized on figure 1 for two specimens fitting in two samples belonged to the same bore: one undisturbed with  $OCR=1.43$  (Fig. 1a) and the other disturbed with  $OCR=0.90$  (Fig. 1b).

## Validity of triaxial test results

The shear and rupture characteristics of Guiche soft clay (Adour valley, France) were obtained by means of standard triaxial cells starting from:

- isotropically consolidated undrained triaxial compression tests (CIU-tests),
- $K_o$ -consolidated undrained triaxial compression tests ( $CK_oU$ -tests),
- $K_o$ -consolidated and isotropically consolidated undrained triaxial compression tests ( $CK_oIU$ -tests),
- $K_o$ -consolidated undrained triaxial extension tests ( $EK_oU$ -tests),
- $K_o$ -consolidated and isotropically consolidated undrained triaxial extension tests ( $EK_oIU$ -tests);

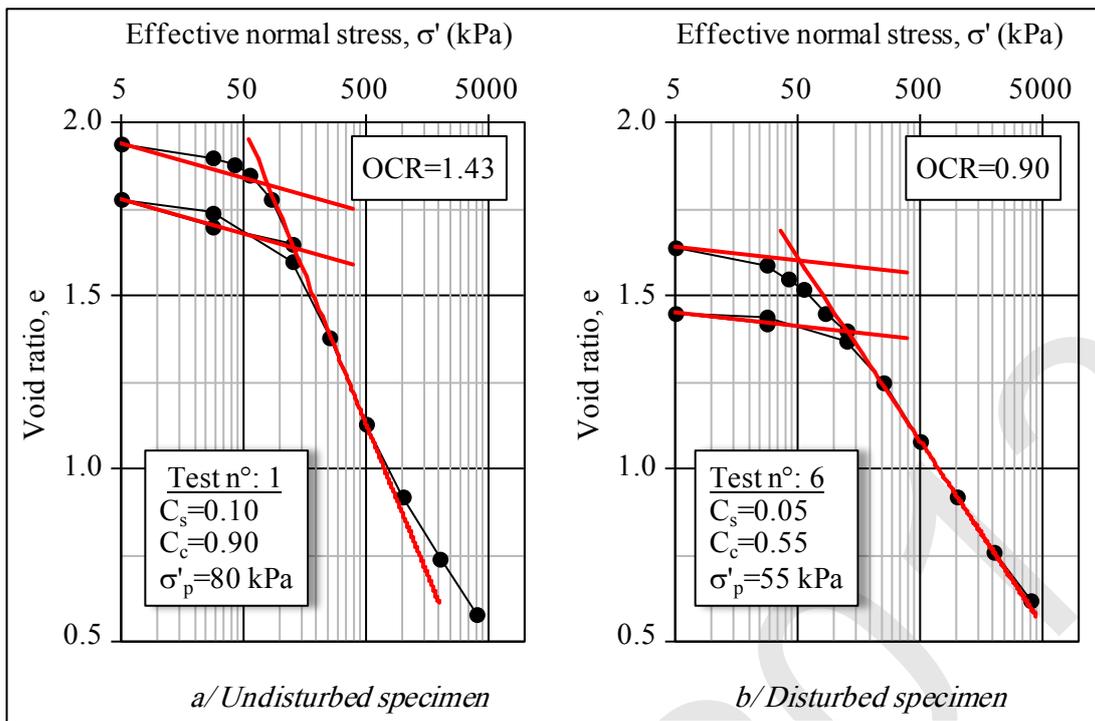
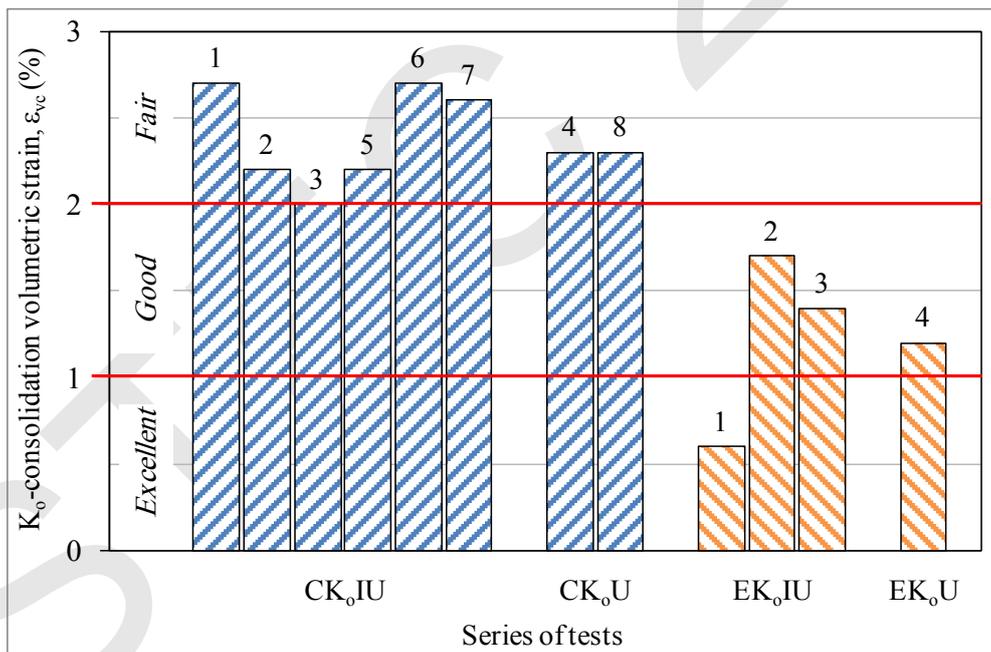
$K_o$  being the coefficient of earth pressure at rest. The performed experimental program also comprised, for study of the limit state behavior of this clay, a series of anisotropically consolidated triaxial tests carried out on specimens subjected to a loading system of which the stress paths correspond to a constant radial and axial stresses ratios (CAP-tests).

Data analysis was carried out by means of a software developed at the Laboratoire Central des Ponts et Chaussées in France (Khemissa, 1988). This software offers the possibility, inter alia, to correct the errors which can take place during the acquisition of measurements (errors of instrumental origin or errors due to the operations carried out in particular at the beginning of each phase of the triaxial test).

The criteria adopted to validate the triaxial test results are described hereafter.

## Consolidation criterion

This criterion is defined starting from triaxial test results on specimens reconsolidated with in-situ effective stresses. It is translated by values of the consolidation volumetric strain  $\epsilon_{vc}$  measured at end-of-reconsolidation as much higher than the soil is disturbed. Terzaghi et al. (1996) suggest these  $\epsilon_{vc}$ -values for sample quality: <1% (excellent), 1-2% (good), 2-4% (fair), 4-8% (poor) and >8% (very poor). Figure 2 shows the  $\epsilon_{vc}$  peak values measured on each  $K_o$ -consolidated specimen ( $CK_oU$ ,  $CK_oIU$ ,  $EK_oU$  and  $EK_oIU$  -tests) and their quality according to the consolidation criterion. It can be noted that the specimens characterized by  $\epsilon_{vc}$  values ranging between 2 and 2.7% can be considered as fair quality, the others as good to excellent quality.


**Figure 1.** Compressibility criterion

**Figure 2.** Consolidation criterion

### Resistance criterion

This criterion is defined starting from undrained triaxial shear test results. It is translated, for a disturbed specimen, by values of undrained shear strength  $S_u = (\sigma_1 - \sigma_3)_f / 2$  weaker than those obtained for an intact specimen tested under the same conditions;  $(\sigma_1 - \sigma_3)_f$  being the deviator stress at failure corresponding to peak of shear curve. Figure 3 shows the variations of  $S_u$  with effective consolidation stress  $\sigma'_c$  for all undrained triaxial shear tests results. It can be noted that the points located under the line characterizing the normally consolidated state of clay (i.e. critical state line in the principal plan of stresses) correspond to disturbed specimens. Thus, for a same consolidation state, the disturbed specimens, even after their  $K_0$ -consolidation, have undrained shear strength values lower than those of undisturbed specimens.

### ***Rigidity criterion***

This criterion is defined starting from undrained triaxial shear test results. It is translated, for a disturbed specimen, by values of undrained shear modulus  $E_u$  weaker than those obtained for an intact specimen tested under the same conditions;  $E_u$  being defined as a secant modulus corresponding to 0.5% of axial strain because of uncertainty to measures taken at the beginning of shear phase and of their representativeness. Figure 4 shows the variations of  $E_u$  with effective consolidation stress  $\sigma'_c$  for all undrained triaxial shear test results. It can be noted that the points located under the line characterizing the normally consolidated state of clay (i.e. critical state line in the principal plan of stresses) correspond to disturbed specimens. Thus, for same consolidation state, the disturbed specimens, even after their  $K_o$ -consolidation, have undrained shear modulus values lower than those of undisturbed specimens. We can in addition think that the disturbance affects the initial soil deformability before affecting significantly its maximum resistance: the specimens, whose maximum resistance is considered as decreased by the disturbance, have also lower initial rigidities; the reverse not being necessarily checked.

### **Impact of the sample disturbance on yield envelope of clayey soils**

The analysis of oedometric and triaxial test results obtained on Guiche soft clay (Adour valley, France) made it possible to define the position of limit state and critical state points corresponding to effective stress paths followed for all specimens. The preconsolidation pressure being variable with depth, the limit state points corresponding to samples extracted at various depths do not follow the same limit and critical states curve. This explains undoubtedly the preconsolidation effect of clay on its limit state characteristics and justifies the use of normalized principal plan of stresses compared to preconsolidation pressure. In normalized Lambe's diagram, the limit state points follow an appreciably elliptic limit state curve, with  $K_o$ -line as principal axis characterizing the state of in-situ effective stresses of clay, and  $\sigma'_c$ -line characterizing the critical state line (Fig. 5). It can be noted that the shear tests, in which specimens were  $K_o$ -consolidated, lead to shear strengths higher than those corresponding to other shear tests. However, it is not certain that this difference can constitute an indication of the quality of a given test compared to another similar test because each result is associated only with one limit state point. All things in addition equal, it can be affirmed that the disturbance of specimens can involve a reduction at the same time of undrained shear strength, undrained shear modulus and preconsolidation pressure of clay. The disturbed specimens are characterized by limit state points located inside the limit state curve (and not on this one), when they are consolidated under stress lower than the preconsolidation pressure (overconsolidated state), and by critical state points located under the critical state line (and not on this one), when they are consolidated under stress higher than the preconsolidation pressure (normally consolidated state). For the ones, as for the others, only effect of the disturbance can be given as a probable explanation more especially as these same specimens were declared as disturbed by at least one of the four validity criteria of test results previously proposed.

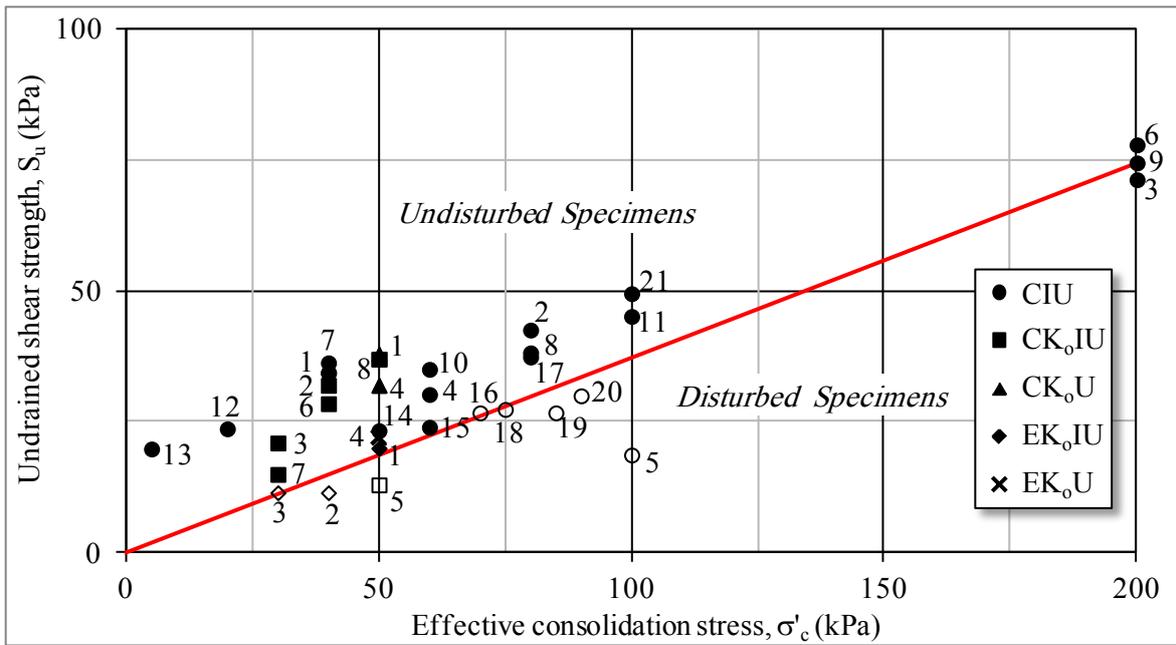


Figure 3. Resistance criterion

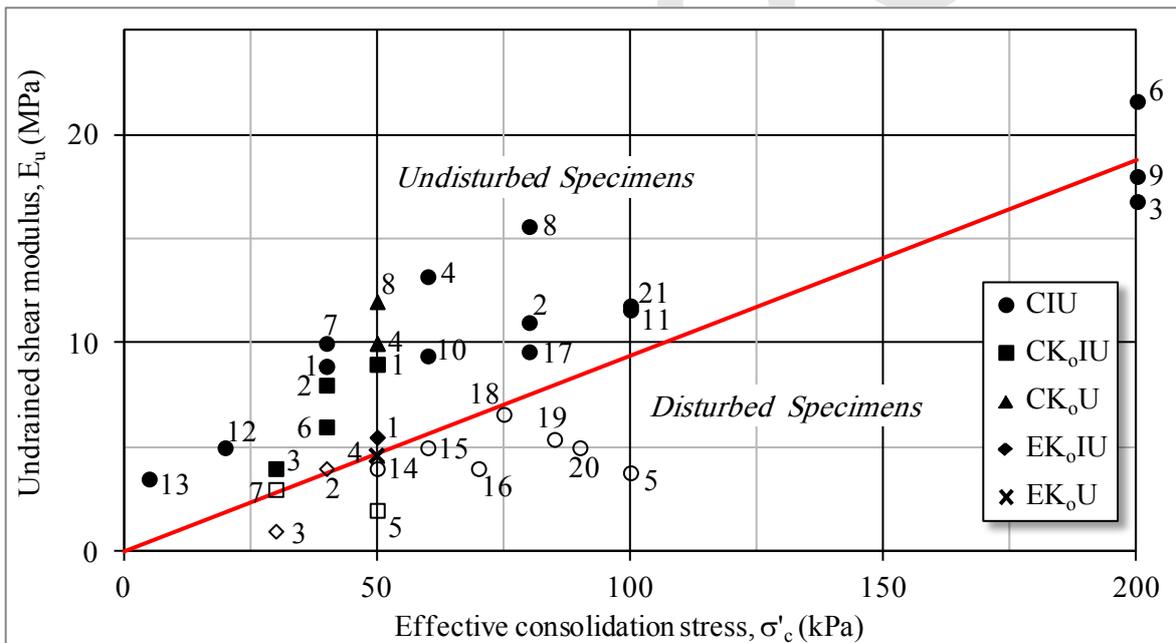


Figure 4. Rigidity criterion

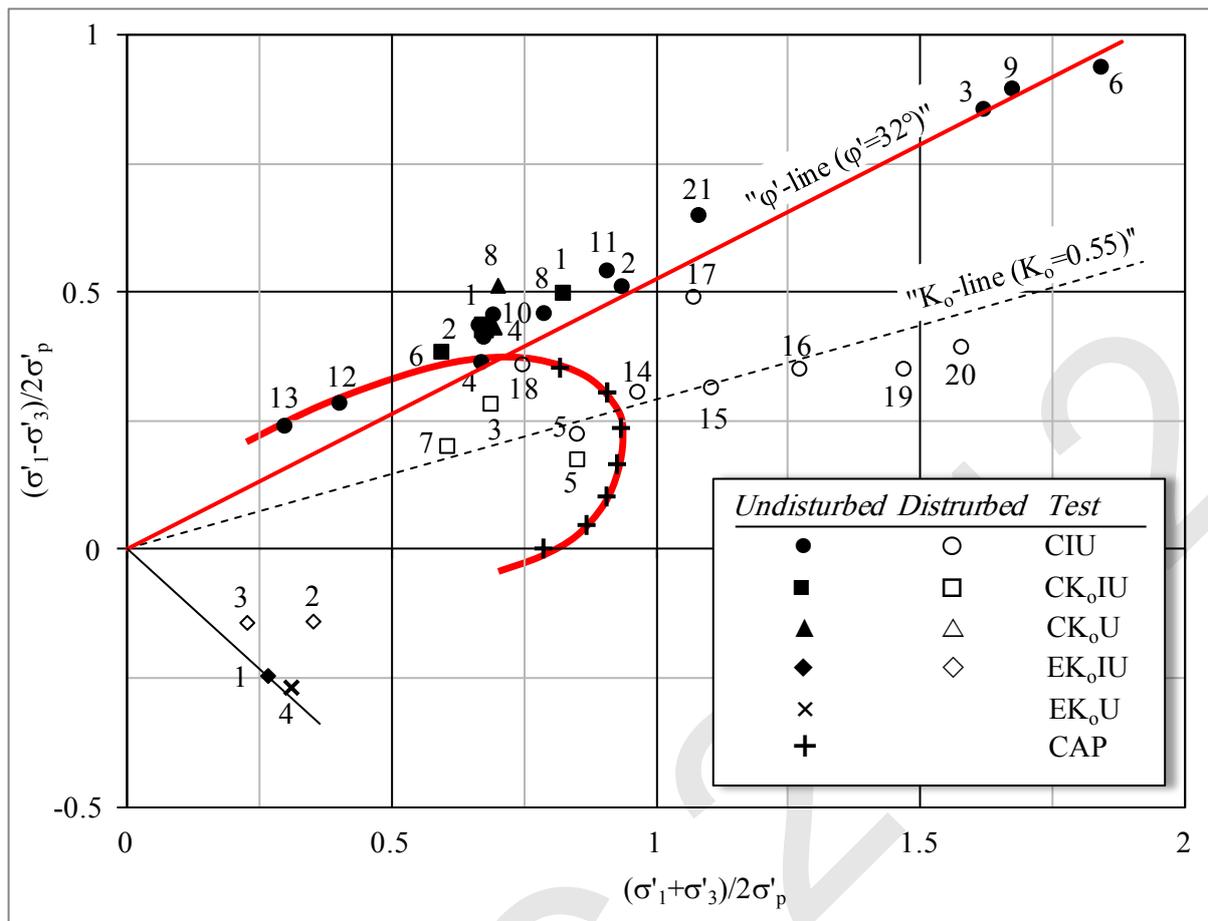


Figure 5. Normalized yield envelope for Guiche soft clay (Adour valley, France)

## Summary and conclusions

Oedometric and triaxial test results obtained on Guiche soft clay (Adour valley, France) made it possible to analyze the effects of disturbance of specimens on limit state behavior of this natural clay. These results show that the mechanical parameters values can well be influenced by quality of specimens:

- for oedometric tests, it seems that the disturbance of specimens can seriously affect the compressibility and consolidation parameters of clay. It causes to decrease the compressibility of clay in overconsolidated state (thus to decrease its swelling index) and in normally consolidated state (thus to decrease its compression index). It returns thus difficult the definition of point of compressibility curve corresponding to preconsolidation pressure, because this curve is flattened according to the degree of disturbance of specimens;
- for triaxial tests, the behavior of clay is mainly controlled by its limit and critical states. The undrained shear strength and undrained shear modulus vary with effective consolidation stress, which conditions the position and shape of limit state curve of clay. The disturbance of specimens can affect these parameters and influence the corresponding limit and critical states.

The validity criteria of oedometric and triaxial test results proposed in this paper are complementary. They can be employed to analyze the resistance and deformability properties of natural soft clays in order to distinguish the disturbed from undisturbed specimens and, consequently, to reject those presenting an excessive disturbance.

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# VALUE OF BLENDED LEARNING IN SUPPORTING LEADERSHIP DEVELOPMENT PROGRAMS

Dr. Ann Toler Hilliard  
Bowie State University, U.S.A.  
[draph1@juno.com](mailto:draph1@juno.com)

The future is now! Blended learning is evident in professional development training for educational leadership development programs today. With the limitation of funding and time constraints, more professional development training organizations are infusing blended learning as another educational tool to use during the leadership development training process. The leadership development process continues after face-to-face training with the support of blending learning technology. Blended learning has many definitions, but the most common meaning for blended learning is used to show a combined effort with face-to-face instruction to meet the needs of participants in the instructional environment. Leadership development programs must include three dimensions for participants such as awareness of concepts, definition and procedures/policy, understanding of measurable skills and knowledge and the application of such skills and knowledge. This study will discuss research related blended learning and its benefits, an approach to blended learning, vision and mission, professional development, collaborative leadership practices and learning communities, monitoring and evaluating program quality.

**Keywords:** *blended learning, facilitators, professional development, participants, learning communities*

## Introduction

Leadership development training programs for school leaders are utilizing software programs to improve the delivery of instruction and assessment of participants' work. Program participants are able to self-check their work before submission to program facilitators. Therefore, needed programs and technology tools are a must to have today in leadership development training programs. It is important for facilitators of the training program at the university to have the support from the leadership team at the university. The leadership team at various levels at the university should make sure that the infrastructure is in place to accommodate or support blended learning programs. It is important too, to have at the maintenance stage blended learning teaching programs that are strong. Blended learning programs should be mapped out properly strategically, updated and improvements should be clearly defined by facilitators in all planning and implementation stages and evaluation of new or improved technology for blended learning program activities. Blended learning programs should be updated only when it is necessary in meeting the current needs of participants. Regardless of the instructional methods for training, it is important to have quality course content. Participants in leadership development training should give feedback at the end of each session in order for facilitators to improve program quality. Regardless of training experiences for participant feedback is important (Garrison & Vaughan, 2008). The leadership team at the university should support quality blended learning programs by providing needed resources to facilitators guiding the program to ensure that participants are receiving quality services.

## What is blended learning and Its Benefits?

There is not any one definition for blended learning. However, the most common definition is using a percentage of online learning combined with face-to-face instructional services is a common definition. The benefits of blended learning are as follows: learning can be used easily for over long periods of time with limited instructional facilitation, learning gives times for participants to reflect on their own practices immediately and learning offers multiple contexts of practices globally (Graham, 2006).

Blended learning is a practical framework that can be used to communicate a broad range of effective approaches to learning, teaching and leading. Blended learning uses various contemporary technologies to enhance learning, and the development of flexible approaches to course design and instructional methods to enhance participants' engagement (Queensland University of Technology, 2011)

## An Approach for Blended Learning

From the literature review there is little information to suggest that there is a formal systematic approach to blending learning. The leadership development facilitators should seek common ways of using blending learning tools to engage participants in various training sessions by frequent engagement individually or as a group as follows:

1. Provide blended learning training that is relevant for program participants.
2. Use several technology tools to engage participants in a number of learning activities related to leadership.
3. Keep participants focused on immediate tasks and exercises during the training session.
4. Seek input/feedback from participants based on their views about blended learning practices used during the leadership development training experience.
5. Monitor how well participants are performing using blended learning based on tasks completion in a timely manner.

Some common tools used in blended learning training sessions are power point, videos and interactive whiteboards; virtual communication tools such as discussion boards, chat rooms and podcasting; social networking software such as blogs; e-learning systems and group collaborative software, mobile and face book learning (Gillani & Relan, 2007).

### **Vision and Mission**

The participants in the leadership development program need to gain skills in writing a collaborative vision based on where the organization wants to go. Usually the vision statement's origin is based on values in essence what drives the organization toward its mission. The mission statement tells participants in the training program what the organization intends to do to get to where the organization wishes to go to achieve its vision. The participants in the leadership development program need to know how to articulate a typical vision and mission statement to a larger audience during the training experience (Littlejohn & Pegler, 2007).

### **Professional Development Activities**

Relevant professional development is a must for participants in the leadership development training program and the upgrading of skills and knowledge in order for these participants to keep up with the latest trends in online learning or blended learning at the university. The leadership team at the university should continue to update facilitators, faculty and students' skills and knowledge regarding new and improved technologies through blended learning. Therefore, it is important for university leadership team to communicate the online policy for new or improved programs; schedule differentiated professional development based on participants' needs, offer participants incentives to participate in program training. The facilitators of the leadership development program should also offer mentoring services to participants in order to show participants how to use the variety of technology management tools to enhance skills and knowledge in leadership (Krause, 2007). Research indicates educational district leaders are responsible for many tasks in school districts and at the university and these individuals must have knowledge and know the expectations within the job description. District school leaders for example must show competence (*without this author altering words*) by:

1. Developing a broadly collaborative vision and mission to guide district decisions and to support change at the school level and knowledge of how to develop trust, that is a requisite variable in shared visioning, for school improvement by using data technology evidence to inform district decisions, and knowledge of the importance of professional development
2. Developing school culture and climate is critically important; therefore, the district leaders must apply knowledge of how to create a culture of trust, learning, and high expectations by building effective learning communities by the support of blended learning.
3. Knowing curriculum planning and how to develop the curriculum to motivate students in learning environments using various technology tools to enhance instructional services.
4. Infusing technology into leadership practices has become a recognized domain of practical knowledge essential to effective instructional leadership and that is why blended learning is so important.
5. Using best practices regarding management of a district organization, operations, and resources for a safe, efficient, and effective learning environment using blended learning.
6. Knowing how to craft systemic management and operations, organize education improvement efforts, coordinate accountability systems using technology, and create policy coherence that influences school outcomes and student learning.

7. Knowing the importance of creating systems that focus on school personnel and other Needed resources related to common goals and creating processes by using technology that facilitates effective teaching, learning and leading, because there should be ways to encourage teachers to be leaders.
8. Supporting ways to promote the success of every student by ensuring the management of the district's organization, operation, and resources through monitoring and evaluating district management and operational systems by using technology systems.
9. Using human, fiscal, and technological resources within the district; promoting district-level policies and procedures that protect the welfare and safety of students and staff across the district.
10. Training others as leaders in the capacity for distributed leadership and ensuring that district time focuses on high-quality instruction and student learning by the use of blended learning support tools.
11. Making it a point to collaborate with faculty, families and caregivers, and district community partners; understanding of diverse community interests and needs; and best practices for mobilizing district community resources by the use of technology support systems.
12. Knowing how to collect and analyze data information pertinent to the district's educational environment, and using appropriate strategies and data technology.
13. Supporting the practices of inclusive leadership, and leadership for diversity.
14. Providing clinical experiences with the support of blended learning for all individuals or participants who are seeking certification for district leadership positions from the leadership development training programs (NPBEA, 2011).

Observations by educational experts affirm that an effective district leader must be reflective about leadership practices in order to improve student learning (Knapp, Copeland & Talbert, 2003). Using typical standards articulated by NCATE can guide the success of leadership development training programs, because these standards can give program facilitators a consistent way to plan, organize, implement, monitor and evaluate program effectiveness.

### **Collaborative Leadership Practices and Learning Communities**

A continuation of learning must take place for participants in the leadership development training program. Therefore, collaborative leadership practices and learning communities are all assets to the professional growth of participants in the leadership development training program.

The collaborative practice is encouraged so that participants in the leadership development training program may have mastery of skills in the sharing of power, decision-making and valuable resources. The collaborative leadership practice helps to broaden the network of resources for participants during and after the training experience. The success of collaborative practices creates positive relationships through trust, mutual respect, broader understanding of diversity and improves communication. Collaborative leadership practices offer a chance for participants in training to be full supporters for their areas of interest within the organization and within their own community (Garrison & Vaughan, 2008).

Collaborative learning for the participants in the leadership development training program are in a unique position to establish a viable learning community by using blended learning or e-learning opportunities. Facilitators of the blended learning community can create opportunities for participants to connect to various community technologies to extend the face-to-face into blended learning solutions that include pre and post time for online community building as a practice for participants long after the formal training experience in the leadership development program has ended (Chris lip, 2001).

The benefits of a collaborative electronic learning community for participants are many. For example blended learning communities are able to:

1. Extend interactive learning opportunities informally for all participants
2. Seek unlimited ways to receive and share knowledge and skills with others
3. Share relevant and practical ways to address problems and issues in education and business at the district or building level
4. Allow small and large groups of individuals to work on organizational projects through the use of technology without the expense of travel or hotel (Educes, 2009).

With electronic learning communities, online conferences could be help often for professional development practices. For conference activities, participants may view relevant videos and power point presentations in narrative format that encourage group interaction. Online and blended learning conferences give the participants the opportunity to ask questions, examine resources and network with other participants during the conference. After the conference has ended, if information was saved electronically, participants who wish could review selected presentations for more clarity.

There are many tools available for blended learning or online learning as follows:

1. Asynchronous Tools include discussion boards, calendar, group announcements, messaging or email, decision support tools, surveys and polls and website links.
2. Synchronous Tools include audio conferencing, chat, instant messaging, video conferencing, web conferencing and white boarding.
3. Content Integration includes narrated slideshows, interactive activities, streaming audio and video and web books.
4. Document Management includes document collaboration, permission based access, resource library and version tracking and control (Kaplan, 2002).

In order to have a clear understanding for tool use by participants, the facilitators must ensure that all participants know how to use the electronic tools with maximum proficiency during the leadership development training program.

### **Monitoring and Evaluating Program Quality**

In order to have high quality assurance for all leadership development programs, it is essential that there is a monitoring system in place. Facilitators are responsible for the overall monitoring of the leadership development training program. The facilitators must also encourage participants to self-monitor their own performance too. Evaluation or assessment of the program can be time consuming; however, facilitators must have effective management skill and be able to monitor each assignment to see if certain requirements have met weekly and provide written feedback to participants through document collaboration (Quality Matters, 2008).

### **Conclusion**

From all research, there is added-value to using blended learning in leadership development programs, because of the broad range of integrated and use of electronic tools such as audio, video and web conferencing opportunities and others. Blended learning has many advantages too, because it is cost effective, provides an opportunity for broader audience of diverse participants, many interactive capabilities and provides broader means of communication within learning communities on a global scale.

### **Bio of Author**

Dr. Ann Toler Hilliard is an assistant professor who teaches in the Department of Educational Studies and Leadership at Bowie State University, U.S.A. As an assistant professor, Dr. Hilliard coordinates activities that provide professional experiences for those individuals who are seeking the opportunity to serve as a school administrator. She has held leadership positions at the building level as a principal, college program director, and district level as an academic achievement specialist in Maryland and in the District of Columbia and an international consultant in Europe and Asia. Her experiences as a leader in the area of administration extend from elementary school through graduate school. Dr. Hilliard's research interests include: Leadership Trends, Issues and Data Use, Relationship Building and Teaching, Assessment Standards for University Improvement, and Educators as Entrepreneurs. Dr. Hilliard earned a Doctor of Education degree, George Washington University; Master's of Science degree, The Johns Hopkins University; Master's of Arts and Teaching degree, Trinity University – Washington; B.S. degree, Elizabeth City State University; and earned

Consulting Certificate from Harvard University and holds an Advanced Professional Certificate, Maryland State Department of Education, U.S.A.

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# VAN YÖRESİNE AİT BAZI MADEN SULARININ ESER ELEMENT SEVİYESİNİN AAS İLE TAYİNİ

Beşir DAĞ  
Batman Üniversitesi  
Fen-Edebiyat Fakültesi  
Kimya Bölümü, BATMAN

Fevzi KILIÇEL  
Karamanoğlu Mehmet Bey Üniversitesi  
Fen Fakültesi Kimya Bölümü,  
KARAMAN

**Özet** Su tüm canlılar için vazgeçilmez bir hayat kaynağıdır. İnsan ve canlıların suya olan ihtiyaçları zamanla daha da artmıştır. Bu yüzden içme ve kullanma sularının ağır metal içerikleri hem toksik özelliği bakımından hem de besleyici özelliği bakımından büyük önem arz etmektedir. Bu çalışmamızda suda bulunan ve besleyici özelliği bulunan Mangan(Mn) ve Nikel(Ni) elementlerinin içeriklerinin araştırılması ve maden sularının kalitesinin tespit edilmesi amacıyla bir çalışma yapıldı. Çünkü suda bulunan ağır metal içerikleri insan ve canlı sağlığı ile doğrudan ilgilidir. Bununla birlikte, Musluk (içme suları), kaynak ya da maden sularının kalitesi bazı şehirlerde sanayinin gelişmesi ve nüfus artış hızına bağlı olarak olumsuz yönde etkilenmektedir. Bu çalışmamızın amacı Van yöresinde bulunan bazı maden sularındaki bazı eser element(Mangan ve Nikel) içeriklerinin Atomik Absorbsiyon Spektrofotometre ile ppb cinsinden ölçülmesi ve bu ölçüm yapılırken de en uygun yöntemlerden birisi olan Aktif karbon ile zenginleştirilmesidir. Bu çalışma neticesinde elde edilen eser element içeriklerinin değerleri, bazı uluslararası içme suyu kriterlerine ve Türk Standardı olan TS 266'ya uygun olup olmadıkları araştırıldı. Çalışmamızın sonuç kısmında elde edilen veriler çerçevesinde ölçüm yapılan 10 farklı maden sularının ağır metal (Mangan(Mn) ve Nikel(Ni) ) içeriklerinin birisi hariç hem Dünya Sağlık Örgütü hem de Avrupa Birliği İçme Suyu Kriterlerine uygun olduğu saptanmıştır. Ayrıca üzerinde çalıştığımız bu suların ağır metal içeriklerinin Türk Standardı olan TS 266'ya uygun olduğu belirlendi.

**Anahtar Kelimeler:** Su kirliliği, Eser element, Aktif karbon, AAS

**Giriş** Canlılar susuz yaşayamazlar bu yüzden su canlıların en önemli yaşam kaynağı ve unsurudur(1).Yıllar boyunca bütün medeniyetler yaşamlarını su üzerine tesis etmiş olup suya olan gereksinimlerinden dolayı su kenarlarında yaşamaya başlamışlardır(2). Su yaklaşık olarak dünya yüzeyinin %75'ini kaplamaktadır. Yirminci Yüzyılın ikinci yarısından sonra, Teknolojinin gelişmesi ve Dünya nüfusunun hızlı bir şekilde artmasıyla birlikte insan yaşamını ve doğayı bazı tehlikelerin tehdit etmeye başladığını açıkça ortaya koymuştur(8).İçme sularının önemli bir kısmı yer altı sularından temin edilmektedir. Örneğin; sondaj suyu veya kaynak sularında suyun miktarı kadar kalitesi de aynı ölçüde önem arz etmektedir(8).Suyun diğer bir özelliği de çok iyi bir çözücü olmasıdır ve birçok maddeyi su ile çözmemiz mümkündür. Bu nedenle su karşımıza en önemli evrensel çözücü olarak çıkmaktadır(7).İçme ve kullanma sularının önemli bir bölümü kaynak ve yeraltı sularından temin edilmektedir. Bunlar sondaj suyu ya da akifer olarak adlandırılır(5).Bununla birlikte içme ve kullanma sularını yüzey sularından da elde etmek mümkündür. Yüzey suları da göller, nehirler, ırmaklar ve derelerdir. Diğer kaynaklar yağmur suları, kar suları, biyolojik kaynaklar Örneğin; bitkiler

ve denizler de dâhildir(8).Suda saf olmayan bazı maddeler bulunmaktadır. Örneğin; mikroorganizmalar, çözülmüş organik tuzlar, metal tuzları ve zararlı bakteriler. Bu yüzden birçok durumda doğal(kaynak)sular insanlar tarafından doğrudan içilmezler. Tüketicinin bu suları kullanabilmeleri için bazı işlemlerden geçmeleri gerekmektedir. Sanayinin gelişmesi ve büyük şehirlerde nüfusun artmasıyla birlikte birçok etken suyun kirlenmesine neden olmuştur. Bu gelişmeler neticesinde denizler, nehirler, göller ve dereler fabrika ve sanayi bölgelerinden gelen atıklarla kirlenmiştir. Sulardaki en önemli kirlilik topraktan ve ağır metallere kaynaklanan kirliliktir. Bunların da en ciddi kaynağı yakıtlar, endüstriyel atıklar ve evsel atıklardır(1).Biz bu çalışmamızda yukarıda zikredilen kirleticilerin çalışma yaptığımız noktalardaki suların kirlenip kirlenmediğini kirlendiyse hangi ölçüde kirlendiğini tespit etmekte.

## Materyal ve Yöntem

### 2.1.Araçlar.

Biz bu çalışmamızın ölçümlerini Thermo Solaar ve Perkin Elmer AA700 marka Atomik Absorpsiyon Spektrofotometresi vasıtasıyla gerçekleştirdik. Atomik Absorpsiyon ölçümleri Hava/Asetilen karışımı alevi kullanılarak yapıldı(9).

### 2.2.Kimyasallar.

Tüm çözeltiler diyonize su kullanılarak hazırlandı. Bu çalışmada esasında kullanılan tüm kimyasalların Alman Merck marka kimyasallar olmasına özen gösterilmiştir(7). Kalibrasyon Grafiğini oluşturmak için Merck marka 1000 ppm'lik standart stok çözeltisi 2M HNO<sub>3</sub> ile seyreltilerek hazırlandı.

### 2.3.Deney

Tüm örnekleri ilkönce Mavi bant süzgeç kâğıdı ile süzüldü ve 3 g aktif karbon kolonların içerisine dolduruldu. Bu işlem basamakları her ölçüm için ayrı ayrı olmak üzere tekrarlandı. 35ml %5'lik dietilditiyokarbamat 1L'lik su numunelerine ilave edilerek eser metallere kompleksleşmeleri sağlandı. Daha sonra saf HNO<sub>3</sub> ve ftalat tamponu kullanılarak pH'sı 3.2±0.2'ye ayarlandı. İki saat beklendikten sonra süzme işlemi gerçekleşti, kompleksleşen toksik metaller 20ml 1M HNO<sub>3</sub> çözeltisine alındı tüm işlemler üç paralel halinde çalışıldı ve son olarak Atomik Absorpsiyon spektrofotometresiyle ppb cinsinden konsantrasyonları üç paralel olarak ölçülerek ortalamaları alındı.

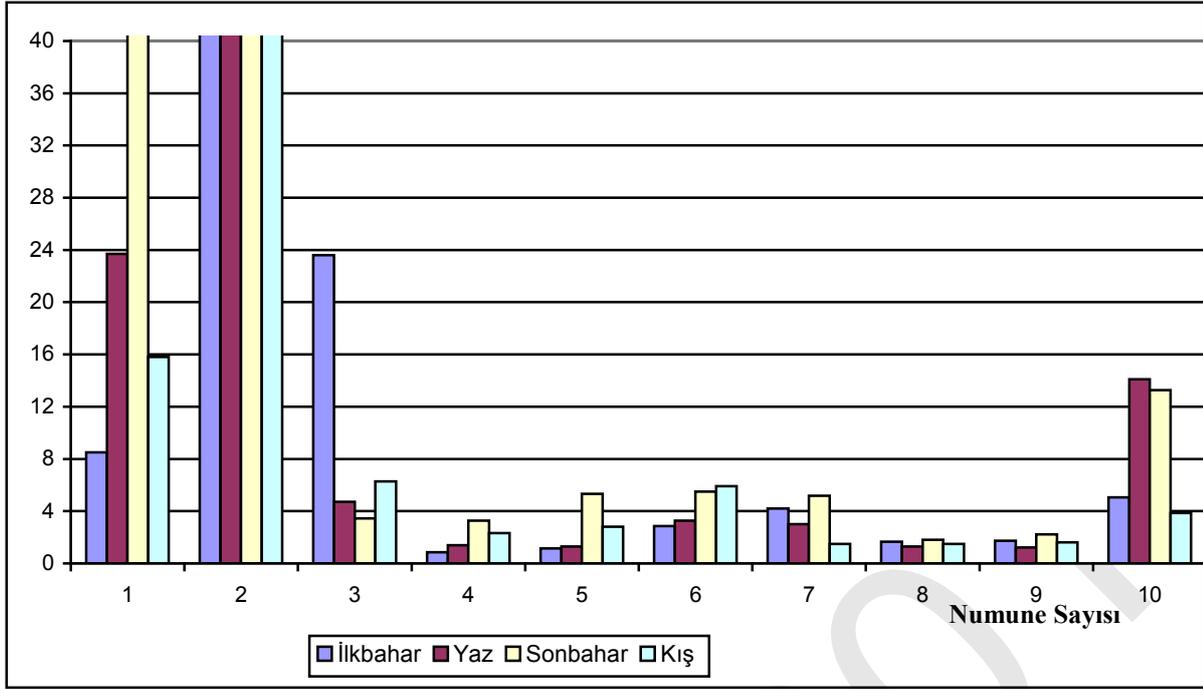
## Bulgular

### Numune Merkezleri

| Numune sırası | Numunenin alındığı yerler        |
|---------------|----------------------------------|
| 1             | Van Faruk maden suyu             |
| 2             | Van Erciş ılıca sıcak maden suyu |
| 3             | Van Erciş ılıca soğuk maden suyu |
| 4             | Van Özalp maden suyu             |
| 5             | Van Özalp Kapı köy maden suyu    |
| 6             | Van Çaldıran Osmanlı maden suyu  |
| 7             | Van Hoşap maden suyu             |
| 8             | Van Güzel dere maden suyu        |
| 9             | Van Gürpınar kilise maden suyu   |
| 10            | Van Gürpınar şehitlik maden suyu |

### Konsantrasyon

$\mu$  g/L (ppb)

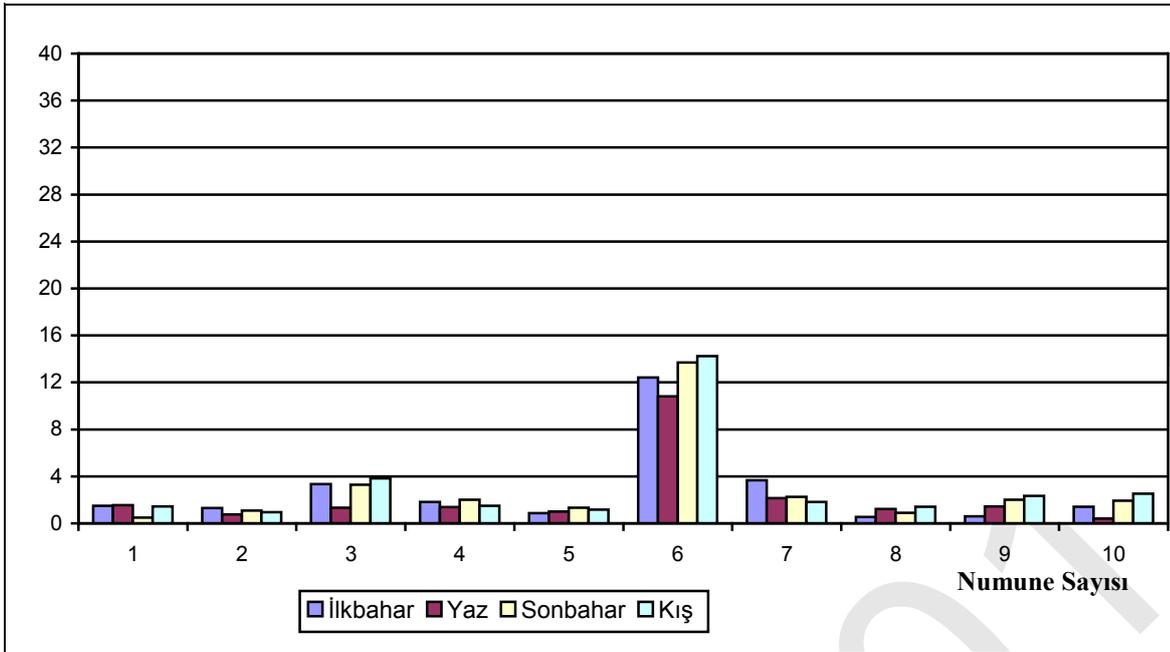


**Şekil 1** Van Yöresindeki 10 Farklı Merkezden Alınan Su Örneklerinin 4 Farklı Mevsimdeki Mangan(Mn) Konsantrasyonları

**Tablo 1** Van Yöresindeki 10 Farklı Merkezden Alınan Su Örneklerinin 4 Farklı Mevsimdeki Mangan(Mn) Konsantrasyonları

| Numune Sırası | İlkbahar    | Yaz         | Sonbahar    | Kış         | Ortalama ± SD |
|---------------|-------------|-------------|-------------|-------------|---------------|
| 1             | 8,51        | 23,7        | 43,2        | 15,8        | 22,80 ± 12,9  |
| 2             | 151,3       | 159,4       | 147,10      | 148,3       | 151,53 ± 4,80 |
| 3             | 23,6        | 4,71        | 3,45        | 6,28        | 9,51 ± 8,20   |
| 4             | 0,86        | 1,40        | 3,28        | 2,32        | 1,97 ± 0,92   |
| 5             | 1,16        | 1,30        | 5,32        | 2,82        | 2,65 ± 1,67   |
| 6             | 2,86        | 3,28        | 5,51        | 5,92        | 4,39 ± 1,34   |
| 7             | 4,20        | 3,00        | 5,18        | 1,50        | 3,47 ± 1,37   |
| 8             | 1,66        | 1,30        | 1,80        | 1,48        | 1,56 ± 0,19   |
| 9             | 1,73        | 1,22        | 2,22        | 1,62        | 1,70 ± 0,36   |
| 10            | 5,05        | 14,1        | 13,28       | 3,85        | 9,07 ± 4,65   |
| Ortalama ± SD | 3,22 ± 1,33 | 2,05 ± 1,43 | 2,84 ± 1,87 | 1,90 ± 1,30 |               |

**Konsantrasyon**  
µ g/L (ppb)



**Şekil 2** Van Yöresindeki 10 Farklı Merkezden Alınan Su Örneklerinin 4 Farklı Mevsimdeki Nikel(Ni) Konsantrasyonları

**Tablo 2** Van Yöresindeki 10 Farklı Merkezden Alınan Su Örneklerinin 4 Farklı Mevsimdeki Nikel(Ni) Konsantrasyonları

| Numune Sırası     | İlkbahar        | Yaz             | Sonbahar        | Kış             | Ortalama $\pm$ SD |
|-------------------|-----------------|-----------------|-----------------|-----------------|-------------------|
| 1                 | 1,50            | 1,56            | 0,50            | 1,45            | 1,25 $\pm$ 0,44   |
| 2                 | 1,30            | 0,75            | 1,10            | 0,96            | 1,03 $\pm$ 0,20   |
| 3                 | 3,33            | 1,33            | 3,30            | 3,83            | 2,95 $\pm$ 0,96   |
| 4                 | 1,82            | 1,38            | 2,00            | 1,50            | 1,68 $\pm$ 0,25   |
| 5                 | 0,86            | 1,00            | 1,32            | 1,16            | 1,09 $\pm$ 0,17   |
| 6                 | 12,43           | 10,82           | 13,70           | 14,25           | 12,80 $\pm$ 1,32  |
| 7                 | 3,66            | 2,16            | 2,25            | 1,83            | 2,48 $\pm$ 0,70   |
| 8                 | 0,55            | 1,23            | 0,90            | 1,42            | 1,03 $\pm$ 0,33   |
| 9                 | 0,60            | 1,43            | 2,00            | 2,33            | 1,59 $\pm$ 0,66   |
| 10                | 1,42            | 0,40            | 1,92            | 2,52            | 1,57 $\pm$ 0,78   |
| Ortalama $\pm$ SD | 3,22 $\pm$ 1,33 | 2,05 $\pm$ 1,43 | 2,84 $\pm$ 1,87 | 1,90 $\pm$ 1,30 |                   |

## Tartışma ve Sonuç

Su insan yaşamının en önemli unsurlarından birisidir. Bu yüzden suyun ağır metal analizi son yıllarda büyük önem kazanmıştır. Suda bulunan ağır metaller Toksik ve Besleyici olmak üzere iki gruba ayrılır Biz bu çalışmamızda maden sularındaki besleyici özelliği olan ağır metallere Mangan(Mn) ve Nikel(Ni)'in konsantrasyonlarını tayin ettik. Bu çalışmada eser analiz tayinlerinin etkili yöntemlerinden birisi olan aktif karbonun zenginleştirme(önderiştirme) yöntemini kullanarak besleyici ağır metaller olan Mangan(Mn)'ın ve Nikel(Ni)'in milyarda bir olarak adlandırılan ppb seviyesinde konsantrasyonları ölçüldü Bu ölçümler neticesinde bu yöntemin doğal kaynak ve maden sularında hem hızlı hem de güvenilir olduğu kanaatine varıldı(9).Bir yıl boyunca dört mevsimde yapılan ölçümler neticesinde Mangan(Mn) ve Nikel(Ni) konsantrasyonlarının bir numune haricinde hem kabul edilebilir hem de mevsimsel ölçümlerinde kararlılık gösterdiği anlaşılmaktadır.Tablo3.1. de de görüleceği üzere Mangan(Mn) ve Nikel(Ni) konsantrasyonlarının Standard sapması% 10'un altındadır. Bu nedenle örneklerin Mangan(Mn) ve Nikel(Ni) konsantrasyonları arasında mevsimsel anlamda çok büyük farklılıklar gözlenmemiştir(6).Ayrıca yapılan çalışma neticesinde ölçüm yapılan 10 farklı merkezdeki sonuçları değerlendirdiğimizde Van Erciş ılıca sıcak maden suyunun Mangan(Mn) konsantrasyonunun en yüksek düzeyde olduğu ve Van Güzel dere maden suyunun Mangan(Mn) konsantrasyonunun en düşük düzeyde olduğu tespit edilmiştir.Ayrıca elde edilen veriler neticesinde ölçüm yapılan 10 farklı merkezdeki Nikel(Ni) konsantrasyonlarını değerlendirdiğimizde sonuçların hem mevsimsel ortalaması hem de ölçüm merkezleri bakımından son derece makul ve standartlara uygun olduğu hem tablo 3.2. hem de grafikten anlaşılmaktadır.Ayrıca bu ölçümler neticesinde Nikel(Ni) bakımından herhangi bir olumsuz durumla karşılaşmamıştır.Ölçümleri yapılan tüm maden sularının Mangan(Mn) konsantrasyonu ölçümleri neticesinde Van Erciş ılıca sıcak maden suyunun Mangan(Mn) konsantrasyonunu ortalaması 150 ppb'nin üzerinde olduğu tespit edilmiştir. Bu değer üst sınırlar bakımından Mangan(Mn)'ın standart değerinin yaklaşık üç katıdır ve ciddi anlamda tehlike arz etmektedir. Diğer 9 merkezde yapılan ölçümler sonucunda ise Mangan(Mn) konsantrasyonu hem Avrupa Birliği İçme Suyu Kriterlerine hem de Dünya Sağlık Örgütü Kriterlerine ve aynı zamanda Türk Standartları İçme Suyu Standardı olan(TS266) ya uygun oldukları ve Mangan(Mn) açısından herhangi bir kirlilik taşımadıkları sonucuna varılmıştır.Ayrıca ölçüm yapılan 10 merkezdeki Nikel(Ni) konsantrasyonlarını incelediğimizde sonuçların son derece makul ve mevsimsel ortalamalara göre kararlı bir durum sergiledikleri anlaşılmaktadır. Mangan(Mn) da olduğu gibi Nikel(Ni) bakımından herhangi bir olumsuz durumla karşılaşmamıştır. Nikel(Ni) konsantrasyonları hem Avrupa Birliği İçme Suyu Kriterlerine hem de Dünya Sağlık Örgütü Kriterlerine ve aynı zamanda Türk Standartları İçme Suyu Standardı olan(TS266) ya uygun oldukları ve Nikel(Ni) açısından herhangi bir kirlilik taşımadıkları sonucuna varılmıştır. Sonuç olarak su kullanımı insan sağlığı açısından son derece önemli olup içme ya da kullanma suyu olsun test edilmeli eğer ağır metal açısından herhangi bir kirlilik taşıyorsa bu kirlilik ya bertaraf edilmeli ya da içilmesi ve kullanılması yasaklanmalıdır.

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## ***VIRUS AND VIRUS-LIKE ELIMINATION BY STIGMA AND STYLE SOMATIC EMBRYOGENESIS OF ALGERIAN CITRUS GERMPLASM***

*Meziane M ; boudjeniba M ; D'Oghia AM ; Frasheri D; Carra A; Carimi F*

*Meziane M . meziane\_ma@yahoo.fr*

*Abstract* Stigma/style somatic embryogenesis is one of the efficient methods in plant regeneration and sanitation of most *Citrus* ssp., without inducing somaclonal variations. This technique was applied on Algerian citrus collection. The main varieties of different citrus species (*Citrus sinensis*, *C. limon*, *C. reticulata*, *C. maxima* and *C. paradisi*) were chosen and tested for the presence of the main virus and virus-like agents. Most of the genotypes showed to be infected by one or more infectious agents, primarily viroids. Closed flowers were collected from these genotypes during blossoming and, after sterilization, cultured on a MS medium supplemented with mg/l BAP (6-benzylaminopurine). All explants produced callus at the cut end of the styles, about 4-9 days after culture initiation, whereas embryogenesis occurred later (after 38 -150 days) in most of the cultured genotypes. Formed embryos were cultured in a single tube before in vivo acclimatization. After sanitary assays, plants regenerated from stigma/style culture showed to be free from the agents and diseases detected in the mother trees. The successful and easy application of this technique under Algerian conditions showed that somatic embryogenesis could be largely applied not only for *Citrus* in vitro conservation but also for the production of healthy citrus plants to start up the citrus certification program in the country.

Keywords : Citrus germplasm, Algeria , Virus\virus-like , sanitation, somatic embryogenesis

# WEB TABANLI HARİTA BİLGİ SİSTEMLERİNE GOOGLE MAPS API ENTEGRASYONUNUN GERÇEKLEŞTİRİLDİĞİ BİR UYGULAMA

## AN APPLICATION CARRIED OUT THROUGH THE INTEGRATION OF GOOGLE MAPS API INTO WEB BASED INFORMATION SYSTEMS

Dr. Mustafa ULAS  
Department of Software Engineering, Fırat University  
[mustafaulas@gmail.com](mailto:mustafaulas@gmail.com)

Dr. Aytug BOYACI  
Department of Informatics, Fırat University  
[aytugboyaci@firat.edu.tr](mailto:aytugboyaci@firat.edu.tr)

**Özet:** Gelişen yeni nesil teknolojiler ile harita bilgi sistemlerine duyulan gereksinimin arttığı görülmektedir. Bu gereksinimin giderilmesine yönelik olarak yapılmış çeşitli uygulamalar mevcuttur. Google'ın geliştirdiği ve diğer uygulamaların kullanımına ücretsiz olarak sunduğu Google Maps API'ler çok çeşitli ihtiyaçları karşılar niteliktedir. Google'ın oluşturmuş olduğu güncel haritaların ve bu haritalar üzerinde işlem yapacak olan hazır uygulama parçalarının iyi şekilde incelenmesi ve uygulamaların oluşturulması yeni yapılacak çalışmalara destek niteliğindedir. Yapılan bu çalışmada, Google Maps API'lerinin web tabanlı harita bilgi sistemlerine entegre edildiği bir yapı oluşturulmuştur. Bu yapı aracılığı ile Google Maps uygulamasının bir harita bilgi sisteminde kullanılması gerçekleştirilmiştir. Bu çalışma ile bir üniversitenin kampusu içerisindeki önemli noktaların, haritalar üzerinde interaktif şekilde gösterilebilmesini sağlayan web tabanlı bir harita bilgi sistemi oluşturulmuştur. Bu sistemin uygun bir şekilde yönetiminin sağlanması için yönetici arabirimi geliştirilmiştir. Yönetim arabirimi üzerinde yine Google Maps API uygulamalarının kullanılması sağlanmıştır.

**Anahtar Sözcükler:** Harita Bilgi Sistemi, Google Maps API, Web Tabanlı Yönetim, Harita Servisleri

**Abstract:** It has been understood that the requirement of map information systems with advancing new generation technologies has been increased. There are several applications devoted to satisfying these demands. Google Maps APIs, which have been developed and given to the service of other applications free of charge by Google, have the qualifications for satisfying a lot of needs. Deeply analyzing Google's updated maps and the sections of ready-made applications provide new studies to be carried out further. In this study, a structure, in which Google Maps APIs integrated with map information systems, has been established. With the aid of this structure, the application of Google Maps into a map information system has been put into practice. With this study, a web based map information system, which provides the demonstration of important locations in a university campus interactively, has been created. In order to operate this system effectively, an administrator interface has been developed. The application of Google Maps API has also been adapted into this administrator interface.

**Keywords:** Geographic Information Systems, Google Maps API, Web Based Management, Geographic Services

## 1 Giriş

Son dönemlerde sıkça karşılaştığımız Coğrafi Bilgi Sistemleri alanında insanların yön bulma ihtiyaçlarından dolayı tarihin her evresinde farklı teknikler ile ve farklı formlarda karşımıza çıkmaktadır. İnsanlar ilk haritayı çizdiği günden bugüne her defasında daha yeni tekniklerle yön bulma ve nesne konumlarının işaretlenmesini sağlama konusunda ilerleme kaydetmişlerdir. Yüz yılarca harita ve pusula ikilisi ile gerçekleştirilen konum ve yön tespiti, GPS (Global Positioning System; Küresel Konumlama Sistemi) kullanımının başlaması ile çok daha farklı bir hal almıştır. GPS uydular ile yön tayini tekniği, haritaların üzerinde çok daha verimli işler yapılmasına yol açmıştır.

İnternet kullanımının yaygınlaşması haritalara bağlı yapılan araştırma ve geliştirme çalışmalarına başka bir yön vermiştir. İnternetin yaygın kullanımı bu konuda yapılan çalışmaların daha hızlı yayılması ve daha fazla kullanıcıya erişmesini sağlamıştır (Bildirici, Böge, & Alpsal, 02-06 Kasım 2009). Kullanıcıların değişen ihtiyaçları yeni araştırma ve geliştirmeleri tetiklemiş ve yeni ürünler ortaya koyulması sağlanmıştır. Özellikle cep telefonları ile internet üzerinde haritaların kullanıldığı uygulamalar ortaya koyulmuştur (Google Maps API Örnekler, 2012). İnsanlar geliştirilen yeni çözümler ile artık yön bulma konusunda farklı seçeneklere sahiptir.

Ar-Ge yapan önemli içerik sağlayıcılar, son kullanıcılarında rahatlıkla uygulamalarına entegre edebilecekleri uygulama ara yüzü kodlarının, açık kaynak olarak internet ortamında yayılmasını sağlamışlardır (Microsoft BING

Maps, 2012) (Yandex MAPs API, 2012) (Google Maps API, 2012) (Yahoo Maps, 2012). Bu daha hızlı bir ürün geliştirme ortamı sağlamıştır. Özellikle Google gibi dünyanın en önemli içerik sağlayıcı ve veri kümesi yöneticilerinin bu alana duyduğu ilgi, burada üretilen hizmetlerin açık kaynak olarak geliştirilmesi ve tüm web tabanlı araştırma ve geliştirme yapan uygulama geliştiricilerin kullanımına sunması sonucunu doğurmuştur (Google Maps API, 2012). Google başta olmak üzere dünyanın bilişim devleri bu alanda ürünler ve hazır scriptler üretmeye ve yaygınlığının artırılmasını sağlamaya çalışmıştır. Bilindiği üzere Google, Microsoft, Yahoo, Yandex olmak üzere birçok içerik sağlayıcı coğrafik harita bilgi sistemlerine yönelik hizmetler ve ürünler üretmişlerdir (Microsoft BING Maps Örnekleri, 2012) (Google Maps API, 2012) (Yahoo Maps, 2012) (Yandex Maps API-Örnek Uygulamaları, 2012).

Geliştirilen hizmetlerin kullanımının artırılmasını sağlamak için içerik sağlayıcılar her platformda hizmet veren hazır scriptler üretmiş ve açık kaynak olarak kullanıma sunmuştur. Üretilen bu açık kaynak scriptlerden çeşitli alanlarda kullanılan üçüncü parti yazılımlar çıkarılmıştır. Bu yazılımlardan biri ise bu bildirinin konusunu teşkil etmektedir. Bildiride; Google Maps API (Application Programming Interface)'si kullanılarak internet tabanlı bir Harita Bilgi Sistemi geliştirilmiştir. Ayrıca kullanılan uygulama parçaları incelenmiştir. Geliştirilen ayrıca uygulamanın Genel ziyaretçi ve Yetkili ara yüzleri hakkında bilgi verilmiştir. Bu çalışmada Coğrafi Bilgi Sistemlerinden ziyade, bu sistemlerden elde edilen haritaların web tabanlı bir uygulama ile kullanılması amaçlanmıştır. Geliştirilen uygulama vasıtasıyla gerçek zamanlı harita üzerinde noktalar oluşturulmaktadır. Bu noktalarla ilgili detaylı bilgi içeren sayfaları hazırlanabilmesini sağlayan yönetim ara yüzleri geliştirilmiştir.

## 2 Açık Kaynak Harita API'leri

İnternet tabanlı harita bilgi sistemleri hakkında birçok açık kaynak yazılım bulunmaktadır. Bunların arasında en yaygın kullanım Google Maps API 'e aittir. Birçok doküman ve örnek kod parçasına sahip olan Google Maps API en geniş örnek uygulama arşivine de sahiptir (Google Maps API Örnekler, 2012). Harita uygulamalarında kullanılmak üzere hizmet veren diğer üreticileri ise; BING, YAHOO ve YANDEX'dir. Yine bu üreticilerde açık kaynak olarak harita veri kümesini web geliştiricilere sunmuşlardır. Temel olarak tüm içerik sağlayıcılar aynı işi yapsalar da, sunulan örnek kod, içerik ve yaygınlık açısından Google bir adım öndedir.

### 2.1 GOOGLE Maps API

Uygulama, Google Maps API açık kaynak yazılımı kullanılarak gerçekleştirilmiştir. Diğer içerik geliştiricilerde de var olan ortak bir yapı kullanılmıştır. Google Maps API ile harita üzerinde noktalar konumlandırılmıştır. Bu noktaların, yine Google Maps API uygulaması vasıtasıyla bir balon içerisinde detayları gösterilmiştir. Gerçekleştirilen yazılım Google Maps API'nin bir uygulama formatıdır. Birçok ek özelliği olan Google Maps API internet üzerinde açık lisans yolu ile temin edilebilir (Google Maps API, 2012).

Google Maps API kullanılarak gerçekleştirilmiş uygulama sayısı çoktur (Akbulut & Çare, 2011) (Dinçer, 2008). Konu hakkında Google'ın sunmuş olduğu birçok örnek kod bulunmaktadır (Google Maps API Örnekler, 2012). Örnekler arasında;

- Haritalar üzerinde noktalar oluşturma,
- Bu noktaları hareket ettirme,
- Noktalara tıkladığında bir olay yakalayabilme,
- Olayları yeni pencerelere veya sayfa içerisindeki balonlara atayabilme,
- Harita üzerinde Ployline'lar veya hatlar çizebilme,

gibi birçok açıklayıcı örnekler bulunmaktadır. Bu örneklerini kaynak alan birçok uygulama geliştirilmiş ve halka açık kullanıma sunulmuştur.

### 2.2 BING Maps

Microsoft'un varsayılan arama motoru olan BING hizmet kapasitesini artırabilmek için harita uygulamaları alanında da açık kaynak kod ve içerik üretmiştir. Genel amaç itibari ile Google Maps ile benzer özellikleri bulunan BING Maps hızlı ve kolay kurulumu sahiptir. BING Maps Developer sayfasından erişimi sağlanan bu hizmet ile ilgili Google Maps'te de olduğu gibi erişim talebi yapılmalıdır (Microsoft BING Maps, 2012). Bu talep ardından uygulama geliştirme kitlerine (SDK) ulaşılabilir (Microsoft BING Maps Örnekleri, 2012).

### 2.3 YAHOO Maps

Harita veri tabanına sahip olan diğer içerik sağlayıcısı, Yahoo'dur (Yahoo Maps, 2012). Yeni nesil teknolojiler ile entegrasyonu, kullanılabilirliğini artırmaktadır. Sunulan örneklerdeki Ajax teknolojisi daha hızlı bir harita erişimi sağlamaktadır. Ayrıca haritalara Flickr Photos entegrasyonu harita bilgi sistemleri ile sosyal ağların etkileşimi artırmaktadır (Flickr Photos API, 2012). Yahoo Maps'in geliştiricilere yardımcı olmak amacıyla hazırlanmış olduğu

uygulama geliştirme kiti (SDK- Software Development Kit) gerekli olan tüm örnekleri içermektedir (Yahoo Maps API-Solutions Center, 2012).

## 2.4 YANDEX Maps

Son zamanlarda Google Inc.'e paralel bir gelişim seyrinde olan Yandex, harita bilgi sistemleri ve coğrafik içerik sağlayıcılık konusunda da ürün ve hizmet üretmektedir (Yandex Maps API, 2012). Üretilen hizmetlerin geliştiriciler tarafından kullanılabilirliğini artırmak için ise internet ortamında kolayca erişilebilecek kaynak kodlar ve örnek uygulamalar oluşturulmuştur (Yandex Maps API-Örnek Uygulamaları, 2012).

## 3 Web Tabanlı Harita Bilgi Sistemi Uygulaması

Üniversitelerde ve geniş alana yayılmış hizmeti olan büyük kurumlarda harita üzerinde bilgilendirme yapma ihtiyacı bulunmaktadır. Bu ihtiyaç gelişmiş harita bilgilendirme alt yapısına sahip olan Google gibi içerik sağlayıcılardan edinilebilmektedir. Yapılan bu çalışma, büyük içerik sağlayıcıların sunmuş olduğu haritaların uygulamalara entegrasyonu ile ilgilidir. Geliştirilen bu yazılım ile büyük bir alana yayılan hizmetleri bulunan bir kurumun harita üzerinden bilgilendirmeler yapabilmesi sağlanmıştır. Yazılım iki aşamada üretilmiştir. Bu aşamalardan biri, ziyaretçi ara yüzleridir. Bu ara yüzler herkesin kesin ve kolay bir şekilde haritalar üzerinden bilgi edinebilmesini sağlayan bir yapıda tasarlanmıştır. İkinci aşama ise yönetici ara yüzleridir. Yönetici ara yüzleri bilgisayar okuryazarı düzeyinde bilgi sahip olan herhangi bir kullanıcı tarafından yönetilebilir halde tasarlanmıştır.

Geliştirilen yazılım vasıtasıyla haritalar üzerinde özel noktalar oluşturulabilmektedir. Bu noktalar hakkında detaylı bilgi yazılacak olan sayfalar hazırlanabilecektir. Her nokta harita üzerinde bir bilgi içerecektir. Bu noktalar kendi aralarında kategorilendirilebilecektir. Her bir kategori altında istenildiği kadar alt kategori ve nokta oluşturulabilecektir. Harita üzerinde yöneticinin istediği kadar nokta oluşturulabilecektir. Yönetici kullanıcısı tüm bu nokta ve kategorilerin oluşturulması konusunda tam yetkiye sahiptir. Yönetici kategori oluşturmakta ve bu kategorilere alt kategori ve nokta eklemektedir.

Noktalar ve Kategoriler bir veri tabanı içerisinde saklanmaktadır. Bu veri tabanı içerisinde noktaların konumları saklanmaktadır. Veri tabanından çekilen verilerin harita üzerinde oluşturulması bu konular ile gerçekleştirilmektedir.

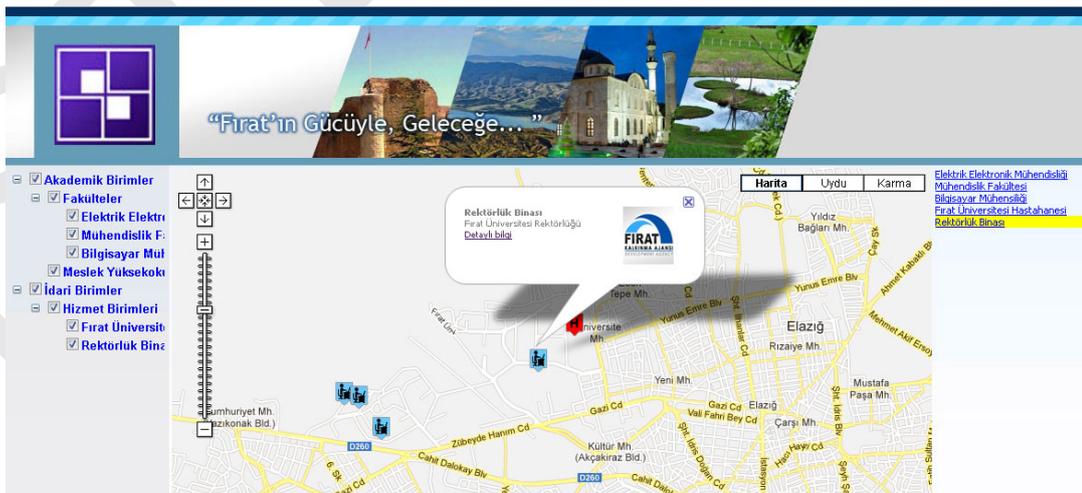
Sistem yapısal olarak iki kısma ayrılmaktadır;

1. Genel Ziyaretçi Ara Yüzleri
2. Yetkili Yönetici Ara Yüzleri

Bu ara yüzlerde Google Maps verileri kullanılarak harita üzerinde bulunan kurumsal hizmet noktaları hakkında bilgi bulunmaktadır.

### 3.1 Genel Ziyaretçi Ara Yüzleri

Geliştirilen harita bilgi sistemi Google Maps harita içerikleri üzerinde konum gösterimi yapmaktadır. Bu gösterimin gerçekleştirilebilmesi için bir genel ziyaretçi ara yüzü bulunmaktadır. Bu ara yüz Şekil 1'de gösterilmiştir.

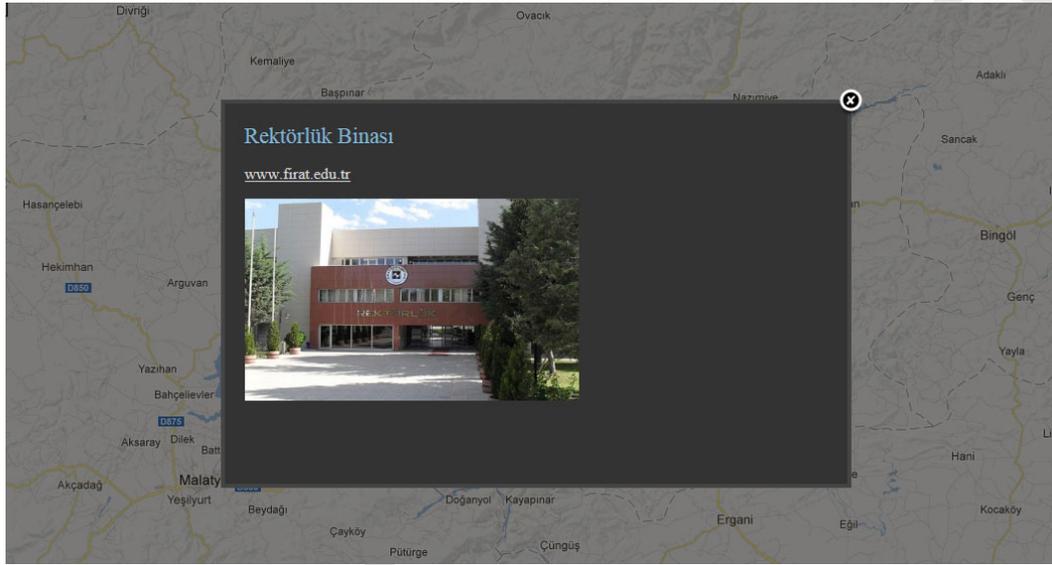


Şekil 1 Harita Bilgi Sistemi genel ziyaretçi ara yüzü

Bu ara yüzde;

- Yetkili kullanıcı tarafından oluşturulan Kategorilerin Listesi
- Seçili olan kategori ve bu kategori içerisindeki elemanların olduğu bir Nokta Listesi
- Google Maps API 'nin uygulamaya entegre edildiği harita bölümü

Kategori listesi içerisinde herhangi bir kaçını seçilerek altında bulunan tüm kategori ve noktaların Google Maps haritası üzerinde gösterilebilmesi sağlanmaktadır. Kategori menüsü sayfa ilk açıldığında veri tabanına bağlı olarak oluşturulmaktadır. Sonraki her sayfa talebi bu hazır kategori menüsü ile yapılmaktadır. Kategoriler arasında seçilen herhangi bir tanesi eğer alt kategoriye sahip ise, altındaki tüm kategorilerde seçili hale gelmektedir. Seçili hale gelen tüm kategorilerin kapsadığı noktalar sağ taraftaki Nokta Listesi kısmında listelenmektedir. Bu listeden herhangi bir tanesine tıkladığında harita üzerinde bir baloncuk ile ayrıntılı bilgiye ulaşılabilecek olan link gösterilmektedir. Şekil 2'de detay penceresi görülmektedir.



Şekil 2 Genel ziyaretçi ara yüzü detay penceresi

Açıklama balonlarında bulunan Detaylı Bilgi bağlantısına tıkladığında ortaya çıkan Javascript pencere, yönetici ara yüzünden yönetilmektedir. Gösterilecek tüm içerik yönetim ara yüzünde hızlı bir şekilde düzenlenebilmektedir.

## 3.2 Yetkili Yönetici Ara Yüzleri

Kategori ve Noktaların tamamı yetkili yönetici ara yüzleri üzerinden yönetilebilmektedir. Tüm yönetim ara yüzüne sahip olan sistemlerde olduğu gibi geliştirilen uygulamada da erişim kullanıcı sorgulamalarının ardından gerçekleşmektedir. Yetkili girişi yapıldıktan sonra aşağıdaki menüye ulaşılmaktadır.

1. Koordinatlar ve Menü
2. İkonlar
3. Kullanıcılar
4. Şifre Tanımlama

### 3.2.1 Koordinatlar ve Menü

Harita üzerinde oluşturulacak olan konum bilgileri bu yönetim başlığı altında tanımlanmaktadır. Buradaki verilerin yönetilmesi için bir framework kullanılmaktadır (Ulaş & Boyacı, 2012) (Akbal & Ulaş, 2012). Bu framework vasıtasıyla tüm kategori ve nokta yönetimi yapılmaktadır. Şekil 3' de bu yönetim framework'u görülmektedir.

YÖNETİM

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**SİSTEM**

- Koordinatlar ve menü
- İkonlar
- Kullanıcılar
- Şifre Tanımla

**Sistem Yönetim**

- Kullanıcılar
- Canlı Tablo
- Menü Seviyeleri
- Menü Yönetimi
- Tablolar

## Koordinatlar ve menü

Ekle | Listele | Ara | Tümünü Excele | Bu Sayfayı Excele

ID =

Tablodaki Verileri Listele

| İşlemler | id  | acıklama | ad                             | AktifPasif | Detaylar                       | koordinatx         | koordinaty         | RESIM_ico | sıra | ust          |
|----------|-----|----------|--------------------------------|------------|--------------------------------|--------------------|--------------------|-----------|------|--------------|
|          | 156 |          | Rektörlük Binası               | Doğru      |                                | 38.67797203752081  | 39.201321601867676 | 4.gif     | 2    | Hizme Birimk |
|          | 155 |          | Fırat Üniversitesi Hastahanesi | Doğru      | <a href="http://ftm.firat.e... | 38.6805517030225   | 39.20466899871826  | 11.gif    | 1    | Hizme Birimk |
|          | 154 |          | Bilgisayar Mühensiliği         | Doğru      |                                | 38.672963200675696 | 39.18673038482666  | 4.gif     | 2    | Fakül        |

Şekil 3 Veri yönetim Framework'u

Veri Ekle

ID

ACIKLAMA

AD

AKTIFPASIF

DETAYLAR

KOORDINATX

KOORDINATY

RESIM\_ICO

SIRA

USTID

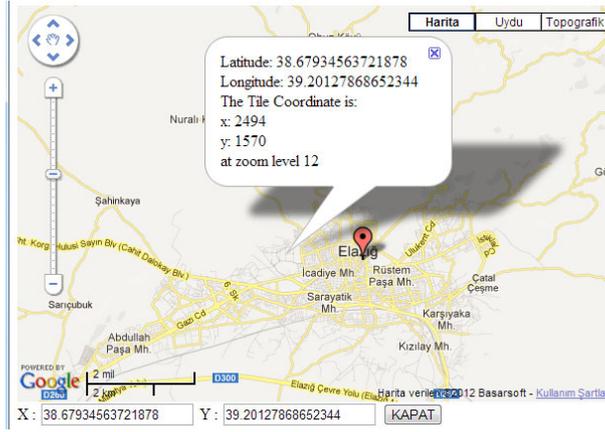
Şekil 4 Yeni kayıt ekleme ara yüzü

Bu framework ile veriler listelenir, aranır, değiştirilir, silinir ve yeni kayıt eklenir. Şekil 4'te yeni kayıt ekleme ara yüzü görülmektedir. Her bir kategori ve nokta için;

- Ad
- Koordinatlar (x,y)
- Sıra
- Balon Açıklaması
- Detay penceresi Açıklaması
- Aktif Pasif Durum bilgisi
- Haritadaki simgesi
- Bağlı olduğu üst Kategori

Yukarıdaki bilgiler girilmektedir. Bu bilgiler genel ziyaretçi ara yüzünde harita üzerinde gösterilebilir olarak hazırlanmaktadır. Ziyaretçinin talebi halinde haritada simgesi ile birlikte gösterilmektedir. Şekil 1'de örneği verilmiştir.

Koordinatlar farklı bir Google Maps API ile harita üzerinden işaretlenerek verilmektedir. Şekil 5'te bu farklı API gösterilmiştir. Bu API ile harita üzerinde herhangi bir yer tıklanarak bu noktanın koordinat bilgilerinin ekleme ara yüzüne gönderilmesi sağlanmaktadır.



Şekil 5 Koordinat seçimi için kullanılan Google Maps API'si

Seçim ekranında bulunan ikonlardan herhangi bir tanesi nokta için seçilebilmektedir. Burada bulunmayan ikonlardan bir tanesi noktaya atanmak istendiği takdirde sisteme yüklenebilmektedir. Yükleme işlemi yönetim menüsü altındaki İkonlar bağlantısından yapılmaktadır. Bu bağlantıya tıklandığında Şekil 6'daki yükleme ve yönetim ara yüzü görülmektedir.



Şekil 6 İkon yönetim ara yüzü

Yeni ikonlar bu ara yüz vasıtasıyla eklenebilir. Eklenen ikonlar silinip değiştirilebilmektedir. Yeni eklenen ikonlar daha sonra Koordinat ve Menü başlığında kullanılabilir.

Sistemin diğer yönetimsel işlemleri de bu ara yüzlerde gerçekleştirilebilmektedir. Kullanıcı yönetimi, şifre değişiklikleri için geliştirilmiş modüller bulunmaktadır.

#### 4 Sonuç ve Tartışma

Yapılan çalışma, hizmet kapsama alanı geniş olan büyük kurum veya işletmelerin, hizmet ulaştırdığı kitleye daha anlaşılır bir konum bilgilendirmesi yapabilmesi için önemli bir uygulama örneğidir. Google Maps API ve benzeri diğer içerik sağlayıcıların sunmuş oldukları bu uygulama geliştirici destek kitleleri açık kaynak olarak yayılmakta ve birçok uygulamanın temel taşı teşkil etmektedir. Bu bildiride yapılan uygulamanın temeli, bir kampus içerisindeki bina ve hizmet dağılımının internet ortamında rahat bir şekilde gösterilebilmesi ve anlaşılır bir harita oluşturulmasıdır. Bu uygulama ile üniversite ziyaretçileri internet ortamında tüm kampus binaları ve hizmet alanları hakkında bilgi edinebilmektedir. Uygulamanın temelini teşkil eden harita bilgileri Google Maps API 'nden faydalanılarak geliştirilmiştir. Geliştirilen yazılım, ileride yapılacak olan e-Belediye, E-devlet gibi uygulama projelerine kaynak teşkil edecek bir çalışmadır.

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# ***WHY IS CZECH UNREGULATED MARKET FOR COMPANY'S FINANCING TEDIOUS?<sup>1</sup>***

Ondřej Kopecký

*University of Economics in Prague*

*Faculty of Business Administration*

*Department of Business Economics*

*xkopo03@vse.cz*

## **ABSTRACT**

The purpose of this paper is a demonstration of successful unregulated capital markets across Europe and their comparison to the unregulated market (market called Start) in the Czech Republic. The paper specifically focuses on the Alternative investment market in the United Kingdom, which has executed plenty of initial public offerings since its origin. In the last chapter the author analyses market Start as one of the newest tools for company financing in the Czech Republic and tries to think about the reasons of disinterest of Czech companies in this kind of financing.

**JEL classification:** G180, G390

## **INTRODUCTION**

Small and medium enterprises are currently having troubles with obtaining capital from banks. This situation is caused by economical and financial crisis, because banks have recently made the conditions for bank loans stricter due to worries about unpaid loans. Emerging companies need a lot of working capital, especially during their start up, to be able to keep their expansion, but from the bank point of view these loans are risky because of the short history of these companies. So here we have contradictory interests – on the one side banks which request trustworthy debtors with the lowest risk possible, on the other hand young companies desiring additional resources. The solution for this problem can be IPO realized on the capital market. Particularly for small and medium enterprises arose so called unregulated markets in Europe, where the conditions for IPO are milder compared to the main markets. Whereas unregulated markets have existed in Poland, the United Kingdom, Italy and Ireland for several years, unregulated market in the Czech Republic was established in June 2012 and there has been no IPO so far<sup>2</sup>.

Going public means costs and benefits for small and medium enterprises (SME). The costs can be direct and indirect, where direct cost may include initial listing fees, admission fees, costs for advisors, auditors or compliance costs whilst indirect costs may include underpricing<sup>3</sup> or trading costs (Kaserer, 2007). On the contrary, the process of IPO brings positive aspects for the issuer, such as a positive effect on sales (Kuchinskas, 1999), more capital for firm's expansions, convenient exit mechanism for current shareholders or improvement of company's public relations (Mendoza, 2008).

The goal of this paper is to describe the basic principles of unregulated markets in Europe and to compare them with the new Czech unregulated market called Start. Moreover, the paper strives to analyze the disinterest of Czech companies in financing on the capital market.

## **UNREGULATED MARKETS IN EUROPE**

Since the Alternative investment market (AIM) started in 1996 in the United Kingdom, a lot of similar markets have risen in Europe (e.g. Mercato Expandi, Italy, 2003; AIM, Italy, 2009; Enterprise Security Market, Irish, 2005; NYSE Alternext 2005; NewConnect, Poland, 2007, Start, Czech Republic, 2012 etc.). All these markets have the same purpose, they are determined for realization of initial public offering (IPO) of SME. The markets mentioned above have many similar characteristics. Firstly, the conditions for realizing IPO are milder<sup>4</sup> than on main markets, secondly, they are using professional advisors<sup>5</sup> who help issuers with the whole process of IPO and information duties after emission as well. Last but not least, they are regulated by stock exchanges only instead of being regulated by domestic regulator of financial market.

<sup>1</sup> This paper is created as one of output from research project *The resources for company's financing on domestic capital market and other capital markets abroad.*

<sup>2</sup> September 2012

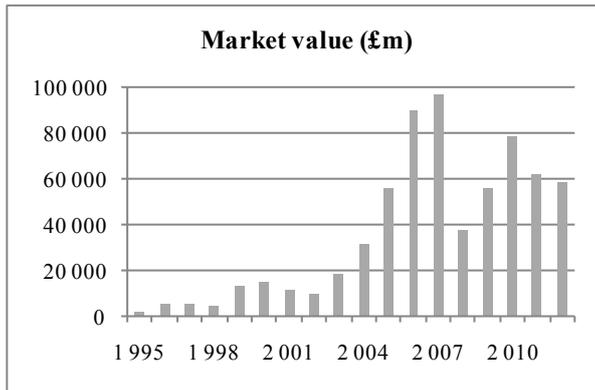
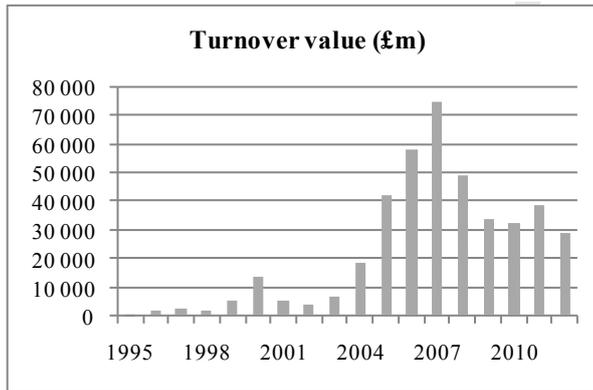
<sup>3</sup> Percentage difference between the price at which the IPO shares were sold to investors during the offering period (offering price) and the market price during the first trading day(s) in the secondary market (Engelsen, 2008)

<sup>4</sup> See <http://www.ise.ie/Equity-Issuers/MSM%20Vs%20ESM%20Rules/>

<sup>5</sup> See <http://www.londonstockexchange.com/companies-and-advisors/aim/advisors/advisers.htm>

AIM is going to be described in great detail due to the long and successful history of this market. AIM is owned and operated by the London Stock Exchange (LSE) and since its origin more than 3000 IPOs there have been realized. AIM is suitable for IPO of domestic as well as foreign companies. There are 226 international companies out of 1110 total companies listed on AIM<sup>6</sup>. This market is unregulated and it belongs to a multilateral trading system (see Article 4 Directive 2004/39/EC of 21 April 2004). Milder requirements<sup>7</sup> for executing IPO are disposed in AIM and that is why it is determined for SME. On the contrary, the issuer has to prepare<sup>8</sup> an admission document, appoint a Nomad<sup>9</sup>, nominate a broker and has no restriction on the free transferability of shares. AIM has 45 rules and 7 schedules which are contained in AIM Rules for companies.

Chart 1 and chart 2 depict the development of AIM in time measured in market value and in turnover value. From 2001 till 2007 there was a significant upsurge in both indicators. But this was followed by rapid slump between years 2007 and 2008. However we can notice moderate increase and stagnation till 2012.

**Chart 1 – AIM market value**

**Chart 2 – AIM turnover value**


Source: <http://www.londonstockexchange.com/statistics/markets/aim/aim.htm>

The success of AIM was influenced by many factors (Mendosa, 2008). Firstly, was London's increasing popularity as a financial market. This was caused by the efficient regulation embodied in the Financial Services Authority, increasing regulatory costs in the United States of America and successful marketing activities of AIM. Therefore London became the leading centre for finance instead of New York. Secondly, AIM brought cheap access for SME with high potential of growth to a private equity. Thirdly, due to initiation of SOX the regulatory costs for financing of companies through capital market move upwards, hence SME were looking for new sources of their financing. Even though there were markets' focusing on financing SME through capital market before, AIM was the first market which offered SME lower regulation, strategic geographic location, and together with efficient marketing this leads to AIM becoming a crucial market for financing SME.

A lot of unregulated markets formed all over Europe. Some of them are not offering their services at present (such as Neuer Markt, Germany, Euro NM Brussels, Belgium, Nuovo Mercato, Italy), but on the other side many unregulated markets in Europe are well established and IPO's of SME are being realised on these markets (such as NewConnect, Poland, Entrepriase Security Market, Ireland, Alternative Investment Market, Italy, Alternative Investment Market, United Kingdom). The development of these markets is depicted in table. 1.

**Table 1 – No. of companies traded on unregulated markets in Europe**

| Market                            | 2009 | 2010 | 2011 | 2012 |
|-----------------------------------|------|------|------|------|
| AIM (ITA)                         | 5    | 11   | 14   | 17   |
| AIM (UK)                          | 1293 | 1195 | 1143 | 1110 |
| NewConnect (POL)                  | 107  | 185  | 351  | 406  |
| Entrepriase Security Market (IRL) | 25   | 23   | 25   | 23   |

(Source: [http://www.borsaitaliana.it/borsaitaliana/statistiche/statistichestoriche/principaliindicatori/2012/principaliindicatori2012.en\\_pdf.htm](http://www.borsaitaliana.it/borsaitaliana/statistiche/statistichestoriche/principaliindicatori/2012/principaliindicatori2012.en_pdf.htm), <http://www.londonstockexchange.com/statistics/markets/aim/aim.htm>,

[http://newconnect.pl/index.php?page=market\\_statistics\\_annual](http://newconnect.pl/index.php?page=market_statistics_annual), <http://www.ise.ie/Statistics-InformationProducts/Publications-Statistics/Annual/AnnualReport2011.pdf>)

<sup>6</sup>Summary AIM: Since launch (<http://www.londonstockexchange.com/statistics/markets/aim/aim.htm>)

<sup>7</sup> Such as no trading record requirement, no minimum shares required in public hands, no minimum market capitalization, no restrictions on the transferability of the company's shares, no requirement to be incorporated in the UK, no requirement to re-state any historic accounts (Investor's Guide to the United Kingdom, 2006).

<sup>8</sup> Investor's Guide to the United Kingdom, 2006

<sup>9</sup> Nominated Advisor is a guide for the company that wants to enter AIM.

Obviously, AIM (UK) is the market with the highest no. of traded IPO's, but there is a significant downturn during the period 2009 and 2012. Contrarily, NewConnect in Poland increases year to year since its origin in 2007. In 2012 there are traded about 406 companies (compare to AIM with 1110 of traded companies).

According to a survey (Board, 2006) of 150 companies listed on AIM market, these companies found that being listed on this market:

|  |     |
|--|-----|
| a) added to the company's credibility              | 85% |
| b) provided long-term growth potential             | 82% |
| c) provided access to institutions                 | 81% |
| d) gave the company a profile in the City (London) | 79% |
| e) gave access to informed shareholders            | 71% |
| f) made it easier to make acquisitions             | 57% |

On the other side, the listed companies mentioned several barriers resulting from IPO process (Board, 2006):

|   |     |
|---|-----|
| a) the floatation process is too time consuming | 20% |
| b) the Entry criteria                           | 14% |
| c) floatation is too expensive                  | 14% |
| d) lack of liquidity in the market              | 9%  |
| e) vetting by the stock exchange                | 4%  |
| f) language difficulties                        | 1%  |

Obviously, listed companies can profit from increasing company's credibility, growth potential and better reputation but they are aware that the IPO process could be protracted, they need to comply with several standards and the whole process is quite costly.

## UNREGULATED MARKET IN THE CZECH REPUBLIC

The financing through capital market in the Czech Republic has changed in the year 2012. Before this year the companies could realise IPO only on main market and free market, which are both regulated by the Czech national bank (as a supervisor of whole financial market in the Czech Republic). But in June 2012 arose so called market Start which is regulated by the domestic stock exchange only. The conditions for IPO's which are being carried out on the market Start are more modest in comparison to the main market and the free market (such as there is not required the history of issuer, the requirement for market capitalization, the requirement for free float, the issuer can run its accountancy in IFRS as well as Czech accounting standards, the issuer does not need to make prospect but only simplified document instead etc.)<sup>10</sup>. As issuer on AIM must have their NOMAD's, the issuer on market Start must also have so called advisors. The stock exchange has currently<sup>11</sup> registered two advisors.

Even though the requirements for realizing IPO's have simplified, the market Start still has been waiting for its first IPO since its origin. Within one month the company Wooky announced its purpose of going public on Start, but this intention was canceled<sup>12</sup> soon after because the company found another strategic investor for its future development. Nevertheless, the company KIT Digital decided<sup>13</sup> to delist its stock from the main market and move its emission into the market Start, this process was executed in October. Despite the listing of KID Digital on market Start, there is no other announced IPO which should be performed in near future.

Manifestly the Czech companies are not engaged in financing their needs on the capital market. This situation is caused by several<sup>14</sup> facts. Firstly, it is caused due to type of privatization in the Czech Republic. In contrast with Poland, where the privatization of public sector was launched continuously during several years, the privatization in the Czech Republic was realized faster. The whole process of privatization was at one-time and that is why Czech companies did not accustomed to process IPO as one of the tools for company's financing (see chart 3). This means that a lot of Czech companies already did IPO in 90's and they are not interested in IPO process anymore. Secondly, the liquidity on the Czech stock exchange is quite low owing to the current global financial crisis. Many investors are reducing their investment on the capital market because of unprofitable deals with shares or bonds during crisis. This low liquidity results in lack of interest of potential issuers (see chart 3).

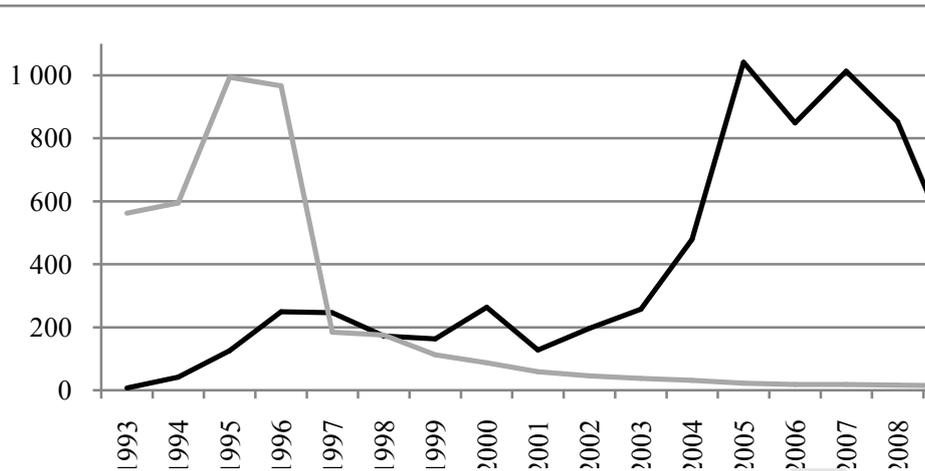
<sup>10</sup> For more information see Rules for market Start (accessible from <http://www.bcpc.cz/dokument.aspx?k=Start>).

<sup>11</sup> See <http://www.bcpc.cz/Clenove-Burzy/>

<sup>12</sup> See <http://www.ipoint.cz/zpravy/89174511-kandidat-na-ipo-v-segmentu-start-spolecnost-wooky-prerusuje-upis/>

<sup>13</sup> See <http://www.ceskatelevize.cz/ct24/ekonomika/197151-kit-digital-opousti-hlavni-trh-prazske-burzy/>

<sup>14</sup> See <http://zpravy.ihned.cz/on-line-rozhovory/c1-57955320-michal-valentik-prazska-burza-nebude-tak-mrtva-jako-bratislavskapomuze-ji-xetra>

**Chart 3 – Prague Stock Exchange` (trade value, no. of issues)**


Source: <http://www.bcpcz.cz/dokument.aspx?k=Statisticke-Soubory> (Klíčová roční data z obchodování 1993 – 2011)

Last but not least, there are also competitors abroad who could bring to issuers more credibility in case of successful IPO process (such as company AVG Technologies N.V. listed on NYSE, Photon Energy a.s. listed on NewConnect etc.).

## CONCLUSION

Evidently all over Europe many companies use IPO's as one effective tool for their financing and since many unregulated markets established across Europe, they are widely use for IPO's of SME. The market Start exists in the Czech Republic for about five months. It offers to the Czech companies fast and easy way for their funding from capital market in comparison to the main market.

From the one point of view it is quite early to judge whether the market Start will be successful after five months of its existence because it is time consuming for companies to decide about going public and this time period is insufficient. Despite the short period of existence of market Start there was no IPO realized so far (except listing of KIT Digital). Moreover according to the available informational resources there should not be any IPO in the near future. Evidently, Czech companies are not very interested in this type of financing.

Even though there are few preconditions why Czech companies do not use IPO's as one tool for their financing, the author has decided to accomplish marketing research in which he will focus on chief financial officers in the Czech Republic to find out the reasons for disinterest in this kind of financing.

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# YAPAY ANAKAYA MODELİ KULLANILARAK HIZLI TRENLERİN YAPILARDA OLUŞTURDUĞU TİTREŞİM ETKİLERİNİN AZALTILMASI

Fatih Göktepe ve Erkan Çelebi  
Sakarya Üniversitesi  
Mühendislik Fakültesi  
İnşaat Mühendisliği Bölümü  
fgoktepe@sakarya.edu.tr , ecelebi@sakarya.edu.tr

**Özet:** Hızlı trenlerin sebep olduğu titreşimler sonucu zeminlerde ve zemin üzerindeki yapılarda kuvvetli yer hareketleri oluşabilir. Bu titreşimler, mevcut yapılara hasar verebileceği gibi, yaşanabilir ortam koşullarını da bozabilir. Mühendislik uygulamalarında yapıları ve temelleri insan yapısı titreşim kaynaklarının etkilerinden korumak için dalga engelleyici yapay kaya etkili bir çözüm yöntemi olarak sunulabilir. Titreşim kaynağının hemen altına ya da korunacak yapının altına dalga bariyeri olarak bir yapay kaya modeli geliştirilebilir. Bu çalışmanın öncelikli hedefi hızlı tren trafiğinin ürettiği zemin titreşimlerini, yapı-zemin etkileşiminin de hesaba katıldığı bir dalga yayılım problemi olarak değerlendirip, ayrık sayısal çözüm yöntemlerinden yararlanarak sistemin matematik modelini geliştirerek incelemek ve dalga engelleyici yapay kayanın yerleştirilmesi ile çevre yapılarıdaki etkilerinin azaltılmasına ilişkin çözümler sunmaktır. Bu amaçla, geliştirilen sayısal model yardımıyla aktif yalıtım durumu için dalga bariyerinin konumlandırıldığı farklı derinliklerin etkisi kapsamlı parametrik çalışmalar yapılarak elde edilmiştir. Analizler sonucu, dalga engelleyici yapay kayanın optimum bariyer boyutlarında, demiryolu üstyapısının yakınında zeminin serbest yüzeyindeki titreşimlerde ciddi bir azaltma sağladığı görülmüştür.

**Anahtar kelimeler:** Yapay anakaya, sonlu elemanlar, enerji yutucu sınırlar, aktif yalıtım, Mohr-Coulomb davranış modeli

**Abstract:** Strong ground motions may occur in soil and structure constructed on it under train induced vibrations. These vibrations can cause damage on the structures and people life quality and comfort. An artificial bedrock as wave impeding barrier (wib) can be used in practical engineering applications as isolation measures to protect foundations and structures from human made vibration sources. The wib can be installed below the load path (active isolation) or below the protected structures (passive isolation). In this paper, the goal is to primarily dealt with the modeling of the railway traffic induced vibrations by using discrete computer models for analyzing related to wave propagation problems with soil-structure interaction effects and mitigation of building responses by installation of wib. For this purpose, parametric investigations by using the developed numerical model for active isolation systems have been executed to conceive the influence of different depth that located wib on the screening efficiency. The analysis confirms that using the optimum wib geometry, a significant reduction of surface vibrations on soil from the railway track can be performed.

**Key words:** Artificial bedrock, finite elements, absorbent boundaries, active isolation, Mohr-Coulomb constitutive model

## GİRİŞ

Hızlı trenler, ağır makine temelleri, yoğun ve hızlı trafik yükleri, masif inşaat aktiviteleri ve patlamalar gibi deprem yer hareketi dışındaki yüksek frekansta insan yapısı titreşim kaynaklarının oluşturduğu yüksek genlikteki titreşimlerden yakın çevredeki yapılar etkilenir. Bu titreşim kaynaklarının oluşturduğu dalgaların yumuşak zemin ortamında yayılışı ve yoğun yerleşim alanlarındaki yapılarla etkileşimi hassas aletlerde işlevsel bozukluklara, insanlarda rahatsızlık verici durumlara hatta yakın binalarda hasarlara neden olmaktadır. Bu nedenle çevreyi titreşim kaynaklarının ürettiği zararlı etkilerinden korumak için en uygun yalıtım aracının belirlenmesi elastik ve elasto-plastik ortamda dalga yayılışının iyi anlaşılmasını gerektirir. Zemin ortamındaki bu titreşim hareketlerinin üst yapılarıdaki dinamik etkilerinin araştırılması yapı, geoteknik ve ulaştırma mühendisliğinin ortak çalışma alanını oluşturmaktadır.

Hareket hızlarını, yolcu ve yük kapasitelerini sürekli arttırarak değiştiren yüksek-hız tren teknolojisi araştırmalarının önemli bir bölümü yalnızca yolcuların konforunu sağlamak için değil, aynı zamanda demiryolu ağının içinden geçtiği yoğun yerleşim bölgelerinde yaşayanlarında maruz kalabileceği gürültü kirliliğinden ve büyük genlikli titreşimlerden korunması ve bu kuvvetli yer hareketlerinin güzergâha yakın yapılardaki hasar verici etkilerinin azaltılması çalışmalarını da kapsamaktadır. Hızlı demiryolu taşımacılığına sahip birçok Avrupa ülkesinde olduğu gibi ülkemizde de yolcu taşımacılığındaki trafik akış hızları  $250 \text{ km/h}$  değerlerine ulaşacak şekilde planlanmış, yolcu ve yük taşımacılığındaki dingil yükleri  $18-22.5 \text{ ton}$  olarak tasarlanmıştır. Yüksek-hızlı demiryolu hatlarında tren geçişlerinin, demiryolu üstyapısında, altyapısında ve çevre yapılarda oluşturduğu kuvvetli yer titreşimlerinin incelenmesi, yapı

temellerinde hasar yapıcı ve insanlarda rahatsızlık verici etkilerinin azaltılması ve en uygun demiryolu üstyapı tasarımının gerçekleştirilmesi günümüzde inşaat mühendisliğinin önemli bir konusu olmuştur. Bu alanda kapsamlı ve yoğun araştırmaların gerekliliği özellikle ülkemizin taşıma gücü zayıf, alüvyon zemin ortamlarından geçirilmesi planlanan ve inşaatı devam eden yüksek hızlı modern demiryolu hatları (Ankara-İstanbul hızlı tren projesi) için güncelliğini korumaktadır.

Bu çalışmanın öncelikli hedefi hızlı tren trafiğinin ürettiği zemin titreşimlerini, yapı-zemin etkileşiminin de hesaba katıldığı bir dalga yayılım problemi olarak değerlendirip, ayrık sayısal çözüm yöntemlerinden yararlanarak sistemin matematik modelini geliştirerek incelemek ve dalga engelleyici yapay kaya yerleştirilmesi ile çevre yapılarıdaki etkilerinin azaltılmasına ilişkin çözümler sunmaktır.

## LİTERATÜR ÖZETİ

Literatürde dalga kaynaklarının oluşturduğu zararlı titreşimlerin yalıtımında kullanılan dalga bariyerleri ile ilgili birçok analitik, deneysel ve uygulanmış çalışma ortaya koyulmuştur. Yüksek-hız tren teknolojisi araştırmalarının önemli bir bölümü yalnızca yolcuların güvenliğini ve rahatını sağlamak için değil, aynı zamanda demiryolu çevresinde yaşayanlarında etkilenebileceği gürültü, konfor bozucu ve binalarda hasar yapıcı titreşimlerden korumak ve bu titreşimlerin azaltılması çalışmalarını da kapsamaktadır (Krylov, 1996, Petyt ve Jones, 1999, Massarsch, 2000, Hung ve Yang, 2001, Yoshioka, 2002, Fiala vd., 2007).

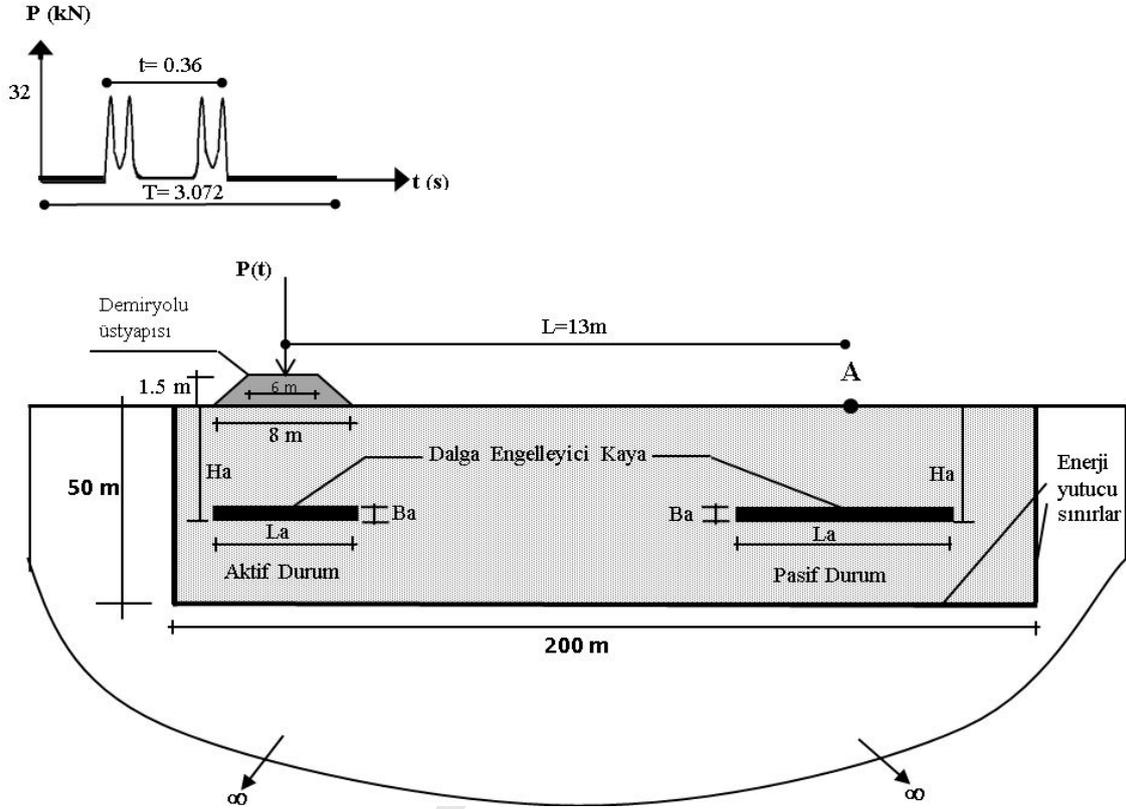
Yüksek frekansta tekrarlı dinamik yüklerden dolayı kuvvetli yüzey dalgalarının neden olduğu büyük genlikli titreşimlerin yakın çevresindeki etkilerini azaltabilmek için korunacak yapı ile titreşim kaynağı arasında malzeme yoğunlukları değişen farklı türlerde geliştirilmiş düşey dalga bariyer modelleri uygulanmaktadır (Ahmad vd., 1996, Andersen ve Nielsen, 2005, Çelebi vd., 2006). Yatay dalga bariyeri uygulamasıyla da zeminin öz frekansları ve buna bağlı titreşim modları yapay kayanın konumlandırılacağı derinlikle değiştirilerek titreşim etkilerinin azaltılabileceği gösterilmiştir (Chouw ve Schmid, 1991, Yang ve Hung, 1997, Adam vd., 2000, Çelebi ve Göktepe, 2012). Durağan veya hareketli titreşim kaynaklarının ürettiği zemin dalgalarının davranışını ve yayılışını düşey yalıtım araçlarının performansı ile birlikte daha iyi anlayabilmek için son dönemlerde az sayıda da olsa sahada deneysel çalışmalar ve laboratuvar test düzeneklerinde bir dizi araştırmalar gerçekleştirilmiştir (Ahmad ve Al-Hussaini, 1991, Shen ve Hung, 2008, Çelebi vd., 2009). Ayrıca zemine gömülü yatay bariyer modeli ile ilgili ilk arazi deneylerini Forchap ve Verbic (1994) pasif ve aktif yalıtım durumları için gerçekleştirmişlerdir. Ana kaya özelliğini taşıyan frekans kontrollü bir yapay taban kaya modeli önermişlerdir. Saha deneyleri dışında dalga yayılım problemleriyle ilgili daha gerçekçi hesap modelleri için ileri analitik çözüm yaklaşımları yirminci yüzyılın sonlarında ortaya çıkmıştır (Fuyuki ve Matsumoto, 1980, Kausel, 1994, Barber, 1996). Son yirmi yılda bilgisayar teknolojisinin hızlı gelişimiyle birlikte dalga yayılım mekaniğinin hareketli yüklere göre daha karmaşık problemlerini çözmek ve yalıtım sistemlerinin etkilerini daha iyi değerlendirebilmek için farklı sayısal çözüm yaklaşımları kullanılmıştır. Bu alanda yapılan önemli çalışmalarda, özellikle farklı zemin formasyonlarının ve gömülü yapı temellerinin modellenmesinde sonlu elemanlar yöntemi etkin olarak kullanılmıştır. Yarı sonsuz zeminin sonlu elemanlarla ayrıklaştırılmasında kesim noktaları için özel sınır koşulları kullanılarak geometrik sönüm hesaba katılmıştır (Haupt, 1978, Yang ve Hung, 2001). Tüm problemi temsil eden matematik modellerin dinamik çözümlerinde radyasyon sönümünü doğrudan hesaba katan sınır elemanlar yöntemi (Leung vd., 1990, Çelebi ve Schmid, 2005) ya da bu tekniklerin sonlu elemanlarla ortak çözümlerine dayalı hibrit çözüm olarak isimlendirilen sayısal yaklaşımlar kullanılarak kalibrasyon hassasiyeti yüksek modeller geliştirilmiştir (Adam ve Estorff, 2005, Karlström ve Boström, 2007). Fakat gerçekleştirilen sayısal çözümlerden elde edilen sonuçlar özellikle zeminin elastik yarı uzay olarak değerlendirilmesiyle sınırlı kalmıştır.

## GELİŞTİRİLEN SAYISAL MODEL VE ÇÖZÜM AŞAMALARI

Gelişen teknoloji ile beraber yük ve yolcu taşımacılığında hızlı tren sistemleri gelişmekte ve giderek yaygın bir şekilde kullanılmaktadır. Hızlı tren sistemlerinin yumuşak zemin ortamlarında yoğun yerleşim bölgelerinden tekrarlı geçişlerinde çevredeki yapılar üzerinde oluşturacağı etkileri incelemek ve yapıları bu etkilerden korumak amacıyla yapı-zemin dinamik etkileşiminin de dikkate alınarak kapsamlı araştırmaların yapılması gerekmektedir. Bu nedenle demiryolu üstyapısını ve çevredeki yapıları tren setlerinin yüksek seyahat hızlarıyla ürettiği kuvvetli yer hareketlerinden korumak ve bu hasar verici titreşimleri azaltmak için arazide konuşlandırılacak en uygun yalıtım aracının sayısal olarak belirlenmesi sunulan çalışmanın ana hedefini oluşturmaktadır. Titreşim kaynağından gelen ve elasto-plastik zemin ortamında yayılan dalgaların genliğini azaltmak için titreşim kaynağının hemen altına ya da korunacak yapının altına bir yapay kaya modeli geliştirilebilir. Titreşim kaynağından gelen dalgaların azaltılması için, titreşim kaynağının altına (Aktif yalıtım) veya korunmak istenen yapının altına bir yapay kaya (Pasif yalıtım) oluşturarak titreşimlerin önlenmesi amaçlanmıştır (Şekil 1).

Bu çalışmada, dalga bariyerinin aktif yalıtım durumuna göre titreşim kaynağından gelen dalgaların azaltılması amacıyla geliştirilen sonlu eleman modeli üzerinde yapay taban kayanın konumlandırılacağı optimum derinliğin bulunması için kapsamlı parametrik araştırmalar yapılmıştır. Burada, dalga engelleyici yapay kayanın uzunluğu ( $L_a$ ),

kalınlığı ( $B_a$ ) ve zemin yüzeyinden derinliği ( $H_a$ ) olarak tanımlanmıştır. Sonlu eleman analizlerinde gözlem noktası olarak Şekil 1’de görüldüğü gibi demiryolu üstyapısından  $L=13m$  uzaklıktaki zeminin serbest yüzeyi (A noktası) seçilmiş olup parametrik analizler için, demiryolu platformunun üst taban genişliği 6 m, alt taban genişliği 8 m ve zeminden yüksekliği 1.5 m olarak belirlenmiştir.



Şekil 1: Dalgı engelleyici yapay kaya için aktif ve pasif yalıtım durumu

### Titreşim Kaynağının Simülasyonu

Yüksek hız trenlerinin demiryolu üstyapısı ve çevre zeminde meydana getirmiş oldukları titreşimlerinin gerçeğe yakın incelenmesi geliştirilen modele etkiyen hareketli dinamik yüklerin doğru tanımlanmasına bağlıdır. Hızlı tren setinin zamana ve konuma bağlı yük dağılımının sayısal modele dâhil edilmesi bu çözüm algoritmasının en önemli aşamasını oluşturmaktadır. Bu çalışmada katar yükü olarak sadece lokomotifin kendisi dikkate alınmıştır. Lokomotifin özağırlığı dingiller aracılığıyla raylara aktarılmaktadır. Vagon ağırlıklarının lokomotif ağırlığına göre daha küçük değerlerde kalması, aynı zamanda da hareketlerinin zemin titreşimine olan katkısının lokomotif göre az olması nedeniyle hesaplarda etkileri dikkate alınmamıştır. Demiryolu üstyapı tasarımında tren yüklerinin zemine aktarılması işlemi kademe kademe gerilmelerin azaltılması prensibine dayanır. En büyük gerilmeler tekerlekler ile raylar arasında oluşurken, raylar ile traversler arasındaki gerilmelerin etkisi ikinci mertebeden kaldığından, traversler ile altındaki balast yatağı arasındaki gerilmeler ihmal edilmiştir (Verbic, 1996).

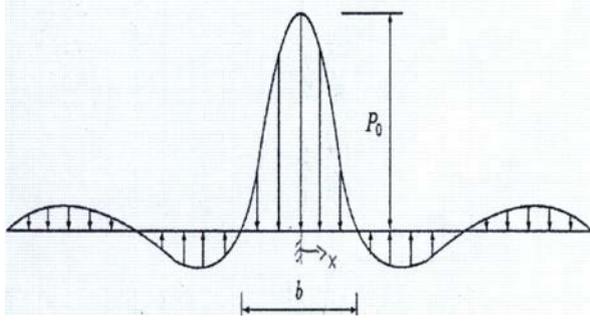
Tüm yapısal çözümler, elastik yarı uzay olarak idealize edilen zemin yüzeyine oturan sürekli bir kirişin üzerinde sabit hızla hareket eden bir yükün dinamik dış etki olarak göz önüne alınmasıyla gerçekleştirilmiştir. Demiryolu ve hemen altındaki zeminde kuvvetli titreşim üreten yüksek-hız trenlerinin balastsız üstyapı düzleminden geçişinin tanımlanması için basit bir model ortaya konulmuştur. Bu modelde hızlı tren dingil yükü, dingil açıklıkları ve hareket hızıyla; üstyapı ise belli bir eğilme rijitliği olan raylar ve traverslerin yatak katsayılarıyla karakterize edilmiştir (Huber, 1988).

Şerit üzerinde hareket eden tekil yükün değme yüzeyinde meydana getirdiği gerilme dağılışı, elastik bir zemine oturan bir kirişin gerilme davranışının belirlenmesinde kullanılan bağıntılardan elde edilir.

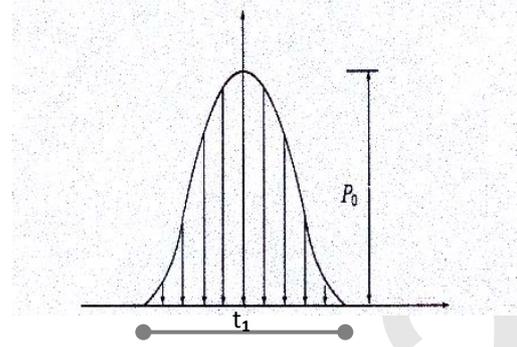
$$\sigma(\rho) = \frac{\rho}{\sqrt{2\rho}} \sigma^{-\frac{\rho}{2}} \sigma \sigma \left( \left| \frac{\rho}{\rho} + \frac{\rho}{4} \right| \right) \quad \sigma = \sqrt[4]{\frac{4\rho\rho}{\rho}} \quad (1)$$

Bu bağıntıda  $L$  elastik boyu,  $K$  ise zemin yatak katsayısını göstermektedir. Burada şeridin rijitliği yaklaşık olarak demiryolu üst yapısının rijitliğine eşdeğer alınmıştır. Gerilme diyagramının ilk iki sıfır noktası arasındaki ve  $b$  uzunluğu ile gösterilen büyük parça katar yükü olarak bu çalışmalarda dikkate alınmıştır (Şekil 2a). Sabit  $v$  hızıyla hareket eden bir kuvvetin, yol güzergâhı üzerinde herhangi bir noktadaki durumu gözlemlendiğinde, o noktada sabit bir yükün darbe

biçiminde etkisinin zamana bağlı değişimi elde edilir (Şekil 2b). Bu darbe yükünün tesir süresi  $t_1$ ,  $b/v$  oranına eşit olur. Birçok sayısal uygulamalarda  $b$  uzunluğu 3 m olarak hesaba katılmıştır (Huber vd., 1984).



a) Üstyapı-zemin arakesitindeki gerilme dağılışı



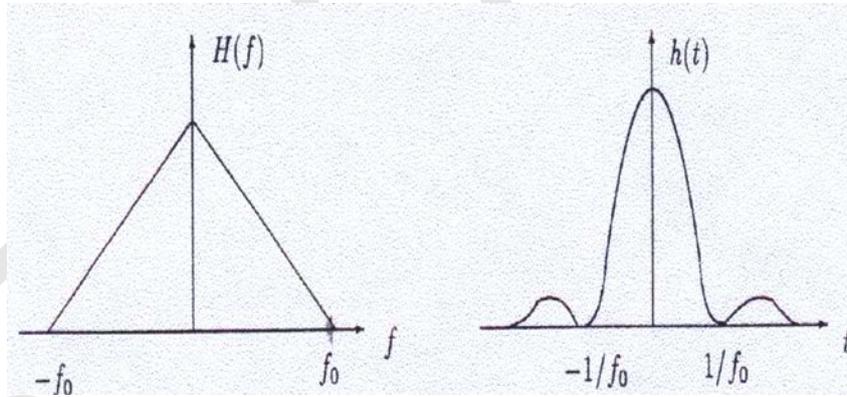
b) Kesik darbesel türde hareketli yük

**Şekil 2:** Elastik zemine oturan bir kiriş üzerinde bulunan tekil kuvvetin zemine arakesitinde meydana getirdiği gerilme diyagramı (Verbic, 1996)

Bazı nümerik çözüm tekniklerine bağlı olarak geliştirilen matematik modellerin SSI2D/3D (Schmid vd., 1988) ve SASSI (Lysemer vd., 1988 a-b) gibi özel programlarda dinamik davranışı belirlemek için yürütülen araştırmaların çoğu frekans bölgesinde gerçekleştirildiğinden zaman bölgesinde tanımlanan darbe yüküne ayrıntılı Fourier dönüşümü uygulanarak frekans tanım aralığında çözümü elde edilir. Demiryolu üstyapısı ile zemin arakesitinde oluşacak gerçek gerilme dağılımı yerine çözümü basitleştirebilmek için aşağıda verilen formül ile tanımlanan başka bir darbe fonksiyonu ele alınmıştır (Verbic, 1996, Tosecky, 2001, Çelebi vd., 2006).

$$\sigma(\xi) = \sigma_0 \frac{\sigma_0^2 \left( \frac{\sigma_0}{\xi} \right)}{\left( \frac{\sigma_0}{\xi} \right)^2} \quad (2)$$

Böyle bir etkinin Fourier dönüşümü de basit bir üçgen biçiminde ortaya çıkar (Şekil 3).



**Şekil 3:** Darbe etkisinin Fourier dönüşümü (Verbic, 1996)

Bu çalışmada, Türkiye'deki yüksek hızlı demiryolu hatlarında kullanılan lokomotif 4 dingilli ve ağırlığı yaklaşık olarak 720 kN olarak hesaba katılmıştır. Rayların belirli bir eğilme rijitliğine sahip olduğu düşünüldüğünde tekerlekten raylara aktarılan yükü, tekil bir yük olarak değil de belli bir uzunlukta tesiri olan yayılı yük şeklinde hesaplara katmak gerekir. Yükün etkili olduğu elastik boy uzunluğu  $L=3.6$  m olarak seçilmiştir. İki travers arasındaki mesafenin 0.6 m olduğu düşünüldüğünde yükün etkisi yedi travers elemanına karşı gelmektedir. Katar yükünün konuma ve zamana bağlı dinamik büyüklüğünün tam olarak elde edilebilmesi için etkili olduğu uzunluktaki yayılı yük dağılımının bileşke değerinin lokomotifin bir tekerleğinin raya uyguladığı kuvvete eşitliğinden bulunmuştur. İlk aşamada yükün etkili olduğu uzunluktaki rayların altında yer alan her bir traverse etki edecek tekil yük değerleri bulunur. Yukarıda verilen (2) nolu eşitlikteki zamana bağlı ifadeler konuma bağlı tekrar düzenlenirse ( $t=x/v$ ,  $t_1=L/2v$ ;  $t \rightarrow x$ )

$$\sigma(\xi) = \sigma_0 \frac{\sigma_0^2 \left( \frac{\sigma_0}{\xi} \right)}{\left( \frac{\sigma_0}{\xi} \right)^2} \quad (3)$$

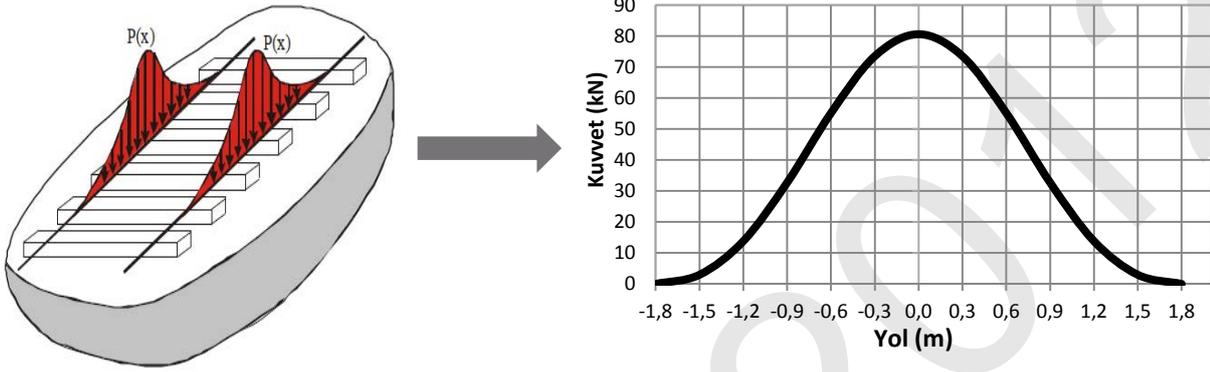
*Hatırlatma:*

$$\lim_{x \rightarrow 0} (\sin ax)/ax = 1; \lim_{x \rightarrow \infty} (\sin ax)/ax = 0$$

elde edilir. Şekil 4’de verilen yük eğrisinin altında kalan alan A ise,

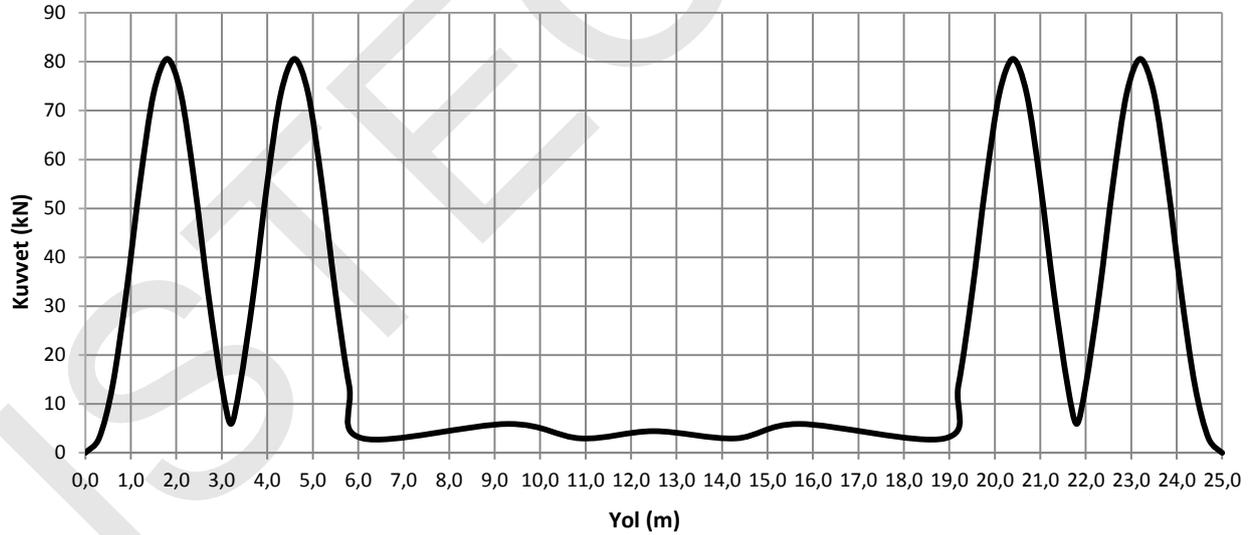
$$A = \int_{-\frac{L}{2}}^{\frac{L}{2}} P(x) dx \quad (4)$$

şeklinde bulunur. Yukarıdaki ifadelerin (3) ve (4) kullanılmasıyla ve tekerlek yükünün Şekil 2 veya 3b’de gösterilmiş olan yük diyagramının alanına eşitliğinden yararlanarak  $L=3.6m$  boyunca yükün genişliği elde edilir. Katardan raylar arasında bulunan her bir travers elemanına aktarılan tekil kuvvetler (4) nolu bağıntıda integral adım mesafeleri  $\Delta L=0.6 m$  (traversler arası mesafe) olacak şekilde düzenlenmiş ve integral çözümleri yapıldıktan sonra tek teker için traverslere aktarılan eşdeğer kuvvet diyagramı elde edilmiştir (Şekil 4).



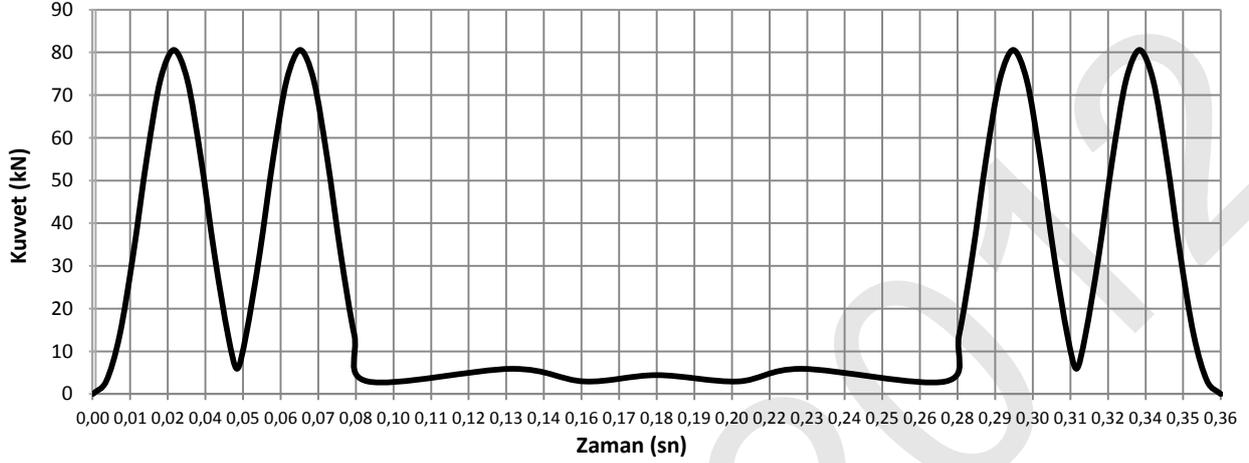
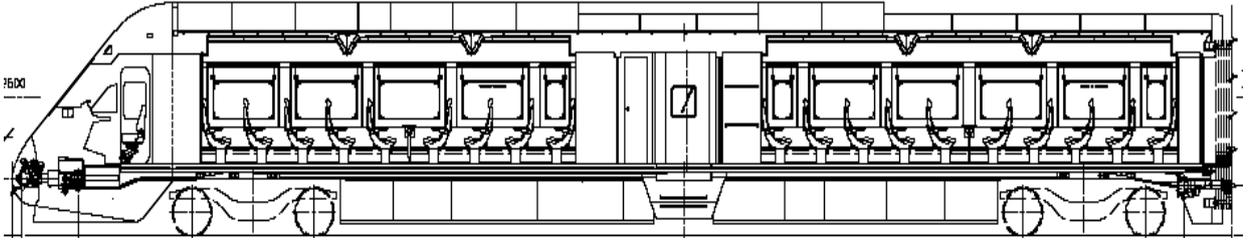
Şekil 4: Traverslere aktarılan tekil kuvvetler ve eşdeğer kuvvet diyagramı

Lokomotifin dört ardışık tekerinin demiryolundan geçişi esnasında ray üzerindeki etkisi, Şekil 4’de verilen tek bir tekere ait yük dağılımının dört kez süperpoze edilmesiyle elde edilmiştir (Şekil 5).



Şekil 5: Lokomotifin tekerlek aksları arasındaki mesafe ve tesir kuvvetlerinin dağılımı

Sayısal işlemlerin ilk aşamasında katar hızı  $v = 250 km/h = 69.44 m/sn$  olarak alınmıştır. Uzunluğu 25m olan lokomotifin geçişi esnasında tekerleklerin değme noktalarında meydana getireceği darbe etkileri  $t = 0.36 sn$  sürmektedir. Şekil 6’da katar yükünün zamana bağlı darbe etkisi gösterilmiştir.



Şekil 6: Tesir kuvvetlerinin zamana bağlı değişimi ( $V=69,44$  m/sn)

### Analizde Kullanılan Malzeme Davranış Modelleri Ve Sonlu Eleman Türleri

Üstyapı-zemin ortak sisteminin zaman bölgesindeki çözümü için sonlu elemanlar yöntemine dayalı bilgisayar programından (Brinkgreve vd., 2002) yararlanılmıştır. Geliştirilen matematik modelde demiryolu altyapısını oluşturan zeminin öngörülen mekanik davranışı lineer elastik ve Mohr Coulomb yenilme kriteri altında elasto-plastik malzeme davranış modeli ile benzeştirilerek dikkate alınmıştır. Mohr Coulomb zemin modelini tanımlamak için beş parametre kullanılmıştır. Bunlar zeminin Young modülü ( $E$ ), Poisson oranı ( $\nu$ ), kohezyon değeri ( $c$ ), kayma mukavemeti ( $\phi$ ) ve kabarma ( $\psi$ ) açılarıdır. Oluşturulan sayısal modelde zemin bölgesi, demiryolu üst yapısı ve dalga engelleyici yapıya kayanın mekanik özelliklerine ait bilgiler Tablo 1-3’de gösterilmiştir.

Tablo 1: Zemin ortamının mekanik özellikleri

| Parametre                      | Sembol          | Birim                | Büyükük  |
|--------------------------------|-----------------|----------------------|----------|
| Birim hacim ağırlık            | $\gamma$        | (kN/m <sup>3</sup> ) | 20.00    |
| Elastisite modülü              | $E$             | (kPa)                | 53100.00 |
| Kayma modülü                   | $G$             | (kPa)                | 20420.00 |
| Poisson oranı                  | $\nu$           | -                    | 0.30     |
| Basınç dalgası                 | $V_p$           | m/s                  | 187      |
| Kayma dalgası                  | $V_s$           | m/s                  | 100.00   |
| Rayleigh sönüm katsayıları     | $\alpha, \beta$ | -                    | 0.01     |
| Boşluk oranı                   | $e$             | -                    | 0.80     |
| Kohezyon                       | $c'$            | (kPa)                | 0.00     |
| Kayma mukavemeti açısı         | $\phi'$         | (°)                  | 28.00    |
| Kabarma açısı                  | $\psi$          | (°)                  | 0        |
| Arayüz dayanım azaltma faktörü | $R_{inter}$     | -                    | 0.67     |

Tablo 2: Demiryolu üstyapısı özellikleri

| Parametre        | Sembol | Birim                  | Büyükük            |
|------------------|--------|------------------------|--------------------|
| Eksenel rijitlik | $EA$   | (kN/m)                 | $3.49 \times 10^6$ |
| Eğilme rijitliği | $EI$   | (kN-m <sup>2</sup> /m) | $6.55 \times 10^5$ |
| Ağırlık          | $w$    | (kN/m/m)               | 29.43              |
| Poisson oranı    | $\nu$  | -                      | 0.33               |

Tablo 3: Dalga engelleyici yapıya kaya özellikleri

| Parametre                      | Sembol          | Birim                | Büyükük         |
|--------------------------------|-----------------|----------------------|-----------------|
| Birim hacim ağırlık            | $\gamma$        | (kN/m <sup>3</sup> ) | 24.00           |
| Elastisite modülü              | $E$             | (kPa)                | $3 \times 10^7$ |
| Rayleigh sönüm katsayıları     | $\alpha, \beta$ | -                    | 0.01            |
| Poisson oranı                  | $\nu$           | -                    | 0.2             |
| Arayüz dayanım azaltma faktörü | $R_{inter}$     | -                    | 0.67            |

## Sonlu Eleman Analizinde Sayısal Doğruluk ve Stabilite

Dalga yayılma hızı ve yük kaynağının frekans aralığı kullanılacak eleman boyutunu belirlediğinden, elemanların sayısının azaltılması genellikle ayrıklaştırılan bölgenin büyüklüğünü sınırlamaktadır. Ayrıklaştırılan bölgenin boyutunun küçültülmesiyle sınır şartlarının probleme etkisi artar. Ancak, kesim noktalarında uygun yapay sınır şartlarının oluşturulmasıyla sonsuza uzanan zemin sonlu bir bölgeye hapsedilerek modellenebilir. Ayrıca kısa dalga boyulu frekans bileşenleri geniş aralıklı düğümlerle modellendiğinde, yüksek frekans bileşenleri filtrelenebilir. Sayısal modelde sonuçların tutarlılığı ve doğruluk düzeyi açısından sonlu eleman boyutunun ( $\Delta h$ ) üst değeri en kısa dalga boyuna ( $\lambda_{min}$ ) göre sınırlanmıştır (Kuhlemeyer ve Lysmer, 1973).

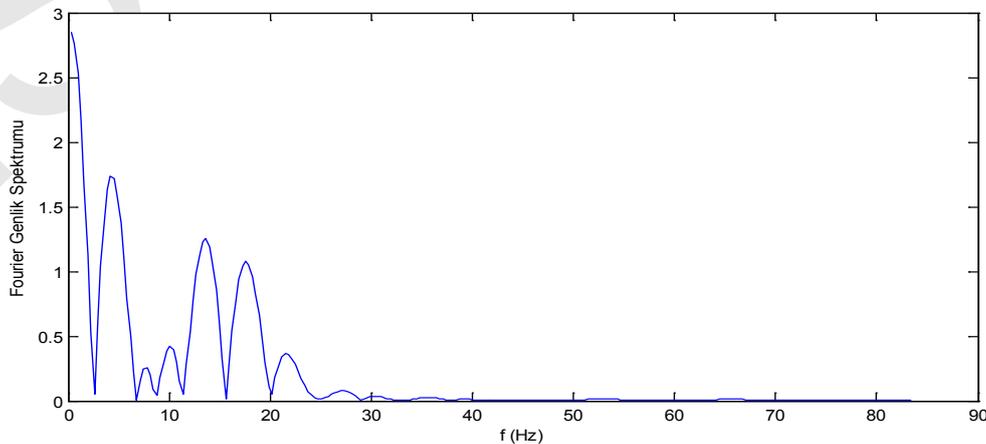
$$\Delta h \leq \frac{\lambda_{min}}{k} = \frac{v_j}{kf_{maks}} \quad (5)$$

Burada,  $k$  çarpan sabiti sonlu eleman tipine ve kullanılan şekil fonksiyonuna bağlı  $5 \leq k \leq 10$  aralığında değişmektedir. Dinamik yüke ait Fourier spektrumunun önemli bileşenlerini veren en büyük frekans değeri  $f_{maks}$  ile gösterilmiştir. Bu çalışmada, Türkiye'nin yüksek hızlı demiryolu hatlarında kullanılan lokomotiflerin  $V = 250 \text{ km/h}$  geçiş hızlarında demiryolu platformuna uyguladığı yük fonksiyonunun Fourier spektrumundaki önemli katkıları  $0 \leq f \leq 25 \text{ Hz}$  frekans aralığında görülmektedir (Şekil 7).

Çalışmanın amacına göre yapısal davranışın birinci dereceden önem kazandığı plastik şekil değiştirmenin beklendiği zemin parçası ( $H_1 = 10 \text{ m}$ ,  $B_1 = 50 \text{ m}$ ) küçük boyutlu sonlu elemanlarla ( $\Delta h_1 = 0.595 \text{ m}$ ) modellenmiştir (Şekil 8). Yakın bölgeden uzaklaştıkça kullanılan sonlu eleman boyutları yukarıda verilen koşulu (5) çok fazla aşmayacak şekilde büyütülerek hesaplama yükü ve buna bağlı olarak analiz süreci dengelenmiştir.

Yapı-zemin dinamik etkileşimi için geliştirilen matematik simülasyonun doğruluk düzeyi iki temel parametre ile kontrol edilmektedir. Bunlardan biri üst sınır koşuluna bağlanan (3) sonlu eleman modelinin nodları arasındaki mesafedir ve diğeri de çözümde göz önüne alınan zaman adım aralığıdır. Bu çalışmada ele alınan iki boyutlu düzlem şekil değiştirme problemini yöneten hareket denklemlerinin zaman tanım aralığında çözümü Newmark'ın sabit ortalama ivme yöntemiyle gerçekleştirilmiştir.

Farklı dalga türlerini hesaba katıldığı zemin titreşim problemlerinin analizinde zaman artımı ( $\Delta t$ ), ortamdaki dalganın en büyük yayılma hızıyla belirlenirken, kullanılacak sonlu eleman boyutunun en küçük dalga hızına bağlı olduğuna dikkat etmek gerekir. Dalgaların en yüksek ve en düşük yayılma hızları arasındaki farkın büyük olmasından dolayı öngörülen model için küçük sonlu eleman kullanımına ve kısa zaman artımıyla sayısal çözümün gerçekleştirilmesine ihtiyaç duyulmaktadır. Yönetici denklemlerin sayısal integrasyonunda zaman adımı  $\Delta t = 0.0103 \text{ sn}$  alınarak analizler yürütülmüştür.



**Şekil 7:** Türkiye'nin yüksek hızlı demiryolu hatlarında kullanılan lokomotiflerin oluşturduğu yük fonksiyonunun frekans spektrumu ( $V=69,44 \text{ m/sn}$ )

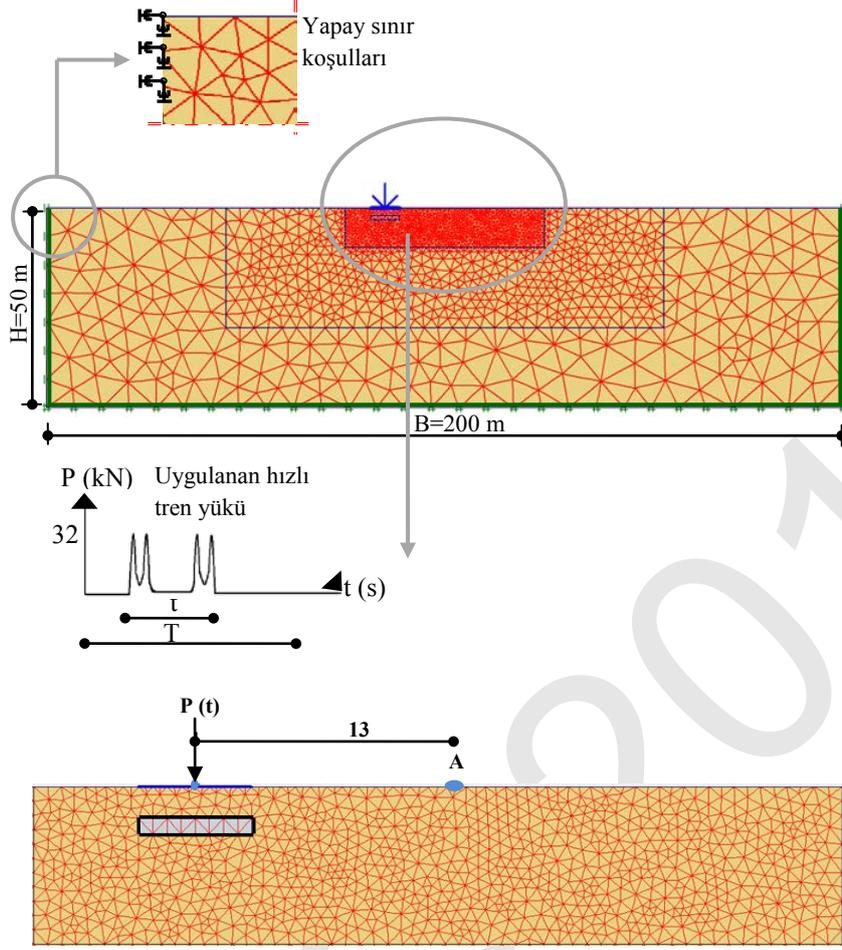
## Viskoz Sönümleyici Sınırlar Ve Histeretik Sönüm

Dalga yayılım probleminin sonlu eleman simülasyonu için yük kaynağından uzak bölgelere iletilen dalgaları model sınırlarında serbest bırakmak ve yayılan enerjiyi bu kesim noktalarında tüketmek için yapay sınırlara ihtiyaç duyulmaktadır. Bu sınırlarda viskoz sönümleyici elemanlar (Lysmer ve Kuhlemeyer, 1969) ve sonsuz elemanlar (Dasgupta, 1982, Wolf ve Song, 1994) yaygın olarak kullanılmaktadır. Eğer ayrıklaştırılan bölgenin sınırları yeterli derecede uzakta seçilmemişse, bölgenin kesim noktalarında geçirgen (soğurgan) sınırlar kullanılsa bile, tam geçirimsizlik sağlanamadığından dolayı uzaklaşan ve yansıyan dalgaların çakışmasından analiz sonuçlarında beklenmedik sayısal belirsizlikler ortaya çıkabilmektedir.

Geliştirilen çözüm yönteminde sistemden dışarıya doğru yayılan ve zeminin sonsuzluğu nedeni ile zemin ortamında kaybolan enerjiyi tanımlamak için bölgenin sınırlarında eşdeğer anlamda kullanılan, radyasyon sönümü adı verilen ve malzeme sönümü ile ilgisi bulunmayan bir sönüm mekanizması kullanılmıştır (Şekil 8). Viskoz etkilerden dolayı fiziksel sönüm Rayleigh sönümü ile dikkate alınmaktadır. Mühendislik uygulamalarında histeretik malzeme sönümü için genel olarak kullanılan parametre  $\xi$  sönüm oranıdır. Sonlu elemanlar yaklaşımında Rayleigh sönümü ( $C$ ), sistemin kütle ve rijitlik matrisleri içerisindeki sönüm etkilerini bir araya toplayan en uygun sönüm ölçütlerinden birini oluşturmaktadır.

$$(C = \alpha M + \beta K) \quad (6)$$

Bu formülasyona göre, sistemin malzeme sönümünde  $\alpha$  oranı sabiti kütle katkıyı gösterirken,  $\beta$  sabiti rijitliğin sönümdeki etkisini belirlemektedir. Yapı sistemlerinin titreşiminde zeminin malzeme sönümü, yeraltının sonsuzluğunda yayılarak kaybolan titreşim enerjisini tanımlayan geometrik sönümle karşılaştırıldığında ikincil derecede kaldığı ve belli kurallar çerçevesinde sayısal hesaplarda gözardı edilebileceği söylenebilir. Sayısal uygulamalarda malzeme sönümünün gözardı edilmesi ( $\alpha = \beta = 0$ ) durumunda bile dalgalar geometrik sönüme bağlı tükendiği görülmektedir. Model sınırlarında geometrik sönümün hesaba katıldığı iki boyutlu sonlu eleman analizleri için Rayleigh sönüm değerini çözümün kararlılığını bozacak kadar da küçültmemek gerekir. Yapısal çözümlemelerde Rayleigh oranı sabitleri dış yük frekansının yüksek olmasından dolayı  $\alpha = 0.01$  ve  $\beta = 0.01$  alınmıştır (Çelebi ve Göktepe, 2012).



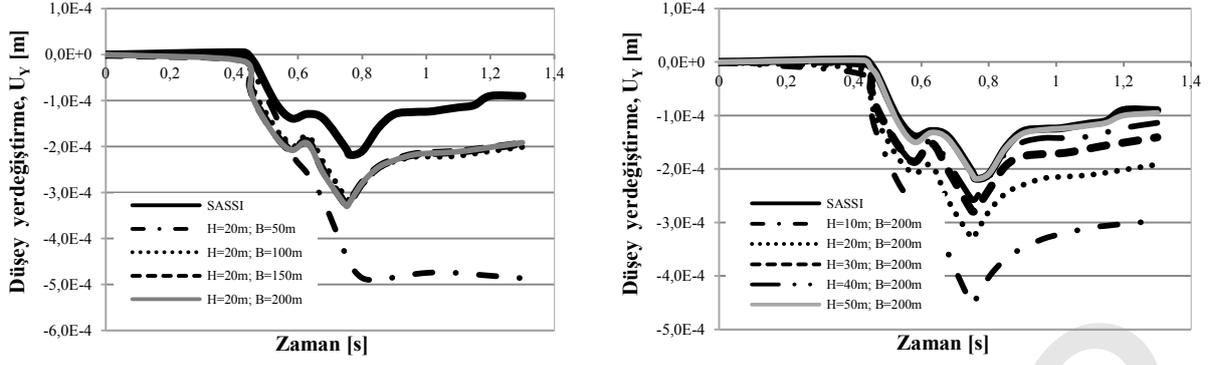
Şekil 8: Yapı-zemin etkileşim problemi için sonlu eleman modeli (Aktif Durum)

## Matematik Modelin Kalibrasyonu

Dalga yayılışının incelendiği sürekli ortam mekaniğinde sistemin sonlu eleman ağ yapısının sıklığı hassas bir yaklaşımla düzenlenirken problemin sınır özelliklerinin de aynı hassasiyetle doğru tanımlanması hem öngörülen doğruluk düzeyine erişebilme hem de çözüm sürecinin hesap yüküne bağlı olarak dengelenebilmesi açısından son derece önemlidir. İletilen dalgaların zemin sınırlarından yansıyıp geri dönmemesi için problemin ele alındığı bölgenin küçük tutulmaması gerekir. Ayrıca sonsuza uzanan zemin bölgesinden çıkartılan sonlu zemin parçasının sınır şartlarının geriye kalan zemin bölgesini nasıl temsil edeceğinin iyi belirlenmesi gerekir.

Bu çalışmada yarı sonsuz zemin ortamının idealleştirilmesi için geliştirilen sonlu eleman modelinin doğruluk düzeyi ve yöntemin geçerliliği, zeminin sınırlarına dalga yayılma şartlarını sağlayan yapay sönümleyiciler yerleştirilerek oluşturulan bölgenin büyüklüğüne göre incelenmiştir. Ayrıca ele alınan problem yakın ve uzak bölgeler için farklı ağ sıklıklarında analiz edilerek en uygun ağ yapısı dış yükün titreşim frekansına bağlı üretilen eleman boyutuna göre belirlenmiştir. Sonsuza uzanan zemin bölgesinin ayrıklaştırılması için farklı ölçeklerde ele alınan sonlu eleman modelleri kullanılarak demiryolu üstyapısından belli uzaklıkta ( $L=14.2 m$ ) serbest yüzeyde seçilen gözlem noktalarındaki düşey yerdeğişmelerin ( $u_y$ ) zamana bağlı değişimleri Şekil 9'da gösterildiği gibi tren hızına bağlı olarak elde edilmiştir (Çelebi ve Göktepe, 2012). Sayısal sonuçların kontrolü, deprem yer hareketinin neden olduğu yapı-zemin etkileşim problemini çözmek amacıyla geliştirilen SASSI (Lysemer vd., 1988 a-b) programının ilgili modüllerini hareketli yüklerin ürettiği yüzey titreşimlerini incelemek için dalga yayılış problemlerine uyarlayan Tosecky'nin çalışmalarına göre yapılmıştır (Tosecky, 2001). Bu sayısal model zemin ortamının sınırsızlığını gelişmiş yapay sınırlar kullanarak altsistem yaklaşımı içerisinde ince tabakalar/esnek hacim yöntemiyle ele almaktadır.

İlk aşamada problemde ele alınacak zemin bölgesinin yatay açılımının uzunluğuna karar verilmiştir. Bu çalışmada sonlu bölgenin toplam uzunluğunun  $B=200 m$  alınması yeterli görülmüştür. Her iki taraftan zemin sınırı yapı taban genişliğinin yaklaşık olarak 8 katı kadar uzakta oluşturulmuştur. Daha sonra ise zemin bölgesinin derinliği saptanmıştır. Derinlik  $H=50 m$  olacak şekilde belirlenmiştir. Şekil 9'da verilen grafikler incelendiğinde, elde edilen sonuçların diğer yöntemle uyum içerisinde olması önerilen modelin yeterliliğini göstermektedir.



Şekil 9: Model büyüklüğünün literatür sonuçlarıyla karşılaştırılması

## Yüzey Dalgalarının Zemin Ortamında Yayılımı

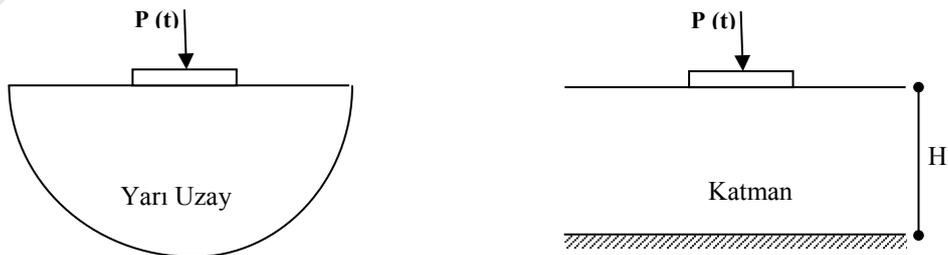
Yük kaynağından yayılan enerji cisim dalgaları ve yüzey dalgaları denen iki farklı türde dalgalar ortaya çıkarmaktadır. Yerin içinde hareket eden cisim dalgaları, P ve S dalgaları olarak ikiye ayrılmakta olup, bu dalga türleri parçacık hareketine neden olup, hareketleri sırasıyla yayılma doğrultusuna paralel ve diktir. Dalga yayılma hızları ortamın fiziksel ve geometrik özelliklerine bağlıdır. Sonsuz bir ortamda P dalgasının yayılma hızı, S dalgasının yayılma hızından en az iki kat fazladır (Geniş ve Gerçek, 2000). Yüzey dalgaları yer yüzeyi ve yüzeydeki katmanlar ile cisim dalgaları arasındaki etkileşim sonucu ortaya çıkar. Bu dalgalar genlikleri kabaca derinliğe göre üssel olarak azalan şekilde yer yüzeyinde ilerler. Bu dalgaların en önemlileri Rayleigh dalgaları ve Love dalgalarıdır. Mühendislik problemlerinde karşımıza sıklıkla çıkan ve çoğunlukla yüzeyde oluşan en yaygın dalga Rayleigh yüzey dalgasıdır.

Rayleigh dalgaları, parçacık hareketinin yatay ve düşey bileşenleri dalga yayılımı düzleminde oluşur. Love dalgaları, yatay ve daha çok yayılma doğrultusuna dik doğrultuda parçacık hareketi oluşturur. Rayleigh dalgasının yayılımı yaklaşık S dalgası hızında olmasına rağmen, Love dalgasının yayılma hızı yüzey tabakasındaki ve alt tabakadaki S dalgalarının yayılma hızları arasındaki bir değerdedir.

Kaynak bölgesinden yayılan sismik dalgalar, geçiş yolu üzerindeki geometri ve malzeme özelliklerinden etkilenir. P ve S dalgaları geçiş yolu boyunca farklı malzeme özelliklerine sahip tabakaların ara yüzeylerinde karşılaştıklarında yansır ve kırılır. Bu dalgalar arasında farklılık, enerji kaynağından çıkan dalgaların genliklerinde bölgesel bir artış ve azalışla sonuçlanabilir. Yüzey topografyası ve yüzeye yakın tabakalanma da yüzey dalgalarının özelliklerini etkiler (Geniş ve Gerçek, 2000). Geometrik sönümleyicinin olmaması durumunda zemin içindeki dalga yayılımı azaltılamaz. Dalgaların geri yansımaları anakaya ile zemin yüzeyi arasındaki zemin tabaka kalınlığına ( $H_a$ ), zemin özelliğine ve titreşimlerin yönüne bağlıdır. Titreşim frekansı verildiğinde, bu frekansa bağlı kritik tabaka kalınlığı ( $H_c$ ) bulunabilir. Bu şartlar altında titreşim frekansı zemin frekansından daha az ise dalga yayılımı olmaz. Eğer titreşim frekansı zemin frekansına eşit ise rezonans durumu beklenir. Titreşim frekansı zeminin frekansından büyük ise dalga yayılımı gerçekleşir.

$$H_c \leq \frac{c_s(2f - 1)}{4f} \quad (7)$$

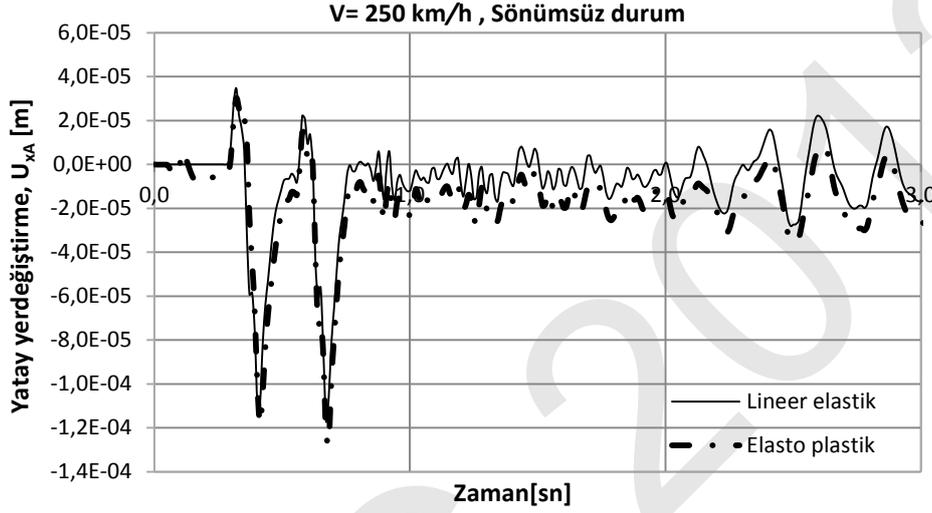
Bu formülasyonda,  $c_s$  zemin malzemesinin kayma dalgası hızı,  $f$  ise titreşim kaynağının frekansdır. Bu çalışmada, titreşim kaynağından gelen dalgaların azaltılması için titreşim kaynağının altında oluşturulacak yapay taban kayanın konumlandırılacağı kritik derinliğin bulunması amacıyla, Rayleigh yüzey dalgasına bağlı olarak yapay kayanın konumlandırıldığı farklı yükseklikler elde edilmiştir (Adam ve Chou, 2001). Çalışmada Rayleigh dalgasının dalga boyu 4m olarak hesaplanmış olup  $H=0.125LR$ ,  $H=1.25LR$ ,  $H=5LR$  ve lineer elastik yarı uzay çözümleri kıyaslanarak rezonans etkisi araştırılmış ve yapay kayanın konumlandırılacağı kritik derinlik tespit edilmiştir. Geliştirilen sayısal modelin lineer elastik yarı uzay ve anakaya tabanlı şematik gösterimi Şekil 10'da verilmiştir.



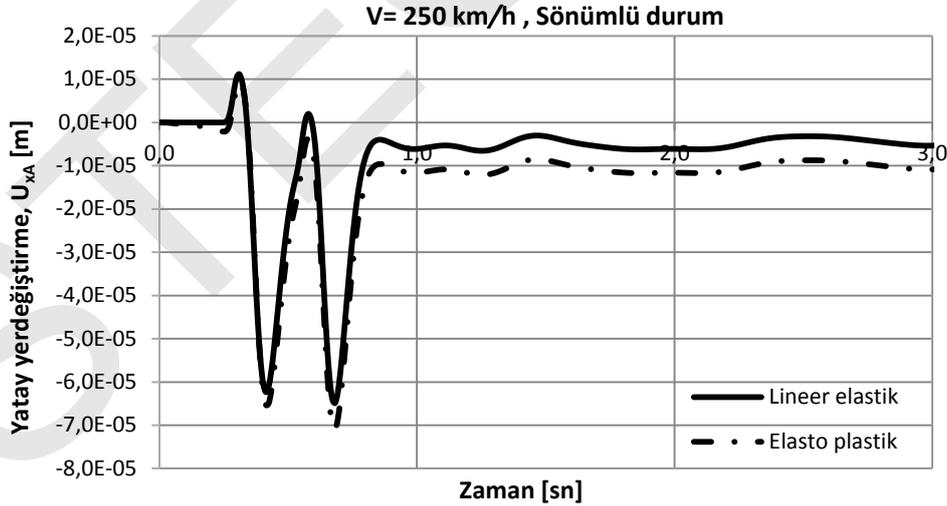
Şekil 10: Geliştirilen sayısal modelin yarı uzay ve anakaya tabanlı şematik gösterimi

## SAYISAL UYGULAMA VE ANALİZ SONUÇLARI

Düzlem şekil değiştirme problemi için, bilinmeyenleri kapsayan denklemler 30967 düğüm noktasına sahip olup, tüm uygulamaların dinamik analizleri bilgisayarın hafızasında 45,35 GB'lık yer kaplamıştır. Sonlu eleman analizlerinde gözlem noktası olarak demiryolu üst yapısından belli uzaklıkta ( $L=13\text{ m}$ ) zeminin serbest yüzeyinde gözlem noktası seçilmiştir (Şekil 8). Yalıtımsız durum için seçilen gözlem noktasında (A noktası) tren hızına bağlı olarak elde edilen yatay yerdeğiştirmelerin ( $u_x$ ) zamana bağlı değişimleri, zeminin mekanik davranışının önemini vurgulamak için malzeme sönümünün hesaba katılıp katılmadığı iki farklı duruma göre lineer elastik ve elasto plastik zemin davranış modelleri Şekil 11, 12'de görülmektedir.



Şekil 11: Sönümsüz durum için yatay yerdeğiştirmenin zaman geçmişi (yalıtımsız durum)

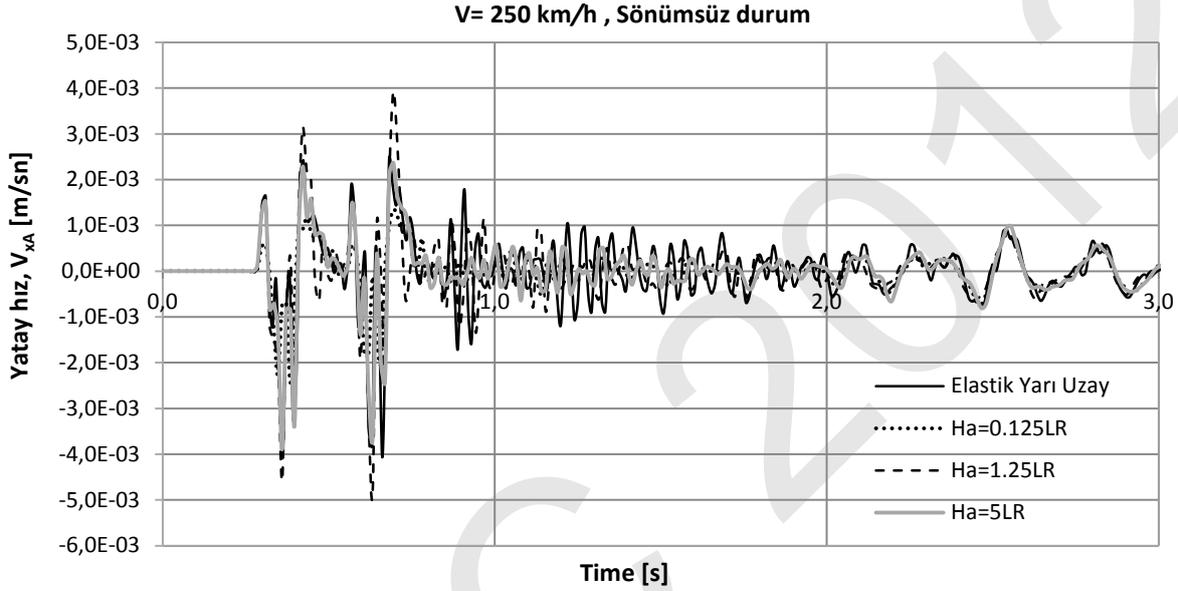


Şekil 12: Sönümlü durum için yatay yerdeğiştirmenin zaman geçmişi (yalıtımsız durum)

Malzeme sönümünün sayısal hesaplara katılmadığı ( $\alpha=\beta=0$ ) durumlarda bile model sınırlarında tanımlanan geometrik sönümün sistemin titreşim enerjisinin tüketilmesinde ne derece etkili olduğu verilen grafikte zamanla genliği azalan yatay yerdeğiştirme eğrisinden anlaşılmaktadır.

Yüksek frekanslı titreşimler içeren hızlı tren geçişlerinin oluşturduğu etkileri azaltmak amacıyla yapay taban kaya bariyer modelinin aktif yalıtım durumuna göre kapsamlı analizler yapılmıştır. Aktif yalıtım durumu için yapay kayanın

konumlandırılacağı kritik derinliği tespit etmek amacıyla seçilen gözlem noktasında (A noktası) tren hızına bağlı olarak elde edilen yatay hızların ( $v_x$ ) zamana bağlı değişimleri malzeme sönümünün dikkate alınmadığı lineer elastik yarı uzay ve yapay kayanın konumlandırıldığı farklı yükseklikler için Şekil 13’de verilmiştir. Bu çalışmada, Rayleigh dalgasının dalga boyu  $LR=4m$  olarak elde edilmiştir. Analizlerde kullanılan  $V=250 km/h$  geçiş hızına sahip tren yükünün titreşim frekansı,  $H_a=0.125LR$  tabaka kalınlığındaki zemin frekansından daha düşük değerde olduğu anlaşılmaktadır. Bunun bir sonucu olarak, dalga yayılımının gerçekleşmediği veya az bir oranda gerçekleştiği anlaşılmaktadır.  $H_a=1.25LR$  katman yüksekliğinin, kritik tabaka kalınlığına yakın olmasının sonucu olarak, tren yükünün titreşim frekansı zeminin frekansına yaklaştığı görülmektedir. Yatay hız genliklerinin çok büyük değerlerde olmasıyla rezonans etkileri gözlemlenmiş olup zemin içerisinde yayılan dalgaların anakayadan güçlü bir şekilde yansıdığı anlaşılmaktadır.  $H_a=5LR$  tabaka kalınlığı için elde edilen yatay hız değerlerinin lineer elastik yarı uzay çözümüne yaklaştığı görülmekte olup, tren yükünün titreşim frekansının zeminin frekansından büyük olduğu anlaşılmaktadır ve dalga yayılımının gerçekleştiği görülmektedir (Şekil 13).



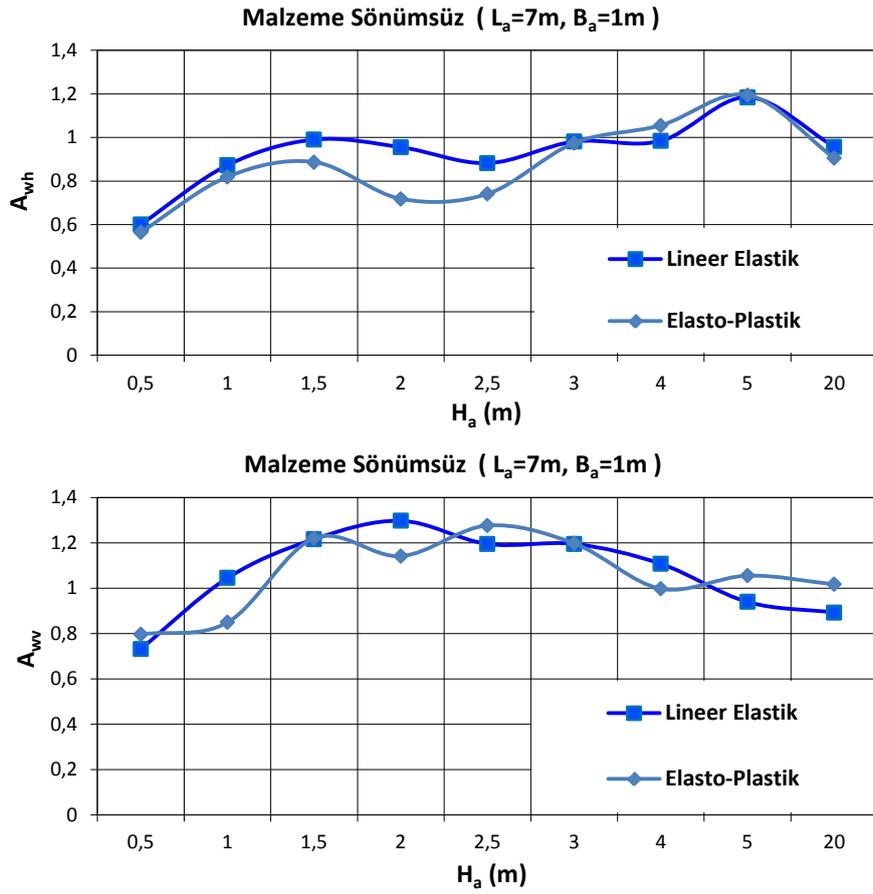
**Şekil 13:** Sönümsüz durum için yatay hızın zamana bağlı değişimi (aktif yalıtım)

Aktif yalıtım durumuna ait dalga engelleyici yapay kaya modelinin konumlandırılması gereken optimum derinliğin tespiti amacıyla, malzeme sönümünün hesaba katılıp katılmadığı iki farklı duruma göre lineer elastik ve elasto-plastik zemin davranış modelleri yapay kayanın yerleştirildiği farklı yükseklikler için karşılaştırılmalı olarak Şekil 14, 15’de verilmiştir. Aktif durum için, dalga bariyer modelinin analizlerde öngörülen optimum uzunluğu ( $L_a$ ) ve kalınlığı ( $B_a$ ) gibi kesit boyutları, daha önceki analitik çalışmalara (Göktepe vd., 2010, Çelebi vd., 2011, Çelebi ve Göktepe, 2012) dayalı olarak belirlendiğinden yapay kaya uzunluğu  $L_a=7m$  ve kalınlığı  $B_a=1m$  olarak alınmıştır. Yapay kayanın dalgayı perdeleme etkisini göstermek için kullanılan dalga azaltma oranı ( $A_{wi}$ ) boyutsuz parametresi;

$$A_{wi} = \frac{v_{XA}}{v_{XA0}} \quad (8)$$

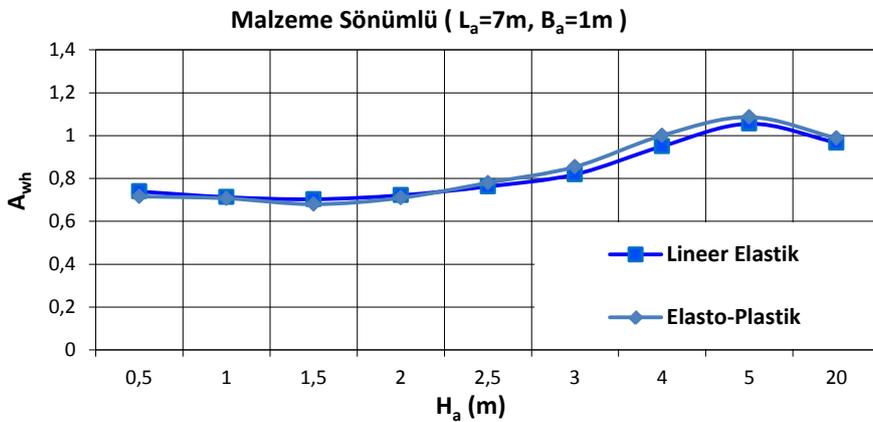
bağıntısıyla hesaplanmıştır. Burada,  $v_{XA}$  yalıtımlı durumdaki hızı,  $v_{XA0}$  ise yalıtımsız durumdaki hızı göstermekte olup düşey değerlerde elde edilen azaltma oranı için  $A_{wv}$ , yatay değerler için ise  $A_{wh}$  olarak gösterilmiştir. Dalga azaltma oranı  $A_{wi}$  değerinin 0 olması durumunda bariyer tam yalıtım sağlamış, 1 olması durumunda ise yalıtım etkisinin gerçekleşmediği düşünülerek çalışmalar değerlendirilmiştir.

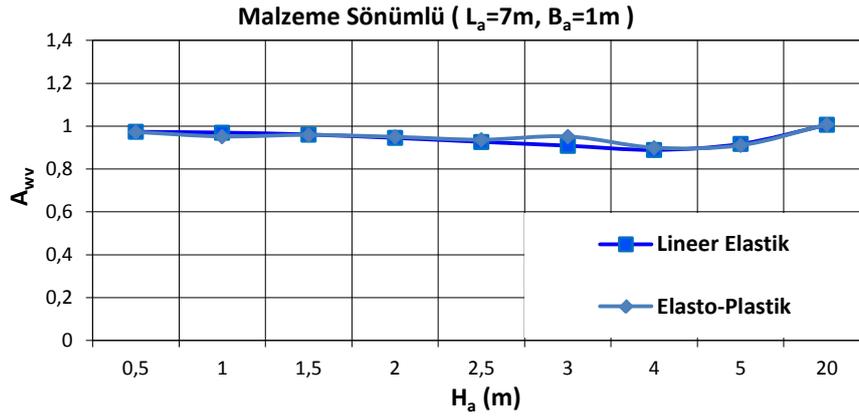
Analizlerde malzeme sönümünün dikkate alınmadığı lineer elastik ve elasto-plastik zemin davranış modelleri için yapay kaya derinliğinin zeminin serbest yüzeyindeki yatay hız genliklerinde % 40-45, düşey hız genliklerinde ise % 20-25 civarında yalıtım gösterdiği görülmektedir. Hızlı tren trafiğinin tekrarlı geçişleri sırasında ürettikleri yüksek frekanslı titreşimlerin binalara olan etkisini azaltmak için yatay hız genliklerinde elde edilen azaltma oranlarından lineer elastik ve elasto-plastik zemin modellerine ait kritik derinliğin 5m civarında olduğu söylenebilir. Düşey hız genliklerinden elde edilen azaltma oranlarına göre ise lineer elastik ve elasto-plastik zemin davranış modelleri için 2-2,5 m civarında olduğu anlaşılmıştır (Şekil 14).



**Şekil 14:** Sönümsüz durum için dalga engelleyici yapay kaya derinliğine bağlı olarak dalga azaltma oranı (aktif yalıtım)

Malzeme sönümünün dikkate alındığı lineer elastik ve elasto-plastik zemin davranış modelleri için dalga bariyeri  $H_a=0.5m$  derinliğinde % 30 civarında azaltma etkisi yapmaktadır. Şekil 15'deki verilen grafiklerden dalga engelleyici yapay kayanın göstermiş olduğu performansın zemin davranış modeline bağlı olarak çok fazla değişmediği gözlemlenmiştir. Bu durum, hızlı tren trafiğinin oluşturduğu büyük genlikteki titreşimlerin etkilerini azaltmak amacıyla geliştirilen sayısal model yardımıyla yapılan hesaplamalarda zeminin öngörülen mekanik davranışı için tercih edilen elasto-plastik Mohr-Coulomb malzeme modelinin yeterliliğini göstermektedir. Sonuç olarak, deprem yer hareketi dışında hızlı trenler gibi yüksek frekansa sahip insan yapısı titreşim kaynaklarının oluşturduğu problemlerin sayısal analizlerinde ileri zemin davranış modellerinin kullanımının gerekli olmadığı anlaşılmış olup yapı-zemin etkileşim problemini dinamik dış yükün simülasyonu ile birlikte doğrudan temsil eden hesap modelinde, sonuçların tutarlılığı ve doğruluk düzeyi açısından zeminin doğrusal olmayan davranışını gerçeğe en yakın biçimde temsil etmek için kullanılan Mohr-Coulomb yenilme kriteri altındaki elasto-plastik malzeme davranışı yeterlidir (Şekil 15).





**Şekil 15:** Sönümlü durum için dalga engelleyici yapay kaya derinliğine bağlı olarak dalga azaltma oranı (aktif yalıtım)

## SONUÇLAR

Bu çalışmada tren setlerinin yüksek seyahat hızlarıyla tekrarlı geçişleri sırasında zeminlerde ürettikleri yüksek frekanslı titreşimlerin çevre üst yapılarındaki dinamik etkilerinin araştırılması ve azaltılması amacıyla bir çözüm önerisi olarak sunulan dalga engelleyici yapay kayanın aktif yalıtım durumu için temel parametrelere göre kapsamlı bir şekilde araştırma yapılmış ve sonuçlar grafikler halinde gösterilmiştir.

Elde edilen veriler neticesinde, dalga bariyerinin aktif yalıtım durumu için en uygun model boyutları  $H_a=0.5m$ ,  $B_a=1m$  ve  $L_a=7m$  olarak tespit edilmiş olup en uygun model boyutlarının yalıtımsız duruma göre üst yapı titreşim etkilerini % 40-45 civarında azalttığı görülmüştür. Doktora tezi olarak devam eden çalışmanın bundan sonraki kısmında, pasif yalıtım durumu için dalga bariyerinin optimum boyutlarını belirlemek üzere araştırmalara yoğunlaşılacaktır.

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# YETERSİZ KESME DAYANIMINA SAHİP BETONARME KİRİŞLERİN FRP ELEMANLARLA GÜÇLENDİRİLMESİ (SONLU ELEMANLAR MODELİ)

Yusuf Sümer, Muharrem Aktaş  
Technology Faculty, Engineering Faculty  
Sakarya University  
Turkey  
ysumer@sakarya.edu.tr  
muharrema@sakarya.edu.tr

**Özet:** Dünyada yıkıcı deprem aktivitelerinin en çok görüldüğü bölgelerden biri olan Türkiye’de, son otuz yılda deprem güvenliği olmayan çok sayıda betonarme bina hasar görmüş veya yıkılmıştır. Yıkım sebepleri arasında projeye uygun yapılmayan binalar, etriye sıklaştırmasına dikkat edilmemesi, yetersiz beton dayanımı gibi sebepler dikkati çekmektedir. Yetersiz kesme dayanımına sahip betonarme kirişlerin, dıştan FRP elemanlarla güçlendirilmesi, güçlendirmede etkin bir yöntem olarak kabul edilmektedir. Son yıllarda betonarme kirişlerin kesme kapasitelerinin dıştan FRP uygulamasıyla artırılması yönünde birçok deneysel çalışma yapılmıştır. Deney yapmak zaman alan, zor ve maliyet gerektiren bir seçenektir. Günümüzde bilgisayara teknolojilerinin ilerlemesiyle artık bilgisayar ortamında da doğruluğu kanıtlanmış simülasyon modelleri üzerinde ayrıntılı deneyler yapmak mümkündür. Bu çalışmada literatürden elde edilmiş zayıf kesme donatılı ve kesme bölgesinden FRP elemanlarla güçlendirilmiş kiriş deneyleri için doğrusal olmayan sonlu elemanlar modeli elde edilmiştir. Oluşturulan nümerik model için öncelikle uygun malzeme ve davranış modelleri belirlenmiş daha sonra kiriş 3 boyutlu olarak modellenmiştir. Sonlu eleman modelinin hassaslığı, çözüm ağı yoğunluğu, çatlama enerjisi gibi parametreler bakımından incelenmiş ve iyi bir model için önerilerde bulunulmuştur. Sonuçlar grafiklerle sunulmuştur.

**Anahtar kelimeler:** Betonarme kiriş, kesme güçlendirmesi, sonlu elemanlar modeli, FRP.

## Giriş

Ülkemizin büyük bölümünün deprem riskini taşıması nedeni ile yapı stoğumuz güçlendirmeye ihtiyaç duymaktadır. Yapısal olarak yetersiz olan bina sayısının fazlalığı, halen kullanımda olmaları ve yapım yöntemlerinin farklılığı gibi sebeplerle, her yapı için uygun onarım ve güçlendirme yöntemlerinin belirlenmesine ihtiyaç vardır. Yapıların taşıyıcı elemanlarını rehabilitasyonu güçlendirmede en kısa yoldur.

Günümüzde, çok sayıda olumlu özellikleri, Fiber Takviyeli Polimer (FRP) malzemelerin etkin olarak kullanılmasına neden olmaktadır. Birçok araştırma çalışmaları, değişik yapı elemanlarına FRP kompozit malzemelerin yapılandırılmasının bu elemanların yük taşıma kapasitesini alışılagelmiş yöntemlere göre önemli ölçüde arttırdığını ortaya koymuştur (Shahawy ve diğerleri (1996), Triantafyllou (1998), Khalifa ve diğerleri (1998), Shehata ve diğerleri (2001), Khalifa ve Nanni (2002), Pesic ve Pilakoutas (2005), Dias ve Barros (2008)). İlk başlarda FRP elemanlar kolonlara sarılarak yük taşıma kapasitesi ve süneklik artırılmaya çalışılmıştır. Son 50 yıldır ise FRP malzemeler betonarme kirişlerin onarım ve güçlendirilmesinde geleneksel çelik plakaların yerini almıştır. Kesme kırılmasının ani ve gevrek olması nedeni ile kesme güçlendirmesi daha da önem kazanmaktadır.

Betonarme elemanların yük altında davranışlarını tespit etmek için laboratuvar koşullarında özenli deneylerin yapılması gereklidir. Deney yapmak yetkin laboratuvar şartları gerektiren, zaman alan ve uygulama zorlukları içeren bir seçenektir. Yük-deplasman ilişkilerinin elde edilmesi için diğer bir seçenek bilgisayar ortamında sonlu elemanlar modeli oluşturularak analiz yapmaktır. Bunun için literatürden elde edilmiş deneylerin bilgisayarda sonlu elemanlar modeli ile doğrulanması ve ardından parametrik çalışmaların yapılması gerek zaman gerekse maliyet açısından daha ekonomiktir (Sümer ve Aktaş, 2009).

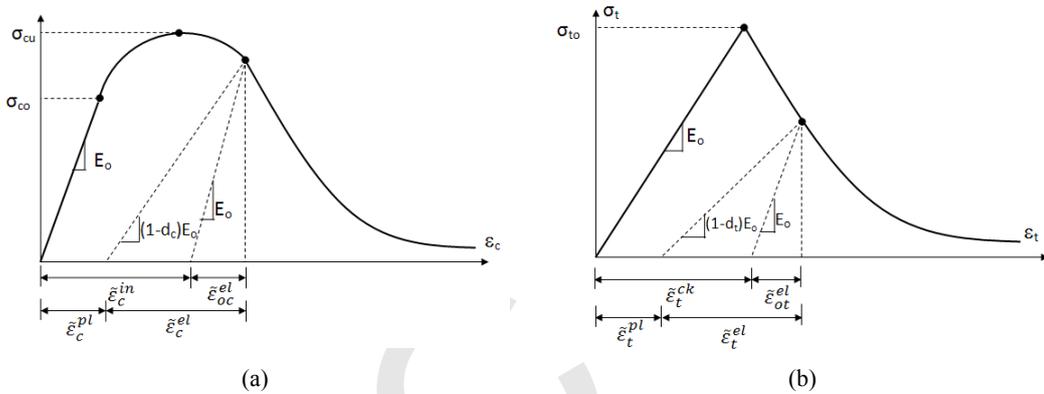
Betonarme elemanı, beton ve donatıdan oluşan kompozit bir yapıya sahiptir. Bununla birlikte güçlendirilme elemanı olarak FRP kompozitlerin de eklenmesiyle bilgisayar modelinin kurulmasındaki zorluk anlaşılacaktır. Birçok farklı model yaklaşımları arasında düzgün çalışan bir model kurmak için öncelikle her bir elemana ait uygun malzeme ve davranış modelini belirlemek gerekir. Bu çalışmanın amacı, FRP kompozitlerle iki yanından kesme kırılmasını önlemek için güçlendirilmiş betonarme kirişlerin yük altındaki davranışlarını nümerik olarak modellemektir.

Araştırmacılar tarafından betonun matematiksel modelini tanımlamaya yönelik birçok davranış modelleri önerilmiştir (Chen ve diğerleri, 1993). Elastisite, plastisite ve hasar mekaniği teoremleriyle beton davranışının modellenmesinde önemli ilerlemeler kaydedilmiştir. Ancak yapılan deneysel gözlemler (Van Mier, 1984; Dong, 1996) beton davranışını tanımlayacak matematiksel modelin betonun çatlama ve çatlama sonrası davranışını, dilasyon etkisini,

plastisite etkisini ve viskozite etkisini dikkate alması gerektiğini ortaya koymuştur (Liu ve diğerleri, 2008). Bu çalışmada betonun doğrusal olmayan davranışının modellenmesinde Beton Hasar Plastisite (BHP) yöntemi kullanılmış, malzeme modeli ise Kent-Park sargısız beton modeli ile tanımlanmıştır. Beton ve donatı arasında tam aderans olduğu kabul edilmiştir. FRP eleman davranışı kopma gerilmesine kadar lineer elastik olarak tanımlanmış ve FRP beton arasındaki etkileşim ise arayüz de kullanılan kohezif elemanlara çekme-ayırılma (traction-seperation) davranış modelinin uygulanmasıyla tanımlanmıştır. Aşağıda öncelikle bu davranış modelleri özetlenmiş ve daha sonra literatürden elde edilmiş, güçlendirilmiş kesme donatısı zayıf bir kirişin deney özellikleri anlatılmıştır. Davranış ve malzeme modellerinin belirlenmesiyle beton için uygun; çözüm ağı sıklığı, dilasyon açısı ve çatlama enerjisi araştırılarak deney sonucuna yakın sonuç veren sonlu elemanlar modeli elde edilmiştir. Sonuçlar grafiklerle yorumlanmıştır.

## Nümerik Modeller ve Malzeme Modelleri

Betonun nümerik davranışının modellenmesinde beton hasar plastisite modeli (BHP) kullanılmıştır. Bu yöntem, beton için plastisite tabanlı sürekli bir hasar modelini içerir (Monteleone, 2008). Bu yöntemde göre betonda temel 2 önemli yenilme mekanizması vardır; çekme çatlama ve basınç kırılması. BHP modelinde betonun eksenel çekme ve basınç gerilmeleri altında gerilme-şekil değiştirme davranışı Şekil 1’ deki gibi ifade edilmektedir.



Şekil 1. Eksenel çekme (a) ve basınç (b) altında beton davranışı (ABAQUS/Standart User Manual, 2009)

Şekil 1’ den anlaşılacağı gibi eksenel çekme ve basınç grafiklerinin azalıma geçmesiyle betonda plastik şekil değiştirmeler oluşmakta yani azalım eğrilerinin herhangi bir noktasından geri yükleme yapıldığında elastisite modülü değişmektedir. Bu değişim BHP yönteminde 0 ile 1 arasında değerler alan hasar değişkenlerine bağlı ifade edilmektedir. Betonda hasar oluşmadığı anda hasar değişkeni sıfır değerini alırken maksimum hasarda 1 değerini alır (ABAQUS/Standart User Manual, 2009).

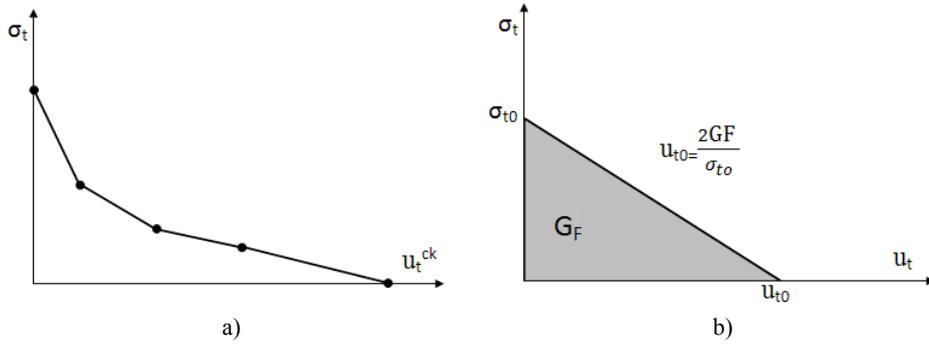
Grafiklerde  $E_0$  malzeme hasarsız elastisite modülünü göstermekte ve  $\epsilon_c^{pl}$ ,  $\epsilon_t^{pl}$ ,  $\epsilon_c^{in}$ ,  $\epsilon_t^{in}$  sırasıyla; eksenel basınç plastik şekil değiştirmesini, eksenel çekme plastik şekil değiştirmesini ve elastik olmayan basınç ve çekme şekil değiştirmelerini göstermektedir. Bu parametrelere bağlı olarak eksenel çekme ve basınç altında betonda gerilme-şekil değiştirmeler arasındaki bağıntı aşağıdaki formüllerle ifade edilmektedir.

$$\sigma_t = (1-d_t) \cdot E_0 \cdot (\epsilon_t - \epsilon_t^{pl}) \quad (1)$$

$$\sigma_c = (1-d_c) \cdot E_0 \cdot (\epsilon_c - \epsilon_c^{pl}) \quad (2)$$

BHP yönteminde donatı boyunca oluşan çatlaklarda beton davranışı çekme rijitliği (tension stiffening) tanımlanmasıyla belirlenir. Bu tanımlamayla aynı zamanda beton eksenel çekme gerilmesi altındaki davranışı da yapılmaktadır. Bu yüzden BHP yönteminde çekme rijitliği tanımlanması önemlidir. Çekme rijitliği tanımlanması gerilme-şekil değiştirme ilişkisiyle tanımlanabildiği gibi malzeme özelliğine bağlı çatlak enerjisi ile de yapılabilmektedir (ABAQUS/Standart User Manual, 2009).

Kesitte donatı olmaması veya az miktarda olması durumunda gerilme-şekil değiştirmeye bağlı çekme rijitliği tanımlanması sonlu elemanlar çözüm ağına problemlere neden olabilmektedir. Bu genel olarak çatlak oluşumunun kesitte düzgün olarak dağılmadığı durumlarda oluşur. Çatlak oluşumundaki bu problemin üstesinden gelmek için çekme rijitliği tanımlanmasında gerilme-şekil değiştirme tanımlanması yerine Hillerborg ve arkadaşları (1976) tarafından geliştirilmiş olan çatlak enerjisi yaklaşımı önerilmektedir. Bu yaklaşımda kesitte 1 birim alanda çatlak oluşturmak için gerekli enerji malzeme özelliği olarak tanımlanmaktadır. Bu yöntemle azalım, Şekil 2a’ daki gibi gerilme-çatlak genişliğine bağlı birkaç parametreye yapılabildiği gibi malzeme özelliği olarak sadece çatlak enerjisi (Şekil 2b) tanımlanmasıyla da yapılabilmektedir. Bu durumda gerilme-çatlak genişliği ilişkisi lineer olacaktır.



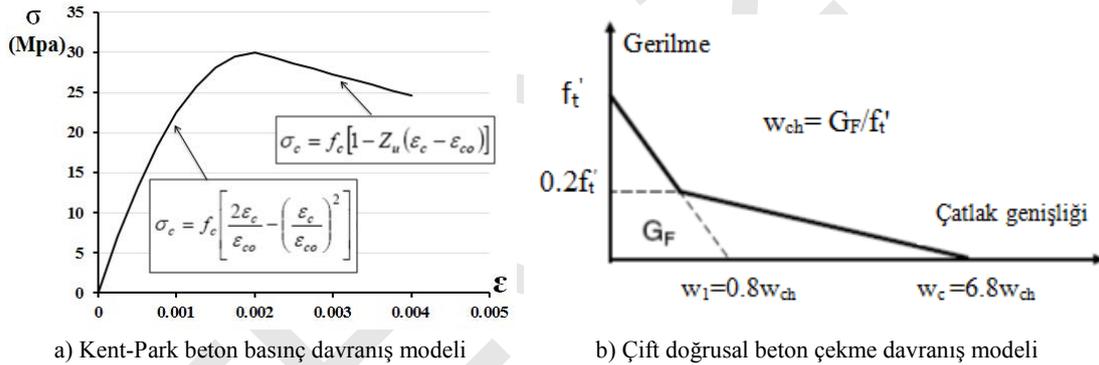
Şekil 2. Çatlama enerjisine bağlı çekme gerilmesi azalım eğrileri (ABAQUS/Standart User Manual, 2009)

BHP yönteminde elastik olmayan deplasman ve birim şekil değiştirmeler aksel çekme ve basınçta altında, plastik birim şekil değiştirmelere aşağıdaki formüllerle dönüştürülmektedir.

$$u_t^{pl} = u_t^{ck} - \frac{d_t - \sigma_t l_t}{(1-d_t) E_0} \quad (3)$$

$$\varepsilon_c^{pl} = \varepsilon_c^{in} - \frac{d_c - \sigma_c}{(1-d_c) E_0} \quad (4)$$

Betonun aksel basınç davranışının modellenmesinde Kent-Park sargısız beton basınç modelinden faydalanılmıştır (Şekil 3a). Beton çekme davranışı ise çift doğrusal azalım modeliyle (Şekil 3b) tanımlanmıştır (Coronado ve Lopez, 2006). Burada çatlak boyu ( $w_{ch}$ ), beton çekme gerilmesine ( $f_t'$ ) bağlı olarak, betonda bir birim alanda tam bir çatlak oluşturmak için gerekli enerji miktarıyla ( $G_F$ ) hesaplanmaktadır.



a) Kent-Park beton basınç davranış modeli

b) Çift doğrusal beton çekme davranış modeli

Şekil 3. Beton aksel çekme ve basınç malzeme modelleri

$$G_F = G_{fo} \left( \frac{f_t'}{10} \right)^{1.7} \quad (5)$$

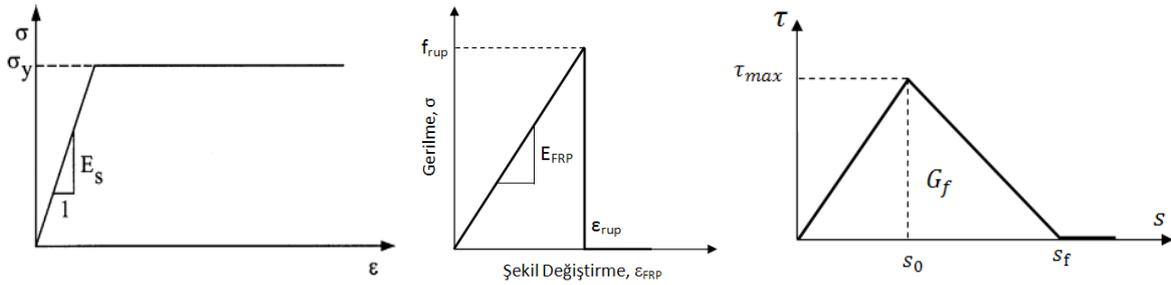
Tablo 1. Agrega çapına bağlı katsayı (CEB-FIB MC90)

| Maksimum agrega çapı, ( $d_{max}$ )<br>(mm) | Katsayı, ( $G_{fo}$ )<br>( $J/m^2$ ) |
|---|--------------------------------------|
| 8   | 25                                   |
| 16  | 30                                   |
| 32  | 58                                   |

Çatlama enerjisi ise Avrupa Beton Yönetmeliği'nde beton basınç gerilmesi ve agrega dane çapına bağlı olarak verilen aşağıdaki formülle hesaplanmış ve farklı dane çaplarıyla elde edilen çatlama enerjilerinin en uygunu nümerik analizlerle belirlenmeye çalışılmıştır. Burada  $G_{fo}$ , maksimum agrega çapına bağlı katsayıdır ve hesaplanmış bazı değerler Tablo 1' de görülmektedir.

Donatı malzeme modeli için nümerik analizlerde elastik tam plastik malzeme modeliyle tanımlanmıştır (Şekil 4a). FRP kompozitler kopma gerilmesine ( $f_{rup}$ ) kadar lineer elastik davranış gösterirler ve öncelikle akselleri doğrultusunda çekme gerilmesi taşımak üzere kullanılırlar (Niu ve Karbhari, 2008). Buna uygun olarak FRP malzeme davranışını bu çalışmada maksimum çekme gerilmesine kadar lineer elastik kabul edilmiştir (Şekil 4b). Arayüz elemanın malzeme modelinin tanımlanmasında Lu ve arkadaşları (2005) tarafından geliştirilmiş olan Bilinear Model kullanılmıştır (Şekil 4c). Bu modele göre kayma gerilmeleri maksimum kayma gerilmesine ( $\tau_{mak}$ ) kadar lineer olarak

artmakta daha sonra artan deplasmanlarla kayma gerilmeleri lineer olarak azalmaktadır. Deplasmanlar kopma deplasman değerini ( $s_f$ ) aştığında kayma gerilmeleri de sıfırlanmaktadır.

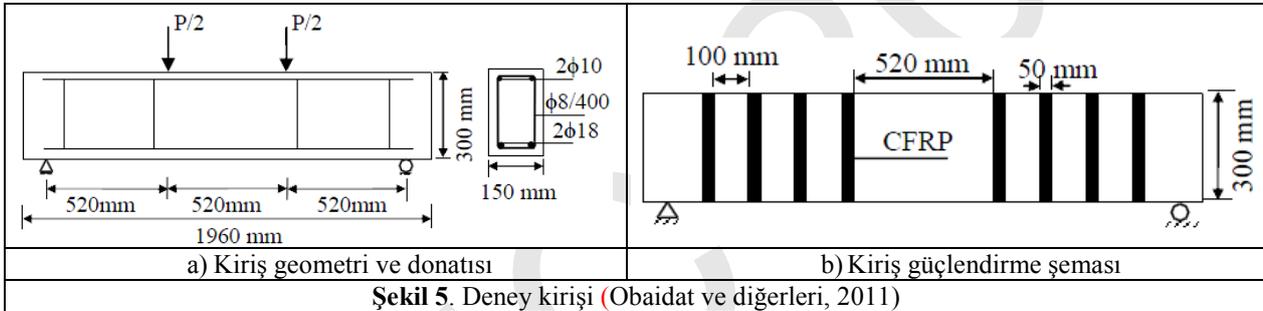


a) Çelik malzeme davranışı      b) FRP malzeme modeli      c) Bilinear çekme-ayırılma modeli

Şekil 4. FRP, çelik donatı ve epoksi malzeme modelleri

## Laboratuvar Deneyi ve Sonlu Elemanlar Modeli

Geliştirilen sonlu elemanlar modeli literatürden elde edilmiş güvenilir bir laboratuvar deneyi ile doğrulanmıştır. Deney kirişleri kesme yenilmesi oluşacak şekilde çekme bölgesinden 2 adet 18' lik basınç bölgesinden ise 2 adet 10' luk donatı ile donatılmıştır (Şekil 5a). Zayıf kesme donatılı olarak üretilen kirişler daha sonra kesme bölgesinden 1.2 mm kalınlığında ve 50 mm genişliğinde CFRP plakalarla güçlendirilmiş (Şekil 5b) ve 4 nokta yüklemesi altında yük-deplasman grafikleri elde edilmiştir.



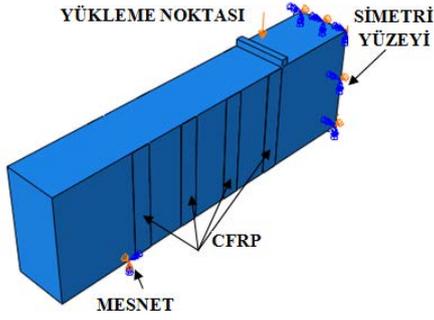
Şekil 5. Deney kirişi (Obaidat ve diğerleri, 2011)

Yükleme deplasman kontrollü olarak 2 mm/dk yüklem oranıyla gerçekleştirilmiştir. Kirişlerde kullanılan malzeme özellikleri Tablo 2' de verilmiştir.

Tablo 2. Kiriş malzeme özellikleri

| Eleman | E (GPa) | $\nu$ | $f_c'$ (MPa) | $f_y$ (MPa) | $f_t$ (MPa) |
|--------|---------|-------|--------------|-------------|-------------|
| Beton  | 26      | 0.2   | 30*          | -           | 1.8         |
| Donatı | 210     | 0.3   | -            | 507         | -           |
| Epoksi | 2.5     | 0.33  | -            | -           | 26          |
| CFRP   | 165     | 0.26  | -            | -           | 2000        |

Sonlu elemanlar modeli kiriş yüklemesi ve sınır şartlarına uygun olarak üç boyutlu katı elemanlarla oluşturulmuş ve simetriden dolayı kirişin yarısı modellenmiştir (Şekil 6). Boyuna donatılar 3 düğüm noktalı bağ elemanları ile modellenmiş ve betonla donatı arasındaki tam aderans olduğu kabul edilmiştir. Beton ve epoksi elemanları 8 düğüm noktasına sahip sürekli elemanlarla modellenirken, FRP ise 4 düğüm noktasına sahip kabuk elemanla modellenmiştir. Analizlerde eğilme deformasyonları gösterebilmesi ve daha az düğüm noktasında çözüm yaparak işlem zamanını kısaltması bakımından azaltılmış integrasyon elemanları kullanılmıştır. Analizlerde kullanılan, ABAQUS eleman kütüphanesinden seçilen eleman türleri Tablo 3' te görülmektedir.



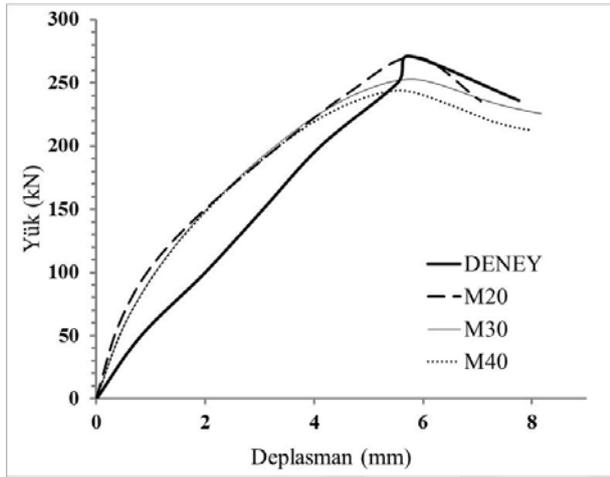
Şekil 6. Güçlendirilmiş kiriş tipik sonlu elemanlar modeli

## Sonuçlar ve Öneriler

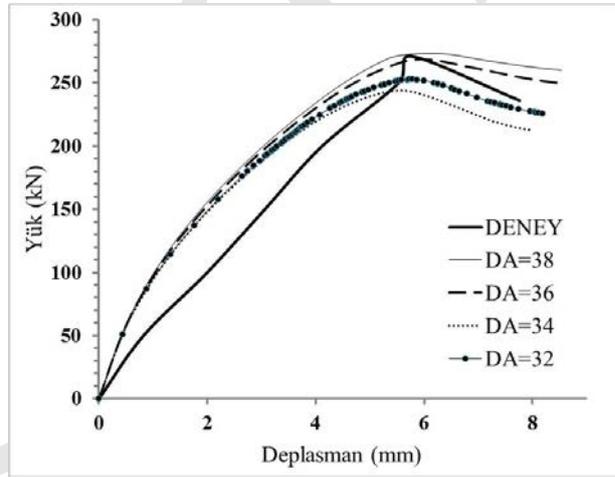
Geliştirilen 3 boyutlu sonlu elemanlar modeliyle zayıf donatılı ve CFRP ile kesme bölgesinden güçlendirilmiş betonarme kirişin doğrulamasında çözüm ağı sıklığı, dilasyon açısı ve çatlama enerjisi için elde edilen sonuçlar aşağıda verilmiştir.

Tablo 3. Analizde kullanılan eleman tipleri

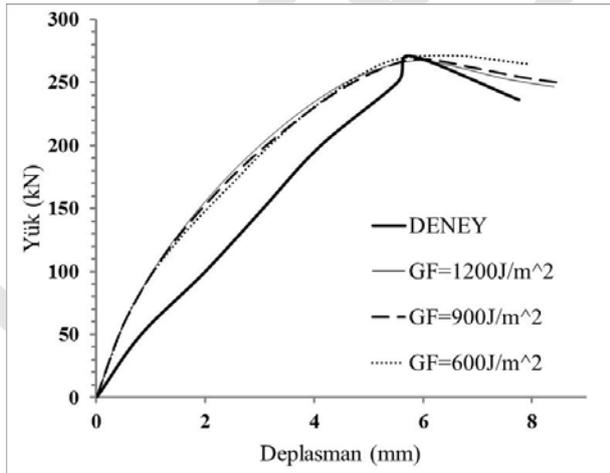
|           | Eleman Adı | Bilgi                                 |
|-----------|------------|---------------------------------------|
| Beton     | C3D8R      | Azaltılmış integrasyonlu katı eleman  |
| Donatılar | T3D2       | Gömülü                                |
| Epoksi    | COH3D8     | Kohezif eleman                        |
| FRP       | S4R        | Azaltılmış integrasyonlu kabuk eleman |



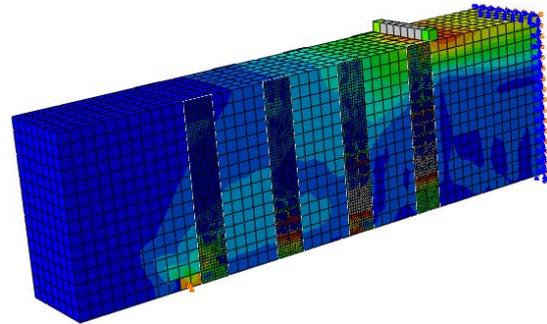
a) Farklı çözüm ağları ile yük-deplasman değişimi



b) Dilasyon Açısı değişimiyle yük-deplasman değişimi



c) Beton çatlama enerjilerine bağlı yük-deplasman değişimi



d) Tipik sonlu eleman boyutları

Şekil 7. Nümerik analiz sonuçları

Uygulanan çözüm ağları ile elde edilen yük-deplasman eğrileri, deney sonucuyla karşılaştırılmıştır (Şekil 7a). Sonlu eleman boyutunun yük taşıma kapasitesi tahmininde etkili bir faktör olduğu elde edilen sonuçların farklılığından anlaşılmaktadır. Farklı çözüm ağlarıyla yapılan analizlerde en iyi sonuç 20 mm' lik (M20) çözüm ağı kullanılan modelde elde edilmiştir. Sonlu eleman çözüm ağı sıklığı arttıkça deney sonucundan uzaklaşıldığı görülmüştür. Betonda plastik hacimsel değişimi belirleyen dilasyon açısının belirlenmesi için yapılan analizlerde ise yük-deplasman ilişkisi

bakımından  $36^{0}$  lik ( $DA=36$ ) açının deney sonucunu en iyi yakalayan değer olduğu görülmüştür (Şekil 7b). Bu değer üstündeki ve altındaki açılarda sonuçtan uzaklaşmaya başladığı görülmüştür. Betonda çatlama enerjisi agrega özelliklerine ve su/çimento karışımı oranına bağlı olarak hesaplanabilmektedir. Elde edilen sonlu elemanlar modelinin beton çatlama enerjisi bakımından hassasiyeti incelenmiştir (Şekil 9c). Bunun için hesaplanan 8, 16 ve 32 mm' lik maksimum agrega boyutuna sahip beton karışımları için elde edilen 600, 900 ve 1200 joule/m<sup>2</sup> çatlama enerjileri için yük-deplasman eğrilerinin değişimi incelenmiştir. Çatlama enerjisi değişiminin sonuçları çok fazla değiştirmedığı ancak 16 mm' lik dane çapı için daha yakın sonuç elde edildiği görülmüştür.

Sonuç olarak BHP yöntemi kullanılarak yapılan üç boyutlu analizlerde elde edilen yük-deplasman değerleri deney sonuçlarıyla yeter derecede uyum göstermiştir. Modelin en büyük hassasiyetinin çözüm ağı sıklığı olduğu elde edilen grafiklerden anlaşılmıştır. Önerilen sonlu elemanlar modeli başarılı olmakla birlikte model farklı deneysel test edilmelidir. Bu çalışmayla zayıf kesme donatılı betonarme kirişlerin güçlendirilmesinde kullanılabilecek bir sonlu elemanlar modeli elde edilmiştir. Bu model ile yapılacak kapsamlı parametrik çalışmalar sayesinde uygulamada kullanılabilecek en iyi güçlendirme yöntemi kısa zamanda belirlenebilecektir.

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# YUMUŞAK KAT DÜZENSİZLİĞİ BULUNAN BETONARME YAPILARIN DAVRANIŞINA FARKLI ZEMİNLERİN ETKİSİ

Naci CAGLAR<sup>1</sup>, Abdulhalim AKKAYA<sup>2</sup>, Muzaffer ELMAS<sup>1</sup>, Hakan OZTURK<sup>3</sup> ve Aydın DEMİR<sup>1</sup>

<sup>1</sup> Sakarya Üniversitesi, Mühendislik Fakültesi, İnşaat Mühendisliği Bölümü, Sakarya, Türkiye

<sup>2</sup> Sakarya Üniversitesi, Teknoloji Fakültesi, İnşaat Mühendisliği Bölümü, Sakarya, Türkiye

<sup>3</sup> Kilis 7 Aralık Üniversitesi, Mühendislik Fakültesi, İnşaat Mühendisliği Bölümü, Kilis, Turkey

**Özet:** Deprem etkisi altındaki yapıların davranışını belirleyen unsurlardan biriside zemin özellikleridir. Bu çalışmada, deprem etkisi altındaki betonarme yapıların davranışına zemin etkisi araştırılmış ve bu etkiyi daha belirgin olarak gözlemleyebilmek için yumuşak kat olumsuzluğu da çalışma kapsamına eklenmiştir. Bu amaçla, farklı özellikteki zeminler üzerinde inşa edilmiş olan ve yumuşak kat düzensizliği bulunan farklı katlara sahip 2 boyutlu yapı-zemin modelleri oluşturulmuştur. SAP2000 sonlu elemanlar analiz paket programı yardımıyla, bu yapı-zemin modellerinin dinamik analizleri yapılmış ve üst yapının davranışları grafikler halinde sunulmuş ve sonuçlar değerlendirilmiştir.

**Anahtar Kelimeler:** Betonarme yapıların davranışı, yumuşak kat, alüvyon ve kaya zemin, sonlu eleman analizi

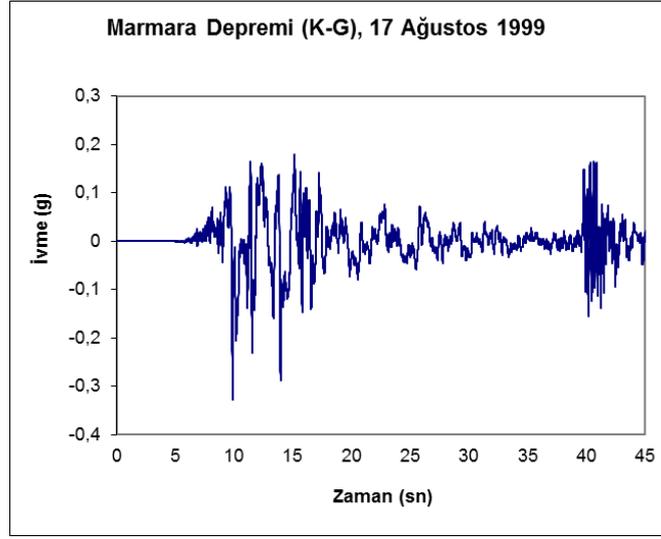
**Abstract:** One of the elements determining the behavior of structures under earthquake effect is the properties of soil. In this study, effects of soils on the structures under earthquake loading have been investigated and also to observe that effect more accurately negativity of soft story added in the scope of the study. For that reasons, 2 dimensional structure-soil models on different soil types and have soft story irregularity have been created. Dynamic analysis of that models have been made by using SAP2000 finite element spread sheet program. Behavior of the upper structure has been represented via graphs and evaluated.

**Key words:** Behavior of reinforced concrete structures, soft story, alluvial and rock soil , finite element analysis.

## Giriş

Ülkemizde ve birçok ülkede meydana gelen depremler çok sayıda can kaybı ve çok büyük miktarda maddi hasarlara neden olmuştur. Bu hasar ve can kayıplarının en önemli nedeni bu yapıların deprem performanslarının yetersiz olması ve yapı tasarımında yapılan hatalardır. Yapılarda bulunan yumuşak kat, zayıf kat ve kısa kolon gibi olumsuzluklar hasarların oluşmasında belirleyici olmaktadır. Bununla birlikte, 17 Ağustos 1999 Marmara depreminde, zemin Adapazarı'ndaki betonarme binaların hasar görmesinde çok önemli bir rol oynamıştır.

Bu çalışmada, deprem etkisi altındaki betonarme yapıların davranışına zemin etkisi araştırılmış ve bu etkiyi daha belirgin olarak gözlemleyebilmek için yumuşak kat olumsuzluğu da çalışma kapsamına eklenmiştir. Bu amaçla 14 adet farklı yapı-zemin modeli oluşturulmuş ve bu yapıların davranışını göstermek amacıyla yatay kat yer değiştirmeler belirlenmiştir. Yapı modellerinin dinamik analizlerinde Marmara depremi ivmesinin (Şekil 1) Yarımca-Petkim istasyonunda alınan ivme kaydı kullanılmıştır. Tüm yapı modellerinin dinamik analizleri, SAP2000 paket programı yardımıyla yapılmış ve sonuçlar grafikler halinde sunulmuştur.



Şekil 1. Marmara depremi ivme kaydı

## 2. Zemin-Yapı Etkileşimi

Zemin-yapı etkileşimi, çeşitli tipteki sistemlerin (alanların) tamamının veya bir kısmının birlikte dikkate alındığı ve analizlerinin yapıldığı birleşik sistemlerdir. Birleşik sistemlerin analizi, her sistemin ayrı ayrı analizi veya sistemlerin birbirlerine olan etkilerinin göz önüne alınması ile yapılır. Bu sistemler hesaplanırken herhangi bir alan (sistem) diğerinden ayrı çözülemez ve herhangi bir bağımsız değişken diferansiyel denklem düzeyinde yok edilemez (Zienkiewicz ve Taylor, 1991).

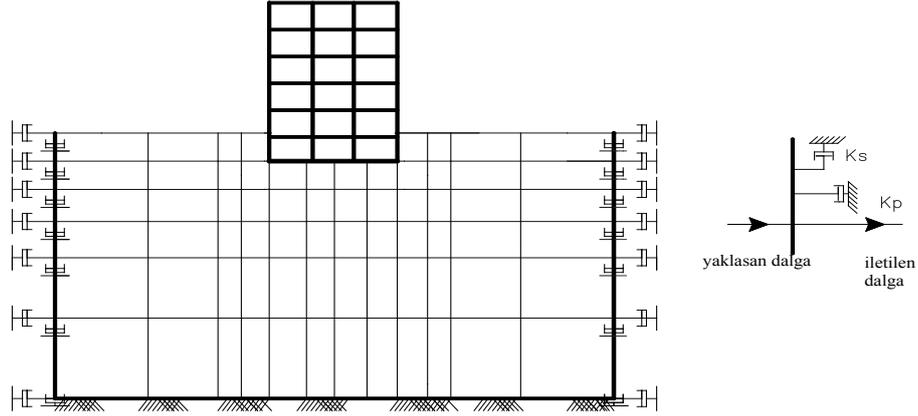
Zemin-yapı sisteminde yükleme ve kuvvetler, ortamlar aracıyla iletilir. Bu ortamlar hesaplama kolaylığı sağlamak için çeşitli gruplara ayrılır ve değişik şekillerde modellenirler: a) Sınırsız Ortam b) Sınırlı Ortam ve c) Etkileşim Ara yüzeyi

Yapı ile bitişik olan sınırlı zemin ortamı (yakın bölge) ve yapının kendisi doğrusal olmayan davranış gösterirken, yarı sonsuz sınırsız zemin ortamının ise doğrusal olarak davrandığı kabul edilir. Yapı ile bitişik sınırlı zemin ortamının büyüklüğü, zemin davranışının doğrusal olmayan davranıştan, doğrusal davranışa geçiş yaptığı etkileşim ara yüzeyine kadar olan bölge kabul edilebilir (Gutierrez, 1976).

Bir yapının sismik davranışı üst yapı, deprem kaynağı, zemin şartları ve temelin özellikleri ile yakından ilgilidir. Zemin ve yapının karşılıklı etkileşimi, üst yapı ve yerel zeminin dinamik karakteristiklerini etkiler. ZYE yapıda kütle ve rijitlik dağılımını etkilediğinden sistemin bütününde frekans ve mod şekillerinin değişimine neden olur. Tasarım aşamasında genellikle yapı zemine rijit bağlı olarak hesaplanmaktadır. Yapının zemine rijit bağlı olarak dinamik çözümü, yapı onu çevreleyen zemin ile etkileşim halinde bulunduğundan tek başına yeterli değildir ve ZYE'nin göz önüne alınması gereklidir. ZYE problemlerinin çözümünde genellikle Direkt Metot kullanılır.

Direkt metotta dinamik yükleme etkisi altında zemin yapı sisteminde, yer değiştirme, mod şekilleri ve kesit tesirleri zaman ve frekansa bağlı olarak tek adımda Sonlu Elemanlar Modeli (SEM) kullanılarak bulunmaktadır. Belirli yönlerde sonsuza uzanan zemin, kesim yüzeyleri ile kesilerek kesim yüzeylerine yarı sonsuz zeminin özelliklerini yansıtacak özel sınır şartları konur. Yapılan parametrik çalışmalar, zemin sonlu eleman ağının, özellikle geometrik sönümün (radyasyonun) önemli olduğu yüksek frekanslı yer hareketlerinde ve zeminin sönümünün büyük olması gibi özel durumlarda, yapı temel taban genişliğinin sağ ve solunda 8~10 katına kadar uzatılmasının yeterli olacağı belirtilmektedir[8].

Viskoz sınır şartı, yapıdan belirli bir mesafeden sonra kesilerek elde edilen zeminin sınır yüzeylerine uygulanmaktadır. Viskoz sınır şartının kullanılabilmesi için, düzlem dalga yayılımının izotrop ve lineer elastik bir ortamda gerçekleşmesi gerekmektedir. Ayrıca dalgaların sınıra çarpma açısını küçültmek için yapay sınırların yapıdan oldukça uzak bir bölgede tanımlanması gerekmektedir. Bu durumda yakın bölge çok sayıda sonlu elemanla modellenerek temsil edilmektedir (Şekil 2).



Şekil 2. Direkt metotta sınır şartları (Viskoz sınırlar)

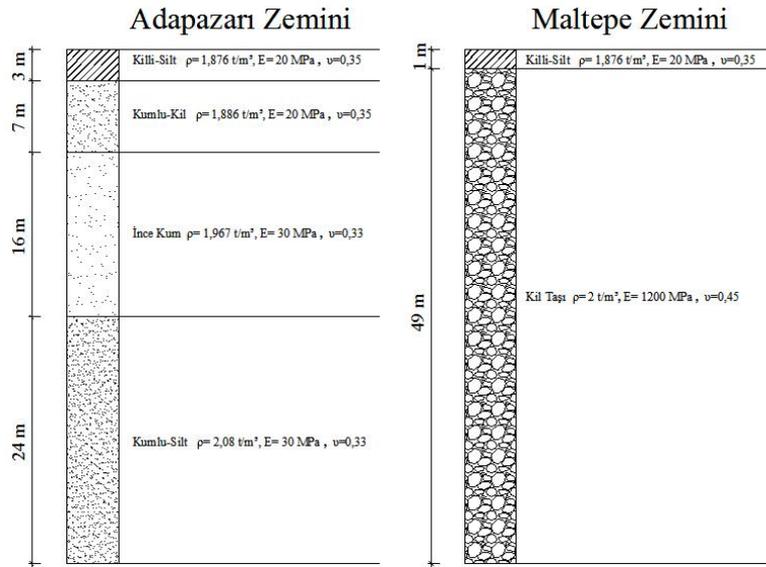
### 3. Sayısal Çalışma

Bu çalışmada, deprem etkisi altındaki betonarme yapıların davranışına zemin etkisi araştırılmış ve bu etkiyi daha belirgin olarak gözlemleyebilmek için yumuşak kat olumsuzluğu da çalışma kapsamına eklenmiştir. Bu amaçla oluşturulan yapı-zemin modellerinin üst yapısı Model A ve Model B olmak üzere iki ana gruba ayrılmıştır. Model A yapılarının zemin kat yükseklikleri 3 m olarak modellenmiştir. Model B yapıları ise yumuşak kat düzensizliği bulunan yapılar olarak modellenmiş ve zemin kat yükseklikleri 4 m olarak seçilmiştir. Yapı modellerin tamamında, normal kat yükseklikleri sabit tutulmuş ve 3 m olarak modellenmiştir (Tablo 1).

Tablo 1. Modellerin genel özellikleri

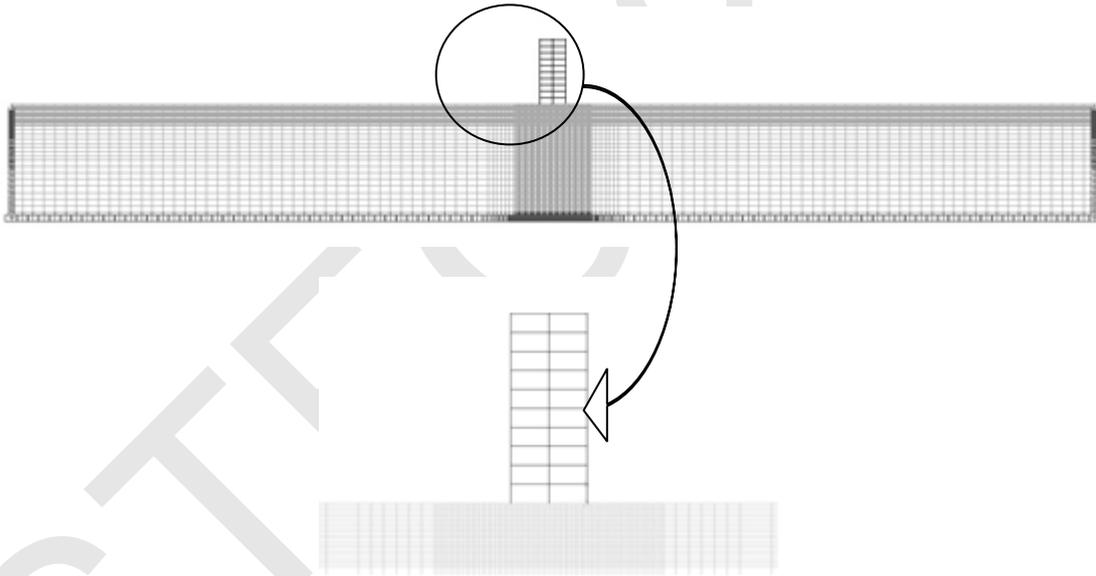
| Modeller | Zemin   | $h_{Zemin}$<br>(m) | $h_{Normal}$<br>(m) | Kat<br>Sayısı |
|----------|---------|--------------------|---------------------|---------------|
| Model A1 | Alüvyon | 3.00               | 3.00                | 4             |
|          | Kaya    |                    |                     |               |
| Model A2 | Alüvyon |                    |                     | 5             |
|          | Kaya    |                    |                     |               |
| Model A3 | Alüvyon |                    |                     | 6             |
|          | Kaya    |                    |                     |               |
| Model A4 | Alüvyon |                    |                     | 7             |
|          | Kaya    |                    |                     |               |
| Model A5 | Alüvyon |                    |                     | 8             |
|          | Kaya    |                    |                     |               |
| Model A6 | Alüvyon |                    |                     | 9             |
|          | Kaya    |                    |                     |               |
| Model A7 | Alüvyon |                    |                     | 10            |
|          | Kaya    |                    |                     |               |
| Modeller | Zemin   | $h_{Zemin}$<br>(m) | $h_{Normal}$<br>(m) | Kat<br>Sayısı |
| Model B1 | Alüvyon | 4.00               | 3.00                | 4             |
|          | Kaya    |                    |                     |               |
| Model B2 | Alüvyon |                    |                     | 5             |
|          | Kaya    |                    |                     |               |
| Model B3 | Alüvyon |                    |                     | 6             |
|          | Kaya    |                    |                     |               |
| Model B4 | Alüvyon |                    |                     | 7             |
|          | Kaya    |                    |                     |               |
| Model B5 | Alüvyon |                    |                     | 8             |
|          | Kaya    |                    |                     |               |
| Model B6 | Alüvyon |                    |                     | 9             |
|          | Kaya    |                    |                     |               |
| Model B7 | Alüvyon |                    |                     | 10            |
|          | Kaya    |                    |                     |               |

Yapı-zemin modellerinin alt yapıları ise alüvyon zemin ve kaya zemin özellikleri kullanılarak oluşturulmuş ve sert zemin ile yumuşak zemin etkileri dikkate alınmıştır. Alüvyon zemin modelinde Adapazarı zemin özellikleri ve kaya zemin modelinde ise Maltepe zemin özellikleri kullanılmıştır (Şekil 3).



Şekil 3. Yapı-zemin modelinde kullanılan zemin profilleri [Seyhan]

Yapı-zemin modellerinin sonlu eleman modelleri (Şekil 4) SAP2000 paket programı kullanılarak oluşturulmuştur. Yapı-zemin modellerinin alt yapısı olan zeminin derinliği 50m olarak seçilmiş ve bu seviyede kaya üzerine oturduğu varsayılarak ankastre mesnet tanımlanmıştır.



Şekil 4. Yapı-Zemin modelinin sonlu elemanlar modeli

Zemin modeli yapının her iki ucundan yapı genişliğinin en az 10 katı kadar uzun olmak üzere 500 m genişliğinde oluşturulmuştur. Yapı-zemin modeline etki eden deprem dalgalarının zemin sınırlarından yansiyarak tekrar modele geri dönmesini engellemek amacıyla zemin sınırlarında sönümleyiciler içeren Lysmer sınırları tanımlanmıştır. Yapı-zemin modellerinin tamamında üst yapı betonarme olarak tasarlanmış dolayısıyla Elatisite Modülünün  $E = 28 \text{ GPa}$ , Poisson oranının  $\nu = 0.20$  ve kütle birim hacim ağırlığının  $\rho = 24 \text{ kN/m}^3$  olduğu varsayılmıştır. Betonarme yapının tüm katlarında zati yük  $p = 2,0 \text{ kN/m}^3$  ve hareketli yük  $q = 1,50 \text{ kN/m}^3$ , kolonları  $50\text{cm} \times 50\text{cm}$  ve kirişleri  $25\text{cm} \times 50\text{cm}$  boyutlarında dikdörtgen olarak tasarlanmış ve yapı yüksekliği boyunca sabit tutulmuştur.

#### 4. Sonular

Yapı elemanlarının zorlanmaları görelı kat yer deęiřtirmeleri ile doęru orantılı olduęundan bu alıřmada yapı-zemin modellerinin görelı kat yer deęiřtirmeleri grafikler halinde sunulmuřtur. SAP2000 paket programı yardımıyla yapılan zaman tanım alanındaki dinamik analizler ile kat seviyesindeki yer deęiřtirmelerin maksimum deęerleri bulunmuřtur. Bu deęerler kullanılarak elde edilen görelı kat yer deęiřtirmeleri her bir yapı-zemin modeli için grafikler halinde sunulmuřtur (řekil 7-8). Bu grafiklerde, zemin-yapı etkileřimi dikkate alınarak yapılan dinamik analiz sonuları ile yapıların ankastre baęlı olması durumunda elde edilen sonular karřılařtırılmıřtır.

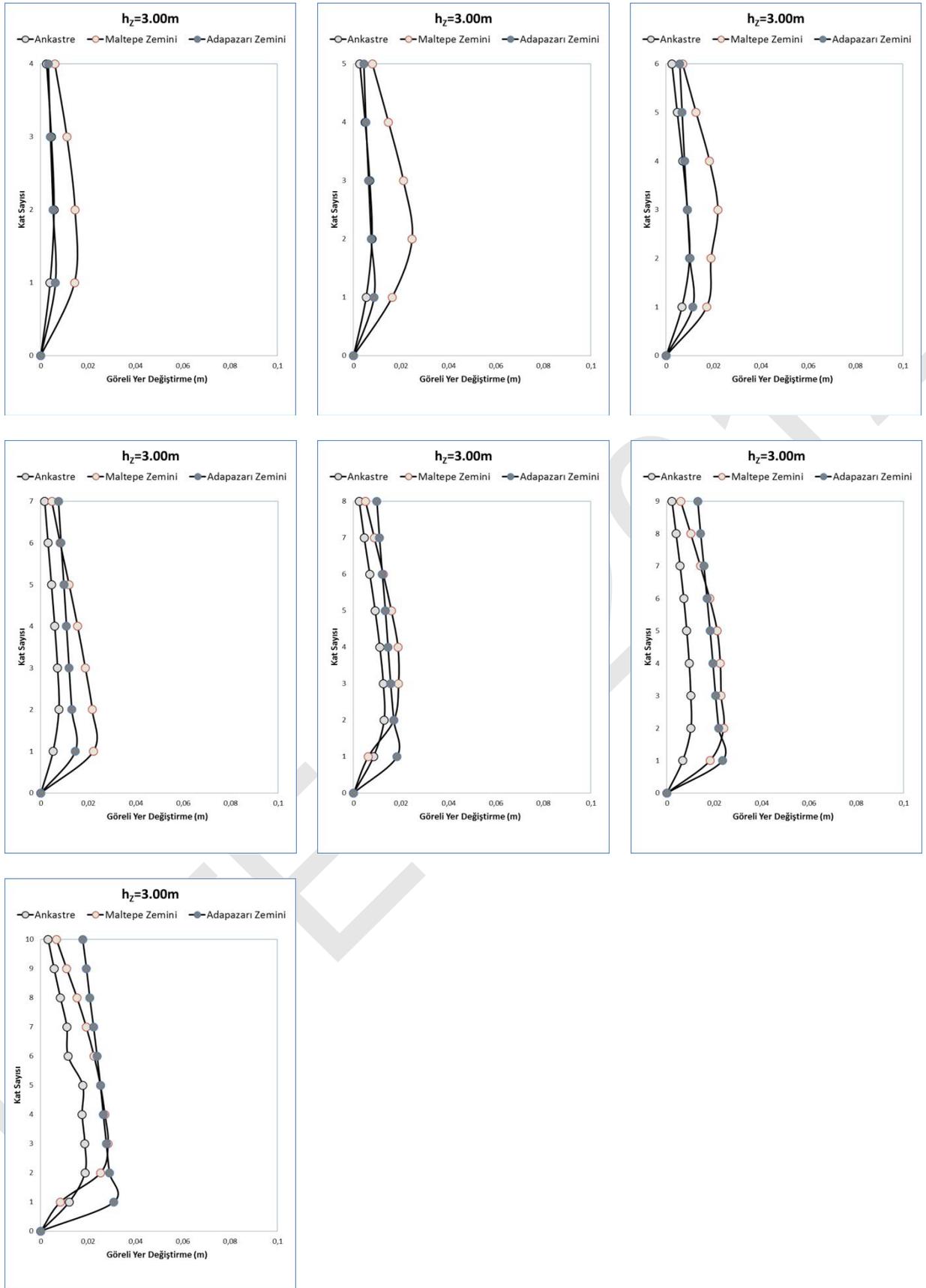
Bu alıřmada sadece, dinamik büyütme katsayısının (řekil 9) zemin-yapı modellerinin dinamik davranıřı üzerindeki etkileri incelenmiřtir. Bu amala, üst yapı (ankastre mesnetli yapı) modellerinin frekansları ile alt yapı (zemin) frekansları oranlanmıř ve dinamik büyütme katsayıları belirlenmiřtir (Tablo 2-3).

Tablo 2. A tipi modellerin (Hz=3m) dinamik büyütme katsayıları

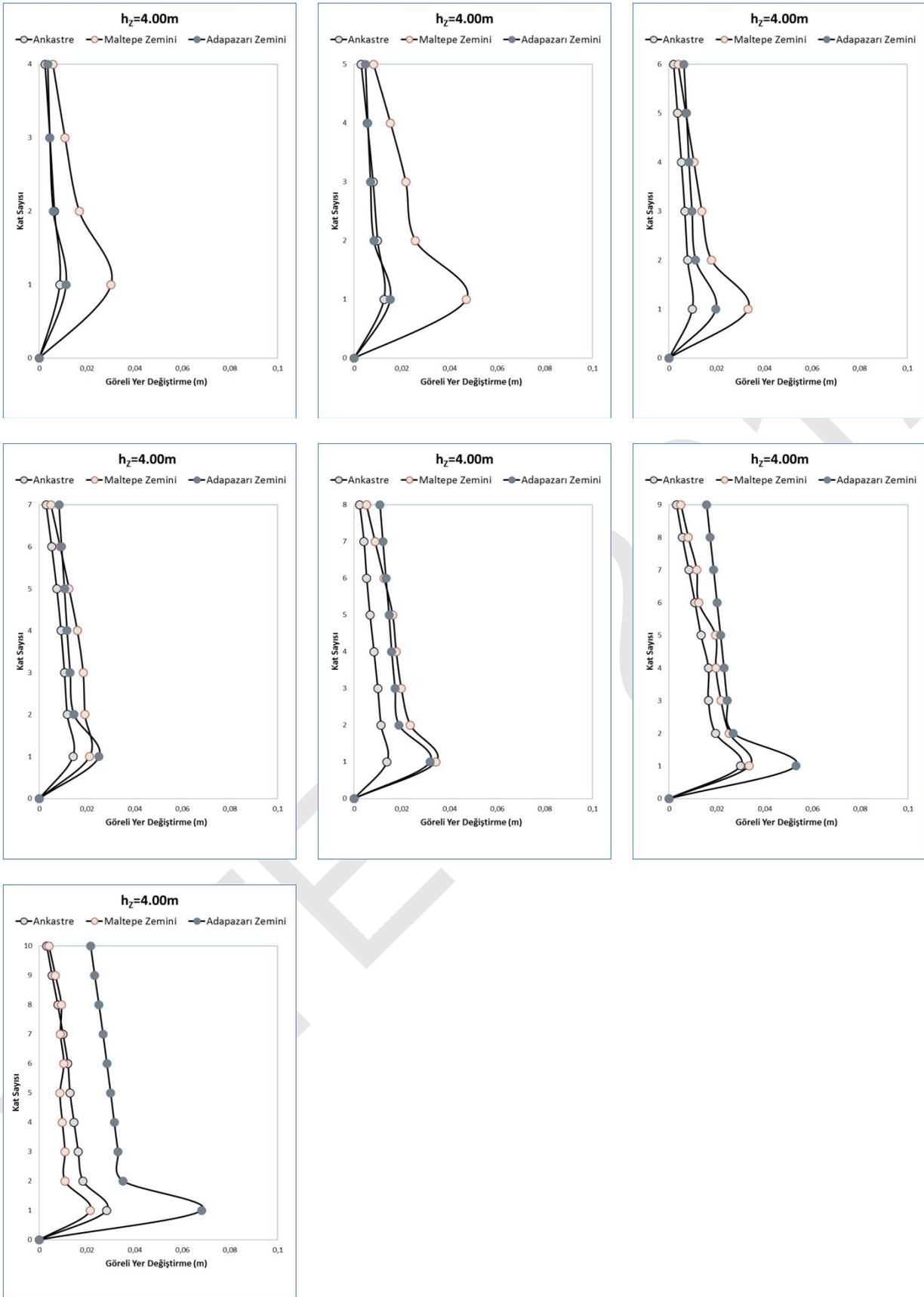
| Modeller | Kat Sayısı | Dinamik büyütme katsayısı |         |
|----------|------------|---------------------------|---------|
|          |            | Kaya                      | Alüvyon |
| Model A1 | 4          | 1,69                      | 1,01    |
| Model A2 | 5          | 2,88                      | 1,02    |
| Model A3 | 6          | 9,84                      | 1,03    |
| Model A4 | 7          | 2,69                      | 1,04    |
| Model A5 | 8          | 1,24                      | 1,05    |
| Model A6 | 9          | 0,76                      | 1,07    |
| Model A7 | 10         | 0,53                      | 1,09    |

Tablo 3. B tipi modellerin (Hz=4m) dinamik büyütme katsayıları

| Modeller | Kat Sayısı | Dinamik büyütme katsayısı |         |
|----------|------------|---------------------------|---------|
|          |            | Kaya                      | Alüvyon |
| Model B1 | 4          | 2,24                      | 1,02    |
| Model B2 | 5          | 5,68                      | 1,03    |
| Model B3 | 6          | 4,34                      | 1,04    |
| Model B4 | 7          | 1,58                      | 1,05    |
| Model B5 | 8          | 0,90                      | 1,06    |
| Model B6 | 9          | 0,60                      | 1,08    |
| Model B7 | 10         | 0,44                      | 1,10    |



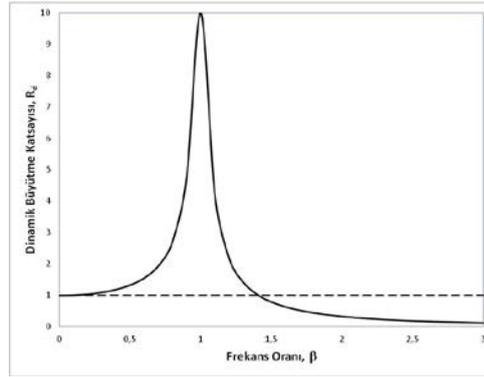
Şekil 7. Model A yapılarının ( $h_2=3m$ ) görelî ket yerdeğişirmelerinin katlara göre deęişimi



Şekil 8. Model B yapılarının ( $h_z=4m$ ) görel ket yerdeğiştirmelerinin katlara göre değişimi

Şekil 7-8 dikkatle incelendiğinde, yapıların dinamik davranışında zeminin etkisinin önemli bir rol oynadığı görülmektedir. Bu grafiklerden de görüldüğü gibi, yapıların dinamik davranışında Tablo 2-3 de verilen dinamik

büyütme katsayılarının paralelinde değişiklikler olduğu açıktır. Bu etki, özellikle yumuşak kat olumsuzluğu bulunan B tipi yapı modellerinde çok daha belirgin olarak gözükmemektedir.



**Şekil 9.** Frekans oranlarına karşılık gelen dinamik büyütme katsayısı değişimi

Şekil 7-8 den görüldüğü gibi, sonuçların bazıları dinamik büyütme katsayılarından farklılıklar göstermektedir. Bunun nedeni, yapı zemin etkileşimi problemlerinde tek belirleyici unsurun sadece dinamik büyütme katsayısı olmamasıdır. Ayrıca, Tablo 2-3 de verilen dinamik büyütme katsayıları, üst yapı ile alt yapının birlikte çalıştığı zemin yapı modellerinin dinamik büyütme katsayılarından farklı olacağı belirgindir.

Dinamik büyütme katsayısının dışında, yapı-zemin etkileşimi problemleri dikkate alındığında sonuçları etkileyen bir çok parametre vardır. Bunlardan bazıları; a) yapı yüksekliği ile temel derinliği arasındaki etkileşim b) alt yapı (zemin) etkisinden dolayı üst yapının mod şekillerindeki değişimler c) yapı yüksekliğinin yapı genişliğine oranının (H/B) değişimi d) yapının katsayısındaki farklılıklar gibi parametreler olarak sayılabilir.

Tüm bu sonuçlar dikkate alındığında, yapıların tasarımı yapılırken zemin etkilerinin dikkate alınmaması veya sadece lineer büyütme katsayıları kullanılarak yapıların davranışının belirlenmesi gerçek davranışın çok uzağında sonuçlar elde edilmesine neden olacaktır. Dolayısıyla, yapıların tasarımı aşamasında zemin etkisi de dikkate alınarak analizler yapılmalı ve tasarımlar bu sonuçlar dikkate alınarak özenle yapılmalıdır.

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# ZAMAN TANIM ALANINDA DOĞRUSAL ANALİZ İLE MOD BİRLEŞTİRME YÖNTEMİNİN KIYASLANMASI: 32 KATLI BETONARME YAPI ÖRNEĞİ

Gökhan DOK, Muharrem AKTAŞ  
Sakarya Üniversitesi  
İnşaat Mühendisliği Bölümü  
Türkiye  
gdok@sakarya.edu.tr, muhrrema@sakarya.edu.tr

**Özet:** Deprem hareketlerinin yapılarda meydana getirdiği dinamik etkileri tespit etmek için mod birleştirme yöntemi en çok kullanılan analiz yöntemlerindedir. Daha çok zaman alan ve gerçek deprem kayıtlarının kullanıldığı zaman tanım aralığında analiz yöntemi daha gerçekçi sonuçlar vermektedir. Bu çalışmada her iki yöntem kullanılarak, 32 katlı betonarme bir yapı üzerinde analizler yapılmış ve sonuçlar kıyaslanmıştır. Planda ve düşeyde düzensizliği bulunmayan, taşıyıcı sistemi perde-çerçeve olan betonarme yapının her iki metotla analizinde de SAP2000 sonlu elemanlar programı kullanılmıştır. Her iki metotla elde edilen taban kesme kuvvetleri, devrilme momentleri, düşey taşıyıcıların iç kuvvetleri ve maksimum yer değiştirmeler karşılaştırılarak analiz yöntemleri arasındaki farklar tartışılmıştır.

**Anahtar Kelimeler:** Zaman tanım alanında hesap, mod birleştirme yöntemi, dinamik analiz

## Giriş

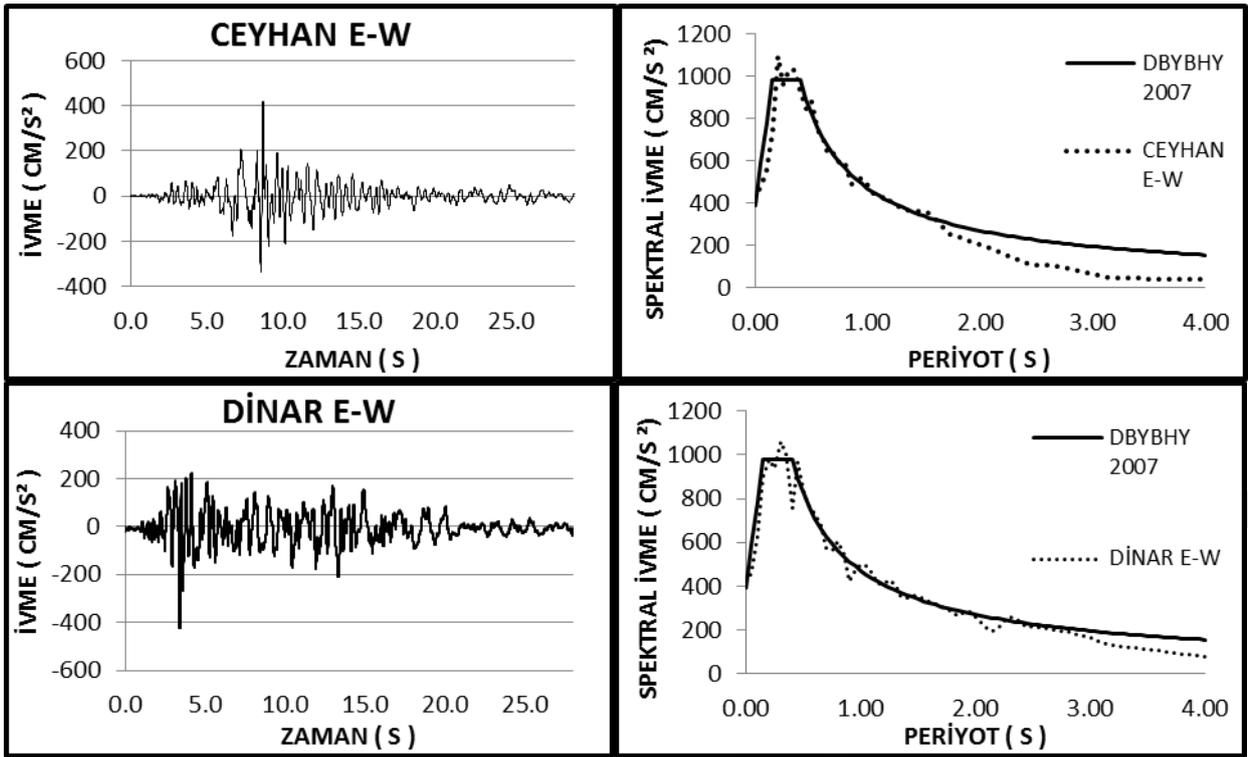
Yapıların dinamik analizlerinde farklı yöntemler kullanılmaktadır. Bu çalışmada yönetmeliklerde de adı geçen ve uluslararası olarak kabul görmüş iki yöntem için yapılan analizlerin betonarme çok katlı bir yapı örneği üzerinde oluşturduğu etkiler karşılaştırılmış ve sonuçlar irdelenmiştir. Elde edilen sonuçlardaki farklılıklar ve benzerlikler tespit edilmeye çalışılmıştır.

## Mod Birleştirme Yöntemi

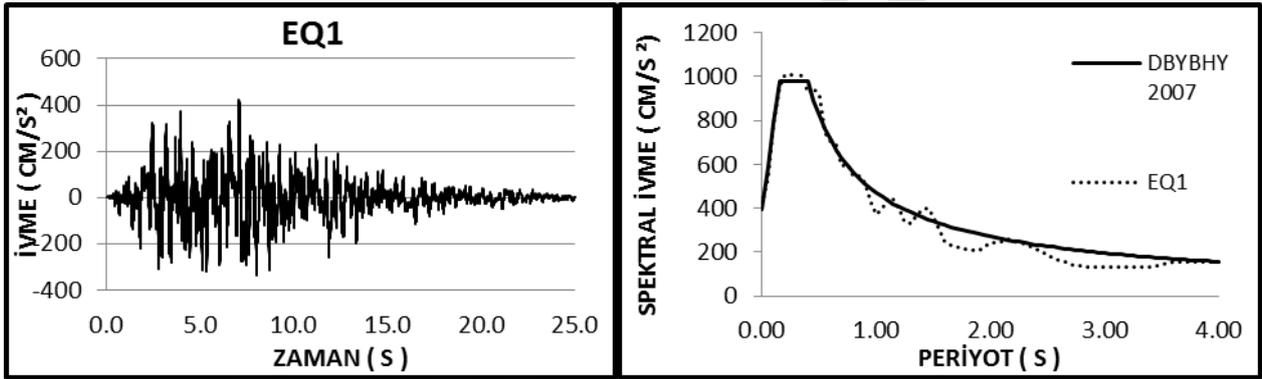
Yapıda oluşan maksimum iç kuvvetler ve yer değiştirmelerin hesaplanmasında, her bir doğal titreşim modunda hesaplanan maksimum katkıların istatiksel olarak bir araya getirilmesi dikkate alınır. Her bir mod için hesaplanan maksimum katkıları istatiksel olarak birleştirilirken iki yöntem uygulanır. Eğer ardışık iki titreşim modunun doğal periyotları oranı 0.8'den az ise; maksimum mod katkılarının bir araya getirilmesinde Karelerinin Toplamının Karekökü kuralı uygulanabilir. Eğer bu oran sağlanmıyorsa, tam karesel yöntem uygulanabilir. Ancak bu yöntemde kullanılacak çapraz korelasyon katsayılarının hesabında, bütün modlarda sönüm oranı % 5 alınmalıdır (Dbybhy 2007).

## Zaman Tanım Alanında Hesap Yöntemi

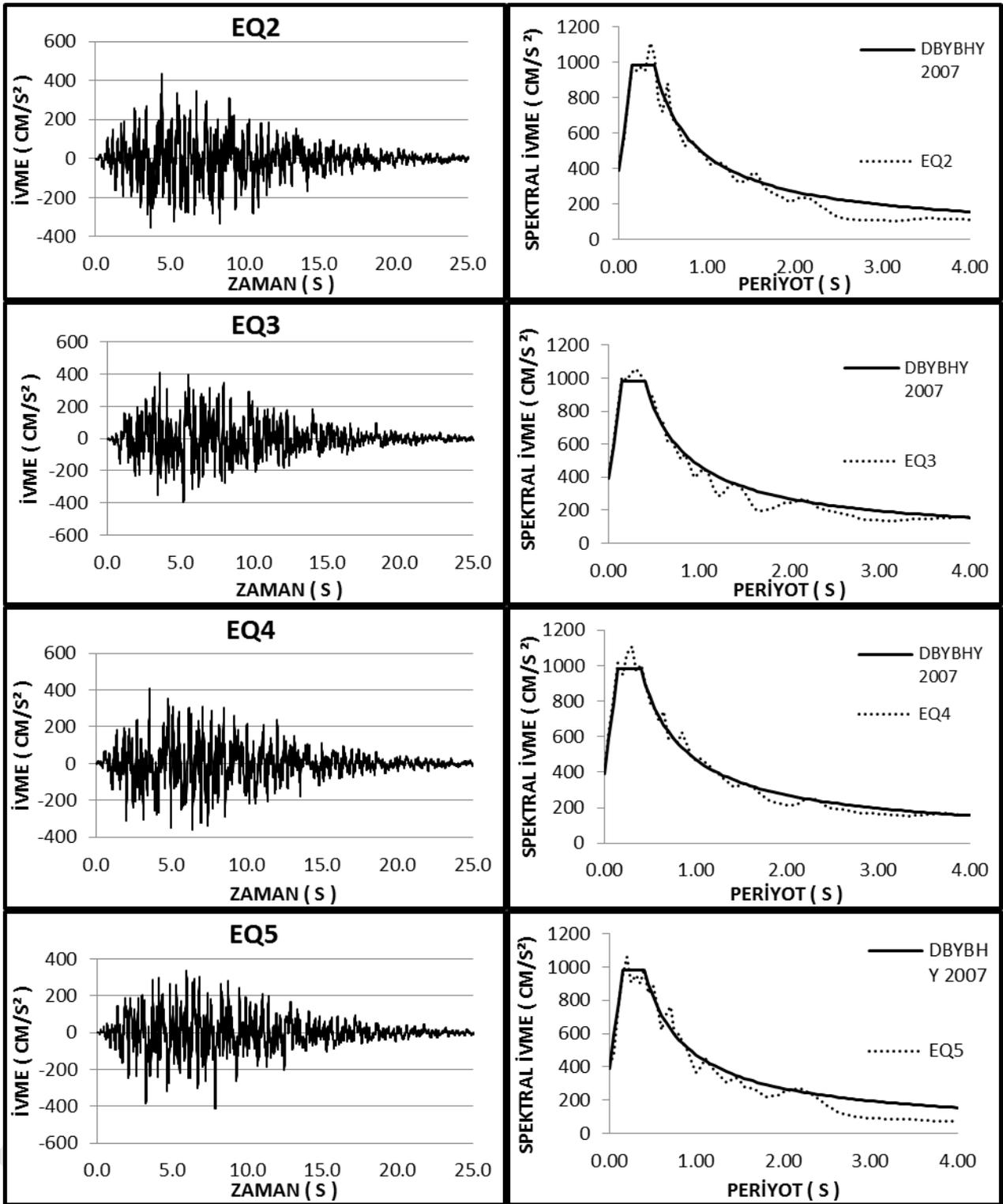
Bu yöntemde bina türü yapıların gerek doğrusal elastik gerekse doğrusal elastik olmayan deprem hesabında, hem daha önce kaydedilmiş hem de yapay yollarla üretilen deprem yer hareketleri kullanılabilir. Ancak yapay yer hareketi kullanılması durumunda en az üç yer hareketi üretilmesi DBYBHY 2007'de istenmektedir. Üç yer hareketi kullanılması durumunda sonuçların maksimumu, yedi ve üzeri sayıda yer hareketi kullanılması durumunda ise sonuçların ortalaması alınarak tasarım yapılabileceği şartnamede belirtilmiştir (Dbybhy 2007). Üretilecek olan bu kayıtların sürelerinin 15 saniyeden kısa olmaması gerekmektedir. Ayrıca birinci doğal titreşim periyodunun 5 katından daha kısa süreli kuvvetli yer hareketi içeren kayıt istenmemektedir. Üretilecek olan kayıtların ivme değerleri ile ilgili olarak (Dbybhy 2007) bölgeler için verilen minimum ivme değerlerinden daha az olmayacak şekilde ortalama spektral ivme değerlerine sahip olması beklenmektedir. Yine üretilen kayıttan elde edilen ivme değerleri hiçbir zaman DBYBHY 2007'de tanımlanan elastik spektral ivme eğrisinin azalan kısmında bulunan değerlerin %90'ından az olmayacak şekilde kayıtlar üretilmelidir. Bu çalışmada Z2 zemin sınıfı için DBYBHY 2007'deki elastik tasarım spektrumuna göre ölçeklendirilmesiyle oluşan Ceyhan E-W ve Dinar E-W kayıtları ile aynı tasarım spektrumuna göre üretilmiş 5 yapay ivme kaydı kullanılmıştır. Ceyhan E-W 29.195, Dinar E-W 27.965, diğer 5 yapay ivme kaydı ise 25 saniyedir.



Şekil 1: Ölçeklendirilmiş ivme kayıtları ve spektrumla ilişkileri (Peer 2011)



Şekil 2: Üretilmiş ivme kayıtları ve spektrumla ilişkileri (Başot T. 2010)



Şekil 3: Üretilmiş ivme kayıtları ve spektrumla ilişkileri (Başot T. 2010)

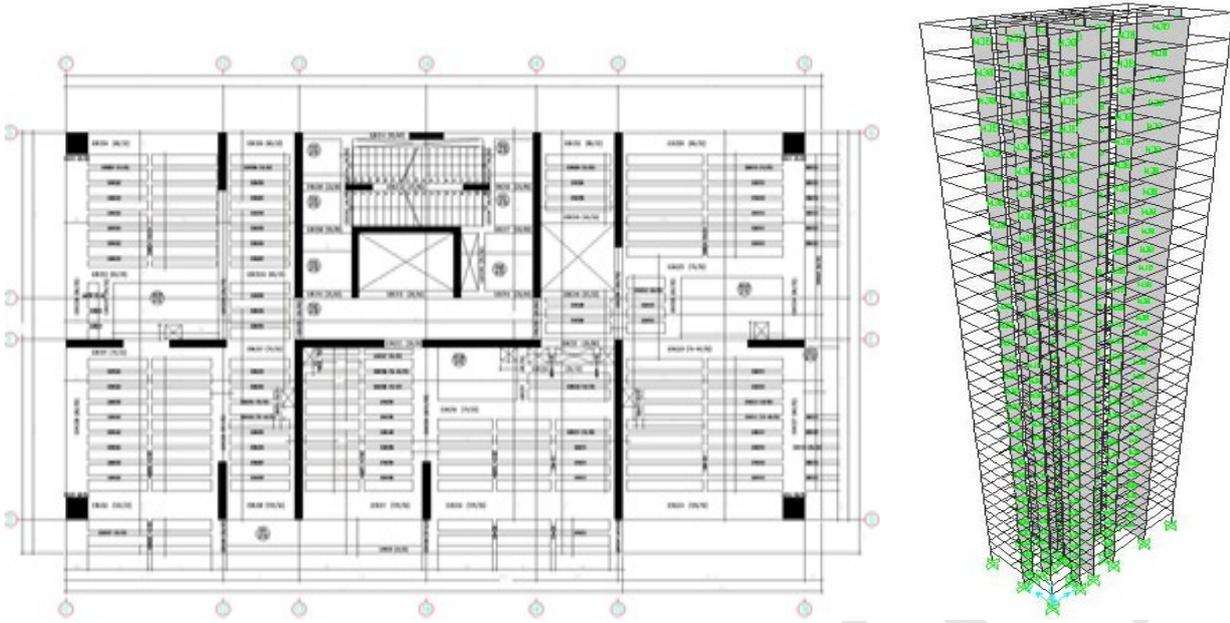
## Yapı Genel Bilgileri

Bu çalışmada incelenen yapının kat yüksekliği 3 m olup 32 katlıdır. Yapımız 27.5 x 14.1 m'lik alan taban alanına sahiptir. Z2 (Sıkı kum) zemin sınıfında bulunan, 1. Derece deprem bölgesinde olan yapının kullanım amacı konuttur. Taşıyıcı sistemi betonarme perde-çerçeve olan yapıda C35-S420 malzemesi kullanılmıştır. Mevcut kalıp planına kesitlerde minimum donatı kabulü yapılmış ve her bir perde, kolon, kiriş kesiti için bu donatılar hesaplanmıştır. Ayrıca perdelerde başlık kesiti ve başlık donatısı tespit edilmiştir. Perdeler deprem etikleri altında iken uç bölgelerinin çok büyük çekme ve basınç gerilmelerine maruz kalmasından dolayı bu düzenleme yapılmıştır. Perde uç bölgelerindeki başlık kesitleri kolon gibi tasarlanmış ve burada kolonlardaki donatı düzenine uygun olarak donatı alanları ve adetleri

seçilmiştir. Donatı alan ve adetleri için yapılan hesaplamalar ve kabuller bütün perde, kolon ve kiriş kesitleri için ayrı ayrı olmak üzere Tablo-1’de ayrıntılı olarak verilmiştir.

**Tablo 1:** Kesit boyutları ve donatı miktarı

| Kesit(Cm) | Başlık Kesiti (cm) | Minimum Donatı Oranı | Minimum Donatı Alanı (cm <sup>2</sup> ) |       | Seçilen Donatı |         |            |
|-----------|--------------------|----------------------|---|-------|----------------|---------|------------|
|           |                    |                      | Başlık                                  | Gövde | Başlık         | Gövde   |            |
| Perde     | 25x250             | 25X50                | 0,01                                    | 12,50 | 13,56          | 8 □ 16  | 12 □ 12/25 |
|           | 25x420             | 25X85                | 0,01                                    | 20,00 | 22,60          | 12 □ 16 | 20 □ 12/25 |
|           | 30x210             | 30X50                | 0,01                                    | 15,00 | 11,30          | 8 □ 16  | 12 □ 12/25 |
|           | 30x345             | 30X70                | 0,01                                    | 21,00 | 20,34          | 12 □ 16 | 18 □ 12/25 |
|           | 30x415             | 30X90                | 0,01                                    | 27,00 | 22,60          | 12 □ 20 | 22 □ 12/25 |
|           | 30x440             | 30X90                | 0,01                                    | 27,00 | 24,86          | 12 □ 20 | 24 □ 12/25 |
|           | 30x600             | 30X120               | 0,01                                    | 36,00 | 33,90          | 14 □ 20 | 32 □ 12/25 |
|           | 30x655             | 30X130               | 0,01                                    | 39,00 | 36,16          | 16 □ 20 | 34 □ 12/25 |
| Kolon     | 80x80              | YOK                  | 0,01                                    | 64,00 |                | 32 □ 16 |            |
|           | 25x100             | YOK                  | 0,01                                    | 25,00 |                | 14 □ 16 |            |
|           | 25x125             | YOK                  | 0,01                                    | 31,25 |                | 16 □ 16 |            |
| Kiriş     | 15x32              | YOK                  | 0,0031                                  | 1,49  |                | 4 □ 12  |            |
|           | 25x32              | YOK                  | 0,0031                                  | 2,48  |                | 6 □ 12  |            |
|           | 35x32              | YOK                  | 0,0031                                  | 3,47  |                | 8 □ 12  |            |
|           | 40x32              | YOK                  | 0,0031                                  | 3,97  |                | 8 □ 12  |            |
|           | 55x32              | YOK                  | 0,0031                                  | 5,46  |                | 10 □ 12 |            |
|           | 57.5x32            | YOK                  | 0,0031                                  | 5,71  |                | 10 □ 12 |            |
|           | 60x32              | YOK                  | 0,0031                                  | 5,95  |                | 8 □ 16  |            |
|           | 67x32              | YOK                  | 0,0031                                  | 6,65  |                | 8 □ 16  |            |
|           | 70x32              | YOK                  | 0,0031                                  | 6,94  |                | 8 □ 16  |            |
|           | 75x32              | YOK                  | 0,0031                                  | 7,44  |                | 8 □ 16  |            |
|           | 80x32              | YOK                  | 0,0031                                  | 7,94  |                | 8 □ 16  |            |
|           | 90x32              | YOK                  | 0,0031                                  | 8,93  |                | 10 □ 16 |            |
|           | 92.5x32            | YOK                  | 0,0031                                  | 9,18  |                | 12 □ 16 |            |
|           | 110x32             | YOK                  | 0,0031                                  | 10,91 |                | 12 □ 16 |            |
|           | 25x60              | YOK                  | 0,0031                                  | 4,65  |                | 8 □ 12  |            |
|           | 30x60              | YOK                  | 0,0031                                  | 5,58  |                | 8 □ 12  |            |
|           | 40x60              | YOK                  | 0,0031                                  | 7,44  |                | 8 □ 16  |            |
|           | 30x70              | YOK                  | 0,0031                                  | 6,51  |                | 8 □ 16  |            |



Şekil 4: 1. Normal kat kalıp planı ve 3 boyutlu Sap2000 modeli (Dok G. 2011)

Analizlerden önce verilen zemin durumuna göre zemin emniyet gerilmesi yapılmış, tahkik sonucunda temel altındaki gerilmelerin emniyet gerilmesini aşmadığı gözlemlenmiştir. Analiz aşamasında zemin etkileri ihmal edilerek çalışma tamamlanmış ve buna uygun olarak sonuçlar karşılaştırılmıştır.

## Analiz Sonuçları

### Spektral Analiz Sonuçları

Bu çalışma için yapılan analizlerde Sap2000 sonlu eleman programı tercih edilmiştir. Yapısal model oluşturulurken perdeler kabuk eleman seçilmiş ve 1m'lik mesh ağı ile sonlu eleman çözüm metodu uygulanmıştır. Kolon ve kirişler ise çubuk eleman olarak modellenmiştir. Yapılan analizler sırasında döşemeler kaldırılmış, döşemelerden gelen yükler kirişlere aktarılarak analizler tamamlanmıştır. Analizler sırasında zeminle ilgili çalışmalar daha önceden tamamlanmış, zemin emniyet gerilmesi tahkiki yapılmış ve temel altındaki çökme değerleri kontrol edilerek yapı-zemin dinamik etkileşimi ihmal edilmiştir. Modal analiz sırasında 30 mod incelenmiştir ancak yapının modal kütle katılım oranı olan ve DBYBHY 2007'de geçen %90'lık modal kütle katılım oranı 15 mod ile sağlandığından sonuçlar 15 mod ile değerlendirilerek yorumlanmıştır. Tablo 2'de modal kütle katılım oranları ve periyotlar ayrıntılı olarak verilmiştir. Elde edilen tüm taban kesme kuvveti, devrilme momenti ve yerdeğiştirme değerleri 15 mod gözönüne alınarak değerlendirilmiştir. Mod birleştirme yönteminde analiz sonuçları birleştirilirken karelerinin toplamının karekökü ( KTKK ) uygulanmıştır.

15 modun katılımıyla birleştirilen analiz sonuçlarında taban kesme, kuvvetleri devrilme momentleri, ve yerdeğiştirmeler elde edilmiştir. Elde edilen bu değerler Tablo 3 ve Tablo 4'te ayrıntılı olarak modlara göre verilmiştir. Spektral analizden elde edilen bu değerler daha sonra zaman tanım alanında analiz yöntem ile elde edilen sonuçlarla hem X hem de Y deprem yönleri için ayrı ayrı karşılaştırılarak iki yöntem ile elde edilen değerler arasındaki farklar değerlendirilecektir.(Celep, Z. ve Kumbasar, N. 2001)

**Tablo 2:** Modlara göre periyotlar ve kütle katılım oranları

| Mod | Period | UX    | UY    | RZ    | $\Sigma UX$ | $\Sigma UY$ | $\Sigma RZ$ |
|-----|--------|-------|-------|-------|-------------|-------------|-------------|
| 1   | 4.25   | 0.165 | 0.020 | 0.108 | 0.165       | 0.020       | 0.108       |
| 2   | 3.47   | 0.267 | 0.407 | 0.586 | 0.431       | 0.427       | 0.694       |
| 3   | 3.04   | 0.291 | 0.254 | 0.004 | 0.723       | 0.681       | 0.698       |
| 4   | 1.19   | 0.035 | 0.001 | 0.012 | 0.757       | 0.682       | 0.710       |
| 5   | 0.91   | 0.088 | 0.023 | 0.100 | 0.845       | 0.705       | 0.810       |
| 6   | 0.75   | 0.011 | 0.135 | 0.032 | 0.857       | 0.840       | 0.842       |

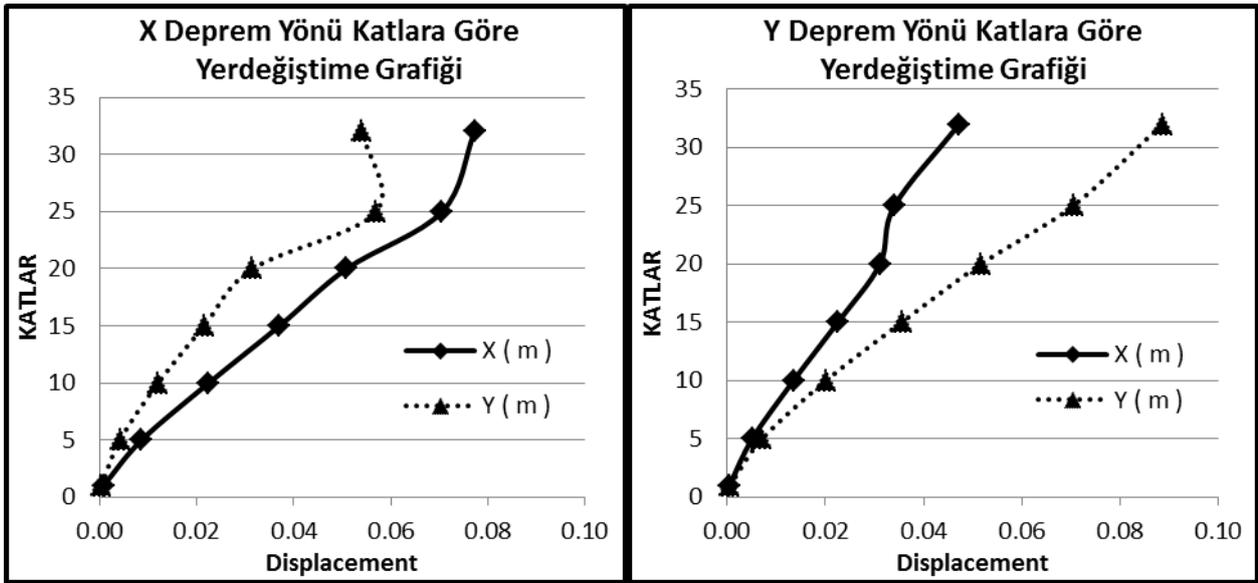
|    |      |       |       |       |       |       |       |
|----|------|-------|-------|-------|-------|-------|-------|
| 7  | 0.56 | 0.015 | 0.000 | 0.004 | 0.871 | 0.840 | 0.846 |
| 8  | 0.43 | 0.031 | 0.003 | 0.032 | 0.903 | 0.844 | 0.878 |
| 9  | 0.33 | 0.009 | 0.002 | 0.000 | 0.911 | 0.845 | 0.878 |
| 10 | 0.32 | 0.004 | 0.051 | 0.019 | 0.915 | 0.896 | 0.897 |
| 11 | 0.26 | 0.015 | 0.001 | 0.018 | 0.930 | 0.898 | 0.915 |
| 12 | 0.23 | 0.000 | 0.000 | 0.000 | 0.930 | 0.898 | 0.915 |
| 13 | 0.22 | 0.007 | 0.000 | 0.000 | 0.937 | 0.898 | 0.915 |
| 14 | 0.21 | 0.000 | 0.000 | 0.000 | 0.937 | 0.898 | 0.915 |
| 15 | 0.19 | 0.000 | 0.003 | 0.001 | 0.938 | 0.901 | 0.916 |

**Tablo 3:** Modlara göre taban kesme kuvveti ve devrilme momenti değerleri

| Mod  | FX (kN) | FY (kN) | MX (kNm) | MY (kNm) |
|------|---------|---------|----------|----------|
| 1    | 104     | 36      | -2454    | 6881     |
| 2    | 198     | -245    | 16660    | 13155    |
| 3    | 270     | 252     | -17186   | 17888    |
| 4    | 616     | 120     | -3216    | 2065     |
| 5    | -1645   | 845     | -11132   | -2698    |
| 6    | -867    | -2987   | 30099    | -2250    |
| 7    | -1773   | -246    | 2939     | -21213   |
| 8    | 4348    | -1422   | 16204    | 51130    |
| 9    | 3922    | -1727   | 15633    | 4911     |
| 10   | -2657   | -10056  | 106499   | -16541   |
| 11   | 8468    | -2547   | 27295    | -8195    |
| 12   | -1329   | 321     | 319044   | -992984  |
| 13   | 8164    | -518    | 103141   | -113339  |
| 14   | -1098   | 32      | 378729   | -214713  |
| 15   | 2158    | 7253    | -167223  | 758231   |
| KTKK | 13944   | 13245   | 545938   | 1274309  |

**Tablo 4:** X ve Y yönündeki analiz sonuçlarına göre kat yerdeğıştirmeleri

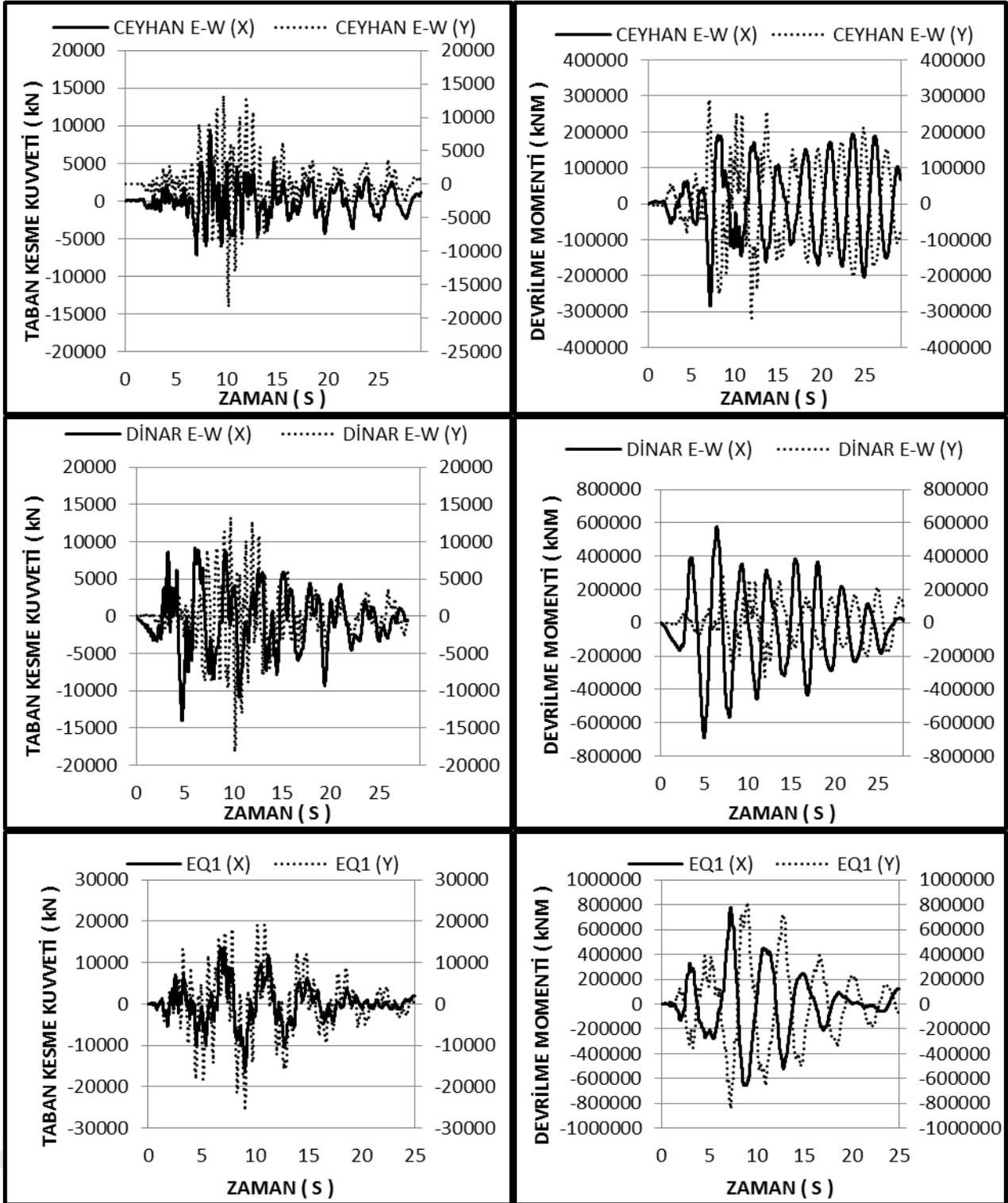
| Kat     | EX      |         | EY      |         |
|---------|---------|---------|---------|---------|
|         | X ( m ) | Y ( m ) | X ( m ) | Y ( m ) |
| 1.kat   | 0.0007  | 0.0003  | 0.0004  | 0.0005  |
| 5.kat   | 0.0086  | 0.0042  | 0.0051  | 0.0071  |
| 10.kat  | 0.0225  | 0.0120  | 0.0135  | 0.0201  |
| 15.kat  | 0.0371  | 0.0215  | 0.0225  | 0.0355  |
| 20. kat | 0.0509  | 0.0315  | 0.0311  | 0.0516  |
| 25.kat  | 0.0706  | 0.0570  | 0.0340  | 0.0704  |
| 32.kat  | 0.0772  | 0.0540  | 0.0472  | 0.0886  |



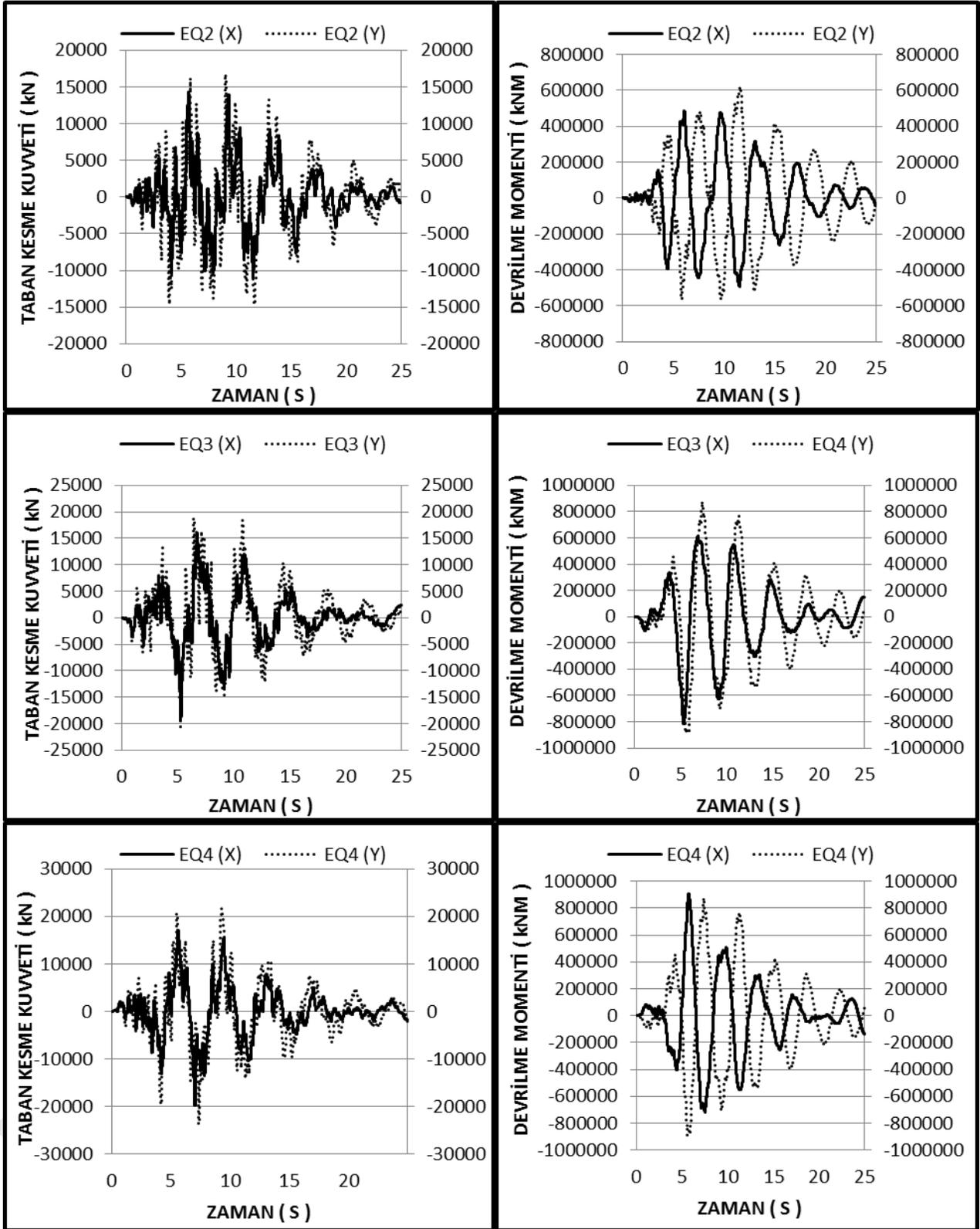
Şekil 5: X ve Y yönündeki analiz sonuçlarına göre kat yerdeğiştirmeleri

### Zaman Tanım Alanında Analiz Sonuçları

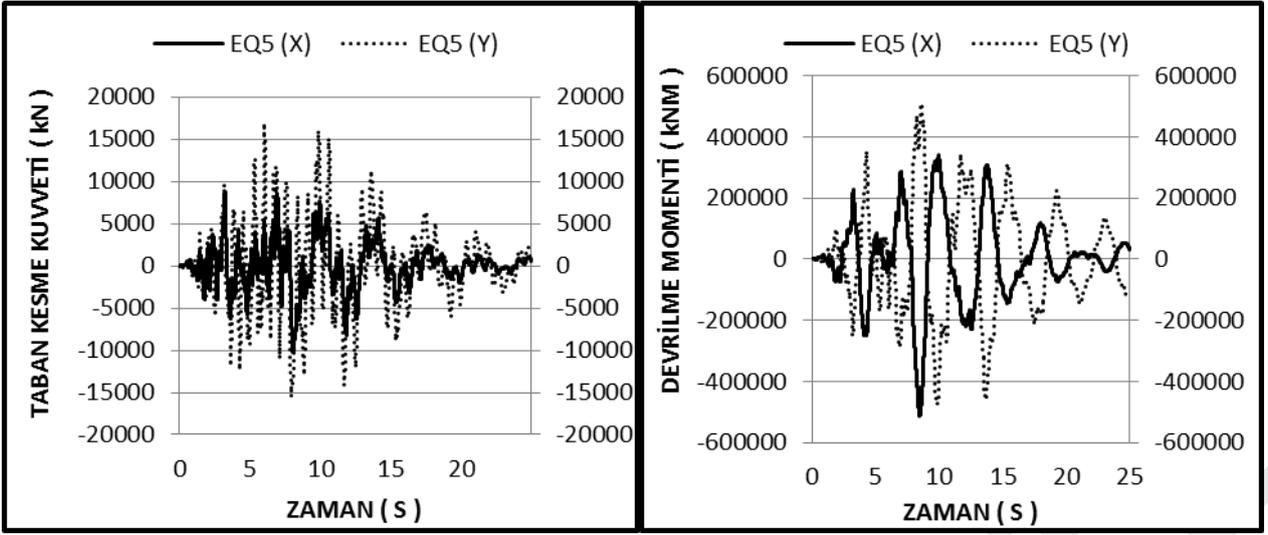
Zaman tanım alanında analizler 7 adet ivme kaydı kullanılmıştır elde edilen bütün sonuçlar zaman bağlı şekilde elde edilmiş ve incelenmiştir. 7 adet ivme kaydı x ve y deprem yönlerinde ayrı ayrı olmak kaydıyla toplamda 14 analiz yapılmıştır. Analizlerden elde edilen değerlerin (+) ve (-) olarak maksimum değerleri birer tablo halinde gösterilmiştir. Spektral Analizde olduğu gibi bu analizlerde de taban kesme kuvveti, devrilme momenti ve kat yerdeğiştirmeleri gibi parametreler incelenmiştir.



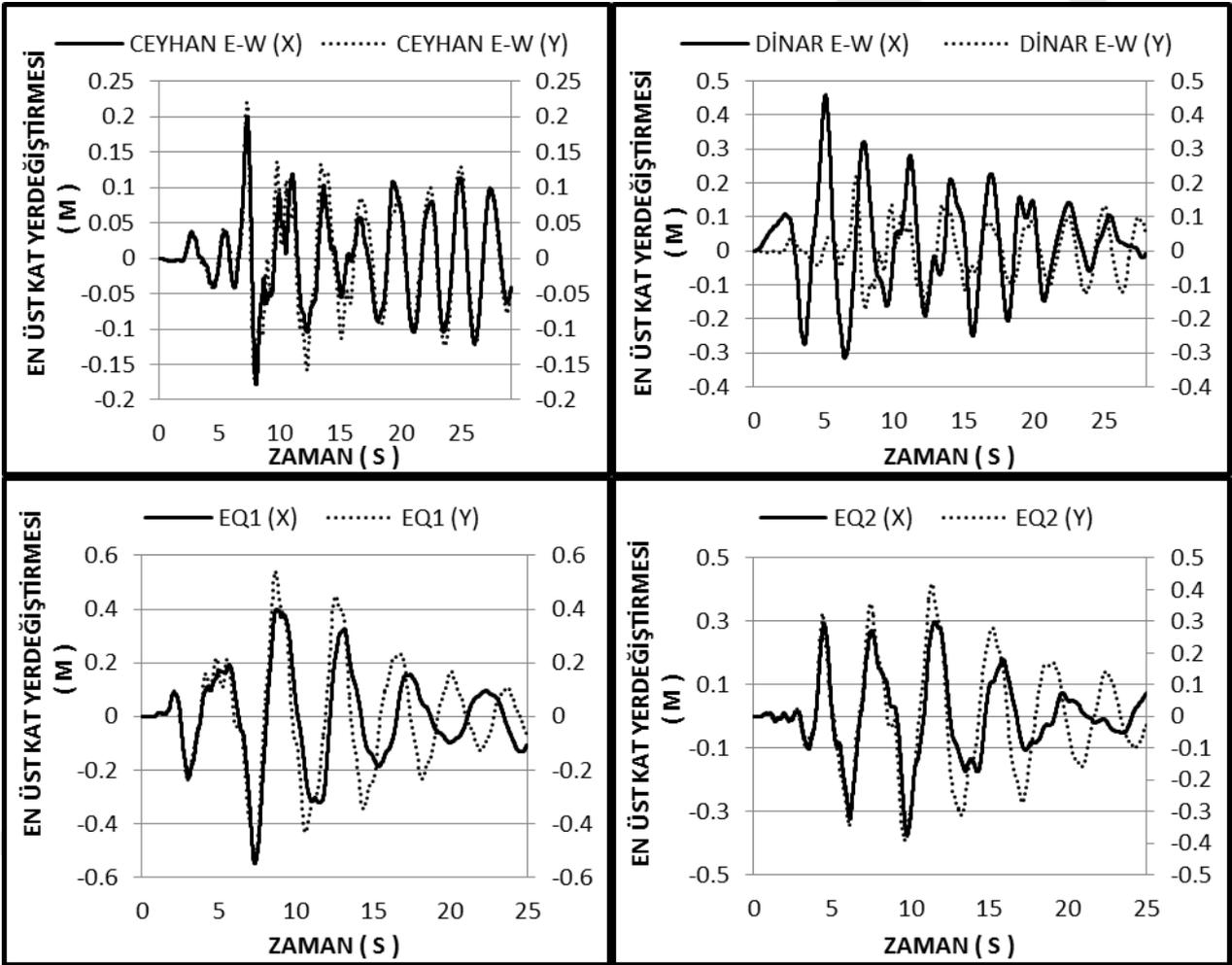
Şekil 6: X ve Y yönündeki analizler için taban kesme kuvvetleri ve devrilme momentleri (Sap2000)



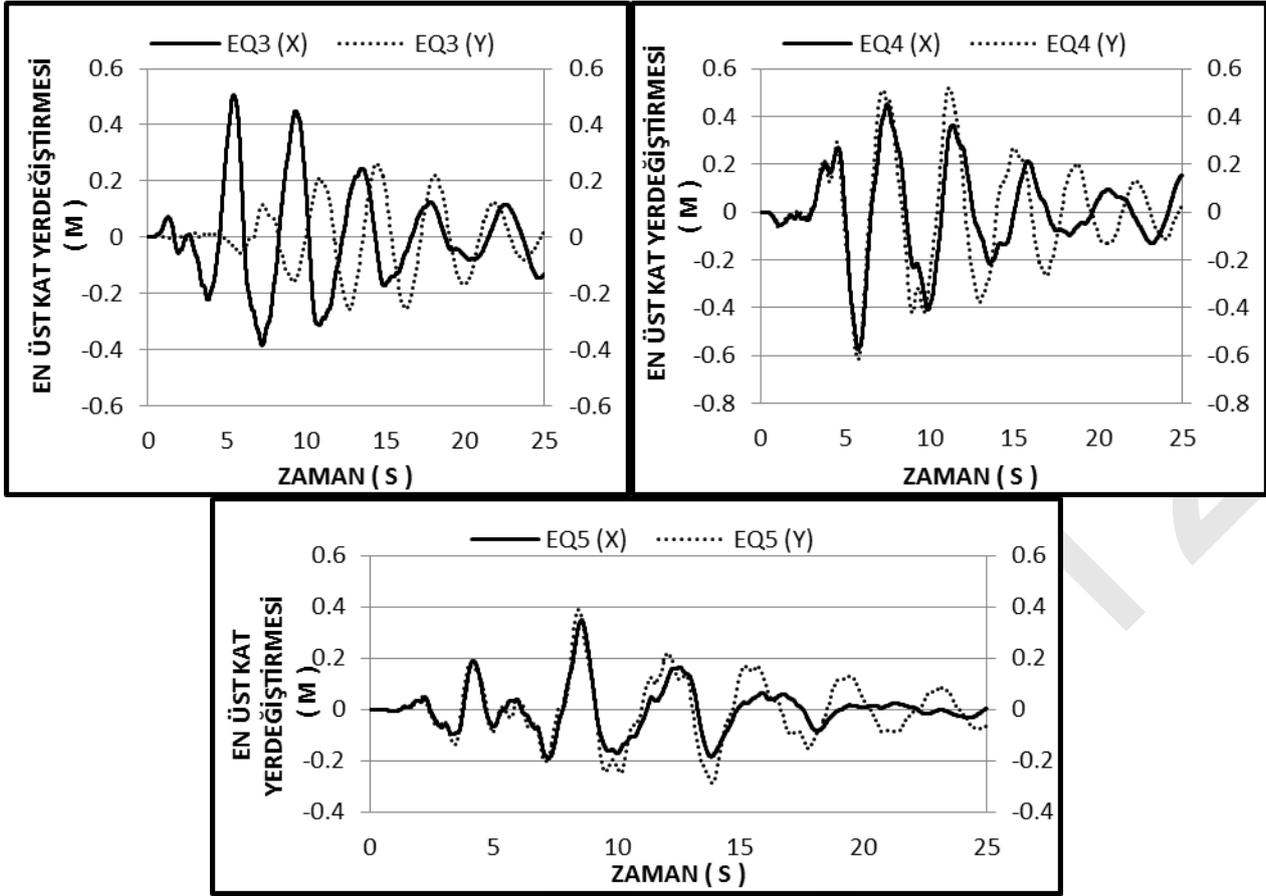
Şekil 7: X ve Y yönündeki analizler için taban kesme kuvvetleri ve devrilme momentleri



Şekil 8: X ve Y yönündeki analizler için taban kesme kuvvetleri ve devrilme momentleri



Şekil 9: X ve Y yönündeki analizler için taban kesme kuvvetleri ve devrilme momentleri



Şekil 10: X ve Y yönündeki analizler için yerdeğiştirme zaman grafikleri

X ve Y deprem yönleri ayrı ayrı olmak üzere her iki analizden elde edilen en büyük taban kesme kuvveti, devrilme momenti ve yerdeğiştirme değerleri bulunmuş bunlar spektral analizdeki sonuçlar ile karşılaştırılmıştır. Tablo 5 ve Tablo 6'da her iki deprem yönü için bu parametrelerin (+) ve (-) yöndeki en büyük değerleri ayrıntılı olarak verilmiştir.

Tablo 5: X yönündeki zaman tanım alanında analiz sonuçlarına göre taban kesme kuvvetleri ve devrilme momentleri

| KAYIT ADI  | TABAN KESME KUVVETİ |             | DEVİRİLME MOMENTİ |              | YERDEĞİŞTİRME |            |
|------------|---------------------|-------------|-------------------|--------------|---------------|------------|
|            | MİN (-) (kN)        | MAK(+) (kN) | MİN (-) (kNm)     | MAK(+) (kNm) | MİN (-) (m)   | MAK(+) (m) |
| CEYHAN E-W | -7116               | 9323        | -236600           | 195000       | -0.179        | 0.198      |
| DİNAR E-W  | -14070              | 9111        | -689100           | 577800       | -0.315        | 0.459      |
| EQ1        | -16450              | 13680       | -655400           | 779100       | -0.550        | 0.399      |
| EQ2        | -11600              | 14380       | -490700           | 488500       | -0.377        | 0.297      |
| EQ3        | -19140              | 106090      | -816700           | 610200       | -0.384        | 0.506      |
| EQ4        | -19720              | 17140       | -722400           | 905400       | -0.573        | 0.451      |
| EQ5        | -10250              | 8764        | -512700           | 343000       | -0.190        | 0.348      |
| ORTALAMA   | -14049              | 12641       | -589086           | 557000       | -0.367        | 0.380      |

Tablo 6: Y yönündeki zaman tanım alanında analiz sonuçlarına göre taban kesme kuvvetleri ve devrilme momentleri

| KAYIT ADI  | TABAN KESME KUVVETİ |             | DEVİRİLME MOMENTİ |              | YERDEĞİŞTİRME |            |
|------------|---------------------|-------------|-------------------|--------------|---------------|------------|
|            | MİN (-) (kN)        | MAK(+) (kN) | MİN (-) (kNm)     | MAK(+) (kNm) | MİN (-) (m)   | MAK(+) (m) |
| CEYHAN E-W | -18290              | 13290       | -324900           | 290200       | -0.173        | 0.220      |
| DİNAR E-W  | -18290              | 13290       | -324900           | 290200       | -0.173        | 0.220      |
| EQ1        | -25670              | 19240       | -844900           | 821700       | -0.512        | 0.541      |

|          |        |       |         |        |        |       |
|----------|--------|-------|---------|--------|--------|-------|
| EQ2      | -14700 | 16680 | -565900 | 618100 | -0.391 | 0.419 |
| EQ3      | -21180 | 18800 | -791800 | 854400 | -0.257 | 0.259 |
| EQ4      | -23630 | 21640 | -722400 | 905400 | -0.616 | 0.519 |
| EQ5      | -15600 | 16870 | -475800 | 507700 | -0.288 | 0.390 |
| ORTALAMA | -19623 | 17116 | -578657 | 612529 | -0.344 | 0.367 |

## Değerlendirme ve Sonuçlar

Bu çalışmada 32 katlı betonarme bir yapı örneği için spektral analiz ve zaman tanım alanında analiz yöntemleri kullanılarak taban kesme kuvveti, devrilme momenti, ve yapıda meydana gelen en büyük yerdeğiştirme değerleri kontrol edilmiştir. Her iki yöntemden elde edilen sonuçlar karşılaştırılmıştır. Elde edilen sonuçlar ışığında taban kesme kuvvetleri ve devrilme momentleri yaklaşık olarak aynı büyüklükte değerlere ulaşmaktadır. Ancak yerdeğiştirme değerleri arasında büyük farklar olduğu gözlemlenmiştir. Spektral analizde en büyük yerdeğiştirme değeri yaklaşık 0.1m iken, zaman tanım alanında analizde 0.38m olarak bulunmuştur. Yüksek yapılar için yerdeğiştirme değerlerine bağlı olarak oluşan ikinci mertebe etkiler büyük önem arz etmektedir. Bu tür etkiler göz ardı edilerek tasarım yapıldığında yapıda toptan göçmeye gidecek kadar kötü sonuçlar oluşabilir. Bu nedenle bu tür yüksek yapılar için zaman tanım alanında hesap yöntemiyle analiz yapmak diğer metotlara göre daha gerçekçi sonuçlar elde edilmesini sağlar.

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## CONSTRUCTIVE FORMATION OF THE KNOWLEDGES BY STUDENTS AT MATH CLASSES

Sanubar Mamedova

School #267. Baku, Azerbaijan

E-mail: huseynli\_s@mail.ru.

Abstract: the current article reviews a process of knowledge building by students within the constructive methods of education. The process of new knowledge formation is realized upon the existing knowledge by means of logical attitude and questions. These types of questions make each student to modify his/her knowledge and form in their thinking modes of consecutive modifications by means setting logical questions.

Key words: constructive education; modification; formation; correlation; logical question; logical justification (rationale);

XXI century is described as era of intellect. Strategic goal of the modern education system are formation of a creative intellect, a person with high scientific skills. However, it is impossible to achieve the above mentioned goals is impossible by relying solely on conventional methods of education. For the intellectual skills development of students' new approaches, new semantic tasks are crucial. Overall, this means modification of educational methods. Transformation from direct knowledge delivery to construction of them by the students themselves. Thus, the construction of new knowledge is fulfilled on basis of existing experience and skills. In this initiative the role of the teacher is in building the logical questions, works of logical thinking. As a result answering these questions leads the students to new qualitative skills. In the constructive education by being involved in interactive and logical works students gain the following intellectual and social skills:

- I. Problem-solving skills;
- II. Question-setting skills;
- III. Logical justification of their answers;
- IV. Analyzing and Synthesizing
- V. Remodeling of their knowledge;
- VI. Generating new knowledge;
- VII. Team working;
- VIII. Sense of responsibility;
- IX. Ability to come to a consensus;
- X. Listening, tolerance and etc. skills.

In the following scenario (6<sup>th</sup> grade class– Finding out of the greatest common divisor) describes the process of new knowledge formation by the students.

**The aim of this lesson is to let the students define greatest common divisor be means of interactive discussions. The interactive activity brings up not only skills of mutual cooperation, but also skills of cooperative intellectual work.**

**The first question of the discussion is of research type. The teacher by logical reasoning sets the dilemma:**

**B.- The divisor is a number that divides. It can be the greatest and the smallest. Multiplication is the inverse operation to division. What do you think? Can there be greatest common multiplier?**

**This dilemma makes the students review their existing knowledge of the division from other perspective. From the perspective of multiplier.** Having group discussions the students come to the following conclusion:

- When multiplying one factor may be less than or greater than another factor. So, the biggest or the smallest multiplier factor can be.

B.- How can you find out multipliers?

O - To find the biggest factor, the product should be divided by a smaller factor; divided by the product of a known factor and thus we find out an unknown factor.

So, students with these rationalizations and questioning reinstated in their understanding the process of finding of the an unknown factor.

Afterwards students work out the following rationale and the question is set. The answer to this question takes them to understanding of the new lesson.

B. The division is the inverse operation of multiplication. The unknown multiplier is found by dividing the product of a known factor,

$56:x=7$ .  $X=56:7=8$  ; testing  $8*7=56$

Then think please, how we can find the unknown divisor? For instance:

$63:x=9$

O. – To find the unknown divisor we need to divide the divisible by the particular.

$63:9=7$ ; testing  $7*9=63$

Y. – thus, to find the unknown divisor we need to divide the divisible by particular, or visa versa.

Now in the natural numbers 36 and 24;

28 and 42; find common criteria for divisibility.

Y- What do you have to do to find these criteria?

O. - Then, you divide these numbers by dividers;

and to find out what numbers they are divided.

As a result the following features are defined –36 and 24 (1,2,3,4,6,9,12,18,36) , (1,2,3,4,6,8,12,24); 28 and 42 (1,2,4,7,14,28) , (1,2,3,6,7,14,21,42)

B.- How many divisors does each particular have? How many trains are composed of subgroups? If consists of two divisors, it is simple, and if more than two, then which number will this be? Simple or compound?

Upon definition of the numbers (36 and 24), (28 and 42) we make a smooth transition to the next question.

B- What common factors between natural numbers 36 and 24 are there? Determine the smallest and the greatest.

# ÜNİVERSİTE ÖĞRENCİLERİNİN ÖĞRENME STİLLERİNİN İNCELENMESİ

Yrd. Doç. Dr. Serap Özbaş  
Atatürk Education Faculty  
Near East University-KKTC  
Mersin-10-Turkey  
[sozbass@hotmail.com](mailto:sozbass@hotmail.com)

**Özet:** Bu çalışmanın konusu, üniversite öğrencilerinin öğrenme stillerini belirlemek ve cinsiyet değişkenine göre karşılaştırmaktır. Çalışmada, McVay Lynch Öğrenme Stili Envanteri kullanılmıştır. 59 maddeli ve 3'lü likert tipinde derecelendirilen öğrenme stili envanteri, “görsel öğrenme stili”, “işitsel öğrenme stili” ve “hareketli (kinestetik) öğrenme stili” olmak üzere 3 boyuttan oluşmaktadır. Çalışmanın sonucuna göre, öğrencilerin yarısını yakını görenek öğrenen oldukları belirlenmiştir. Cinsiyetin öğrencilerin öğrenme stillerine etkisi incelendiğinde; görsel öğrenme stilinde kız öğrencilerin erkek öğrencilere göre istatistiksel olarak anlamlı yüksek ortalama puana sahip oldukları görülmüştür. Öğrencilerin öğrenme stilleri üzerinde hem kayıtlı oldukları bölümlerin etkisi hem de bölüm ve cinsiyetin ortak etkisinin olmadığı saptanmıştır.

## Giriş

İnsanlar, her gün öğrenmeyi kullanırlar. Çünkü öğrenme, bilgiyi işleme sürecidir. Bireylerin öğrenmeyi kullanmasındaki amaç, farklı öğrenme stillerine neden olan şartları yönetmek ve uyarlamaktır (Brown, 2009). Burada bireylerin öğrenmelerinde farklı öğrenme stilleri olabirliği görülmektedir. “Öğrenme stili nedir?” dediğimizde, eğitimde yeni bir araştırma konusu olmayan ve son 20 yıldır çalışmalarda rastlanılan öğrenme stilleri konusu, öğrenmede araştırılan konulardan biridir ve birçok araştırma tarafından incelenmiştir (Huston ve Cohen, 1995; akt. Brown vd. 2009; Ballone ve Czerniak, 2001). Öğrenme stili “bireylerin etkin öğrenme için benimsediği yeni bilgi ve stratejileri işlemede tercih ettikleri yol” olarak tanımlanmıştır. Başka bir ifade ile öğrenme stilleri zaman ve görevler üzerinde sergilenen kavramsal, bilişsel duyuşsal ve davranışsal örüntülerdir (Guild, 1994; akt. Ballone ve Czerniak, 2001).

Öğrenme stilleri konusunda yapılan çalışmalarda, öğrenmenin farklı boyutlarda gerçekleştiği ve uzmanların farklı açılardan odaklanarak öğrenme stillerini tanımladığı için öğrenme stillerinin farklı tanımlarının yanı sıra çeşitli boyutlarda sınıflandırıldığı görülmektedir (Yılmaz-Soylu ve Akkoyunlu, 2002). Örneğin, Gregoric öğrenme stilleri; somut-ardışık, soyut-ardışık, somut-rastgele ve soyut-rastgele olmak üzere 4 boyuttan oluşmaktadır (Guild ve Garger, 1985; akt. Ballone ve Czerniak, 2001). Kolb Öğrenme Stilleri modelinde ise; yerleştiren, ayrıştıran, birleştiren ve özümseyen olmak üzere dört öğrenme stili bulunmaktadır (Can, 2011; Yılmaz-Soylu ve Akkoyunlu, 2002). Felder ve Soloman (1994) tarafından geliştirilen öğrenme stili modelinde; hissederek-sezgisel, görsel-işitsel, yaparak-düşünerek ve sıralı-bütünsel olmak üzere 4 boyut vardır (Samancı ve Keskin, 2007). Vester, 1975 yılında yayımladığı “Düşün-Öğren-Unut” isimli kitabında üç farklı öğrenme stilinden bahsetmiştir. Vester’e göre, görenek öğrenenlerde görsel; duyararak öğrenenlerde işitsel; yaparak ve dokunarak öğrenenlerde dokunsal öğrenme tipleri vardır (Beck, 2005). Bu çalışmada kullanılan McVay Lynch Öğrenme Stilleri Envanteri; görsel, işitsel, hareketli olmak üzere kategorize edilen 3 boyuttan oluşmaktadır. Bu boyutlar incelendiğinde;

- Görsel öğrenme stilinde; öğrenciler, esas olarak görenek öğrenirler. Görsel öğrenenler, resim, şekil, tablo gibi görsel sunum araçlarını tercih ederler (Mills vd. 2010).
- İşitsel öğrenme stilinde; öğrenciler, esas olarak işiterek öğrenirler. İşiterek öğrenenler, sözlü ve yazılı materyali daha çok tercih ederler (Mills vd. 2010).
- Hareketli (kinestetik) öğrenme stilinde; öğrenciler esas olarak yaparak öğrenirler.

Öğrenme stilleri sabit değildir. Öğrencilerin konu ve geçerli öğrenme ortamlarına bağlı olarak farklı öğrenme stillerini benimseyebilirler (Pritchard, 2009; akt. Alharbi vd., 2011). Örneğin kimi öğrenciler, görsel, işitsel ve hareketli (kinestetik) öğrenme stillerinden birine ya da ikisine sahipken; kimileri ise, her üç öğrenme stiline sahip olabilirler.

Öğrencilerin öğrenme stillerini değerlendirmek, onların kısmi tercihleri hakkında bilgi sağlamak açısından önemlidir. Öğrenciye farkındalık kazandırır. Bu farkındalık, öğrencinin öğretim ortamındaki bireysel öğrenme çabasında bilgiyi kazanmasını ve bu bilgiyi uygulamasında uyarılmasını ve motive olmasını sağlar (Federico 2000; akt. Brown et. al., 2009). Öğrencilerin öğrenmeleri hakkında farkındalığı artırdığı gibi onların öğrenenler olarak zayıf ve güçlü hakkında bilgi vermek amacıyla da kullanılabilir (Coffield vd., 2004). Öğrencilerin güçlü ve zayıf yönlerini bilmesi onların öğrenmek için daha fazla motive olmasını sağlayabilir

(Pender ve Tekavciç, 2009). Bu noktadan yola çıkarak bu araştırmada çeşitli bölümlere kayıtlı üniversite öğrencilerde çeşitli öğrenme stillerini tespit etmek hedeflenmiştir. Bu doğrultuda, farklı öğrenme tiplerini görmek için ve çeşitli bölümlere ulaşabilmek için hazırlık sınıfında okuyan öğrenciler üzerinde araştırma yapılmıştır.

Çalışmanın amacı Kuzey Kıbrıs'ta özel bir üniversitenin hazırlık sınıf öğrencilerinin öğrenme stillerini belirlemek ve öğrenme stillerine cinsiyet ve bölümlerin hem ayrı ayrı etkileri hem de ortak etkisini değerlendirmektir. Çalışmadan elde edilen bulguların, öğrenme stilleri ile ilgili yapılan çalışmalara ve üniversite öğrencilerine yönelik düzenlenen öğretim etkinliklerinin şekillenmesine katkı sağlayacağı düşünülmektedir.

Bu noktada, çalışmanın amacı çerçevesinde şu sorulara yanıt aranmıştır:

- Hazırlık sınıfı öğrencilerinin
  - öğrenme stillerinin dağılımı nedir?
  - öğrenme stilleri üzerinde cinsiyetin etkisi var mıdır?
  - öğrenme stilleri üzerinde bölümlerin etkisi var mıdır?
  - öğrenme stillerine bölüm ve cinsiyetin ortak etkisi var mıdır?

Öğrenme stillerinin incelenmesinin faydaları düşünüldüğünde, öğrencilerin öğrenme ile ilgili problemlerini ortaya çıkarmak, öğrenmedeki tercihlerinin ne olduğunu ortaya koymak, tercihleri doğrultusunda, kendilerine uygun öğrenme yollarını keşfetmesine yardımcı olmak ve bu konuda yapılacak araştırmalara katkı sağlamak olarak sayılabilir.

## Çalışma Yöntemi

Çalışma grubu, Kuzey Kıbrıs'ta özel bir üniversitenin 120 (62 bayan ve 58 erkek) hazırlık sınıfı öğrencisidir. Rastgele yöntemle seçilen öğrencilerin yaş ortalaması 19.5'tir (ss:1.3). Çalışmada hazırlık sınıfını öğrencilerinin seçilmesindeki amaç, öğrencilerin hazırlık sınıfı sonrasında çeşitli bölümlerde okuyacağı için farklı öğrenme stillerinin belirlenmesini sağlamaktır. Öğrencilerin hazırlık sonrası okuyacakları alanlar ve dağılımları şunlardır: 1- Beslenme ve Diyetisyenlik bölümünden 20, 2- Eczacılık fakültesinden 17, 3- Hemşirelik Bölümü, 33, 4- İşletme Bölümünden 29, 5- Mühendislik Fakültesinden 21 öğrencidir.

Çalışmada Maggie McVay Lynch Öğrenme Stili Envanteri kullanılmıştır. Öğrenme stili envanteri, Maggie McVay Lynch (2000) tarafından geliştirilmiş ve Dağhan ve Akkoyunlu (2011) tarafından Türkçeye uyarlanmıştır. 3'lü likert tipinde derecelendirilmiş öğrenme stili envanterinin asıl formunda, 60 madde içermektedir. Dağhan ve Akkoyunlu (2011) tarafından yapılan Türkçeye uyarlama çalışması sonucunda, öğrenme stili envanteri, 59 maddeden oluşmaktadır. Envanter, *görsel öğrenme stili* (21 madde), *işitsel öğrenme stili* (19) ve *hareketli (kinestetik) öğrenme stili* (19) olmak üzere üç boyut içermektedir. Envanterin güvenilirliği için, cronbach-alpha iç tutarlılık değeri hesaplanmış ve güvenilirliği, .80 bulunmuştur. Envanterin Türkçeye uyarlama çalışmada, güvenilirliği, .95'tir. Bu çalışmada envanterin öğrenme stili boyutlarında güvenilirlik durumu sırasıyla şu şekildedir: I- Görsel öğrenme stili, .68; II- İşitsel öğrenme stili, .56; III-Hareketli (Kinestetik) öğrenme stili ise, .58'dir.

Çalışmada verilerin değerlendirilmesinde, frekans (n), yüzde (%), ortalama ( $\bar{x}$ ) ve standart sapma (ss) teknikleri kullanılmıştır. Aynı zamanda cinsiyet ve bölümlerin hem ayrı ayrı etkilerinin hem de ortak etkisinin olup olmadığını incelemek amacıyla t testi, tek yönlü varyans analizi ve iki yönlü varyans analizi teknikleri kullanılmıştır. Normallik için, verilerin sayıltıları kontrol edilmiştir. Çalışmada verilerin, basıklık ve kayıklık değerlerinin -1 ve +1 arasında olduğu için, dağılımın normal olduğu kabul edilmiştir (çarpıklık: .138; basıklık: .095).

## Bulgular

Çalışmanın bu bölümünde, analizlerden elde edilen bulgular sırasıyla, “*Öğrencilerin Öğrenme Stillerinin Dağılımı*”, “*Cinsiyetin Öğrencilerin Öğrenme Stillerine Etkisi*”, “*Bölümlerin Öğrencilerin Öğrenme Stillerine Etkisi*” ve “*Cinsiyet ve Bölümlerin Öğrencilerin Öğrenme Stillerine Ortak Etkisi*” başlıklarında verilmiştir.

### Öğrencilerin Öğrenme Stillerinin Dağılımı

Çalışmaya katılan öğrencilerin öğrenme stillerinin dağılımı Tablo 1'de gösterilmiştir.

**Tablo 1.** Öğrencilerin öğrenme stillerine göre dağılımı

|   | Görsel | İşitsel | Hareketli | Görsel-Hareketli | Toplam |
|---|--------|---------|-----------|------------------|--------|
| n | 55     | 25      | 39        | 1                | 120    |
| % | 41.7   | 18.9    | 29.5      | 0.8              | 100    |

Tablo 1 incelendiğinde, öğrenme stillerinden en fazla görsel öğrenme stili olduğu görülmektedir. Öğrencilerin yarısına yakını (%41.7) görsel öğrenme stiline sahiptir. Görsel öğrenme stilinden sonra gelen öğrenme stili, hareketli öğrenme stildir (%29.5). Çalışmaya katılan öğrencilerin 18.9'unu işitsel öğrenme stiline sahiptir. Bir öğrencide ise, hem görsel hem de hareketli öğrenme stilleri bulunmaktadır.

### *Cinsiyetin Öğrenme Stillerine Etkisi*

Öğrencilerin öğrenme stillerinin üzerinde cinsiyetin etkisinin olup olmadığını incelemek amacıyla kullanılan bağımsız örneklem için t testi analiz sonuçları Tablo 2'de sunulmuştur.

**Tablo 2.** Cinsiyete Göre Öğrencilerin Öğrenme Stillerinin Karşılaştırılması

|                                |       | n  | $\bar{x}$ | ss   | t    | p*  |
|--------------------------------|-------|----|-----------|------|------|-----|
| <b>Görsel Öğrenme Stili</b>    | Bayan | 62 | 2.34      | 0.27 | 2.55 | .01 |
|                                | Erkek | 58 | 2.22      | 0.28 |      |     |
| <b>İşitsel Öğrenme Stili</b>   | Bayan | 62 | 2.22      | 0.26 | .99  | .32 |
|                                | Erkek | 58 | 2.18      | 0.24 |      |     |
| <b>Hareketli Öğrenme Stili</b> | Bayan | 62 | 2.22      | 0.25 | .33  | .74 |
|                                | Erkek | 58 | 2.20      | 0.24 |      |     |

\*.05

Tablo 2 incelendiğinde, bayan öğrencilerin görsel, işitsel, hareketli öğrenme stillerinin ortalama değerleri, erkek öğrencilerin ortalama değerlerine göre daha yüksektir. Ortalamada görülen bu değer farkı, sadece görsel öğrenme stili üzerinde anlamlıdır. Başka bir deyişle, işitsel ve hareketli öğrenme stillerinde bayan ve erkek öğrencilerin arasında istatistiksel olarak fark anlamlı değil iken; görsel öğrenme stillerinde bayan öğrencilerin lehine anlamlı bir fark bulunmuştur ( $t_{(118)}=2.55, p>0.05$ ).

### *Bölgülerin Öğrencilerin Öğrenme Stillerine Etkisi*

Öğrencilerin öğrenme stillerinin okuyacakları bölümlere göre karşılaştırılmasında kullanılan bağımsız örneklem için tek yönlü varyans analizi (ANOVA) sonucu Tablo 3'de sunulmuştur.

**Tablo 3.** Bölümlere Göre Öğrencilerin Öğrenme Stillerinin Karşılaştırılması

| Değişkenler                              | Grup Türü                 | n         | $\bar{x}$                  | ss     |
|--|---------------------------|-----------|----------------------------|--------|
| <b>Görsel Öğrenme Stili</b>              | Beslenme ve Diyetisyenlik | 20        | 2.32                       | .22    |
|  | Eczacılık                 | 17        | 2.30                       | .24    |
|  | Hemşirelik                | 33        | 2.30                       | .30    |
|  | Mühendislik               | 21        | 2.23                       | .28    |
|  | İşletme                   | 29        | 2.25                       | .33    |
| <b>İşitsel Öğrenme Stili</b>             | Beslenme ve Diyetisyenlik | 20        | 2.24                       | .21    |
|  | Eczacılık                 | 17        | 2.19                       | .26    |
|  | Hemşirelik                | 33        | 2.20                       | .28    |
|  | Mühendislik               | 21        | 2.24                       | .27    |
|  | İşletme                   | 29        | 2.15                       | .21    |
| <b>Hareketli Öğrenme Stili</b>           | Beslenme ve Diyetisyenlik | 20        | 2.13                       | .24    |
|  | Eczacılık                 | 17        | 2.25                       | .19    |
|  | Hemşirelik                | 33        | 2.25                       | .24    |
|  | Mühendislik               | 21        | 2.22                       | .23    |
|  | İşletme                   | 29        | 2.18                       | .29    |
| <b>Tek Yönlü Varyans Analizi (ANOVA)</b> |                           |           |                            |        |
| <b>Görsel Öğrenme Stili</b>              | KT*=.130;                 | KO*=.003; | F* <sub>4-115</sub> =.400; | p*=.81 |
| <b>İşitsel Öğrenme Stili</b>             | KT*=.140;                 | KO*=.580; | F* <sub>4-115</sub> =.580; | p*=.68 |
| <b>Hareketli Öğrenme Stili</b>           | KT*=.240;                 | KO*=1.00; | F* <sub>4-115</sub> =1.00; | p*=.41 |

\* KT: kareler toplamı; KO: kareler ortalaması; F değeri; p: anlamlılık değeri.

Tablo 3 incelendiğinde, bölümlerin öğrencilerin öğrenme stilleri üzerinde anlamlı düzeyde etkisinin olmadığı görülmüştür. Çalışmada beslenme ve diyetisyenlik, eczacılık, hemşirelik ve işletme bölümlerine kayıtlı öğrencilerin görsel öğrenme stiline sahip olduğu görülürken; mühendislik bölümüne kayıtlı öğrencilerde ise, işitsel öğrenme stili ortaya çıkmıştır.

### Cinsiyet ve Bölümlerin Öğrencilerin Öğrenme Stillerine Ortak Etkisi

Bölüm ve cinsiyetin öğrencilerin öğrenme stilleri üzerindeki etkisinin olup olmadığını incelemek amacıyla yapılan iki yönlü varyans analizi (ANOVA) sonuçları Tablo 4'te sunulmuştur.

**Tablo 4.** Cinsiyet ve Bölümlerin Öğrencilerin Öğrenme Stillerine Ortak Etkisi

| Değişkenler             | Bölüm                     | Bayan |           |     | Erkek |           |     |
|-------------------------|---------------------------|-------|-----------|-----|-------|-----------|-----|
|                         |                           | n     | $\bar{x}$ | ss  | n     | $\bar{x}$ | ss  |
| Görsel Öğrenme Stili    | Beslenme ve Diyetisyenlik | 16    | 2.31      | .24 | 4     | 2.39      | .14 |
|                         | Eczacılık                 | 10    | 2.37      | .24 | 7     | 2.20      | .21 |
|                         | Hemşirelik                | 26    | 2.35      | .27 | 7     | 2.12      | .35 |
|                         | Mühendislik               | 2     | 2.15      | .36 | 19    | 2.24      | .28 |
|                         | İşletme                   | 8     | 2.40      | .41 | 21    | 2.20      | .29 |
| İşitsel Öğrenme Stili   | Beslenme ve Diyetisyenlik | 16    | 2.25      | .22 | 4     | 2.21      | .16 |
|                         | Eczacılık                 | 10    | 2.17      | .26 | 7     | 2.21      | .30 |
|                         | Hemşirelik                | 26    | 2.22      | .30 | 7     | 2.14      | .21 |
|                         | Mühendislik               | 2     | 2.33      | .17 | 19    | 2.23      | .28 |
|                         | İşletme                   | 8     | 2.21      | .24 | 21    | 2.13      | .21 |
| Hareketli Öğrenme Stili | Beslenme ve Diyetisyenlik | 16    | 2.09      | .24 | 4     | 2.29      | .13 |
|                         | Eczacılık                 | 10    | 2.27      | .23 | 7     | 2.21      | .14 |
|                         | Hemşirelik                | 26    | 2.28      | .22 | 7     | 2.16      | .29 |
|                         | Mühendislik               | 2     | 2.47      | .07 | 19    | 2.19      | .23 |
|                         | İşletme                   | 8     | 2.11      | .32 | 21    | 2.20      | .24 |

### İki Yönlü Varyans Analizi (ANOVA)

|                                |                     |           |                                    |
|--------------------------------|---------------------|-----------|------------------------------------|
| <b>Görsel Öğrenme Stili</b>    | KT*=.330;<br>p*=.38 | KO*=.082; | F* <sub>9,110</sub> =1.054;        |
| <b>İşitsel Öğrenme Stili</b>   | KT*=.047;<br>p*=.95 | KO*=.012; | F* <sub>9,110</sub> =.183;         |
| <b>Hareketli Öğrenme Stili</b> | KT*=.414;           | KO*=.104; | F* <sub>9,110</sub> =1.724; p*=.15 |

\* KT: kareler toplamı; KO: kareler ortalaması; F değeri; p: anlamlılık değeri.

Tablo 4 incelendiğinde, bölüm ve cinsiyetin öğrencilerin öğrenme stillerine ortak etkisinin istatistiksel olarak anlamlı olmadığı görülmüştür. En yüksek ortalama değer, hareketli öğrenme stilinde ve mühendislik bölümüne kayıtlı bayan öğrenciler ( $\bar{x}$ =2.47) sahip iken; en düşük ortalama değer ise, hareketli öğrenme stili boyutunda ve beslenme ve diyetisyenlik bölümüne kayıtlı bayan öğrencilere ( $\bar{x}$ =2.09) aittir.

### Sonuç ve Tartışma

Bu çalışmada hazırlık sınıfı öğrencilerinin öğrenme stillerini belirlemek ve öğrenme stilleri üzerindeki cinsiyet ve bölümlerin hem ayrı ayrı hem de ortak etkisini araştırmak amaçlanmıştır. Çalışmaya katılan öğrencilerin en çok benimsedikleri öğrenme stili, görsel öğrenme stildir. Yapılan araştırmalarda baskın öğrenme stilinin görsel öğrenme stili olduğu ortaya çıkmıştır (McCarter, 2008). Görsel öğrenenler, öğrendiklerini zihinsel imgeler oluşturarak hafızada tutarlar (Dunn ve Dunn, 2003; akt. Pender ve Tekavčić, 2009; Pender, Tekavčić ve Dimovski, 2008). Görsel, işitsel ve hareketli öğrenme stillerinden biri veya ikisi normal şekilde baskındır (Pender ve Tekavčić, 2009). Bazı öğrencilerin, görsel, işitsel ve hareketli (kinestetik) öğrenme stillerinden tercih ettikleri bir öğrenme stili vardır. Çünkü öğrenme stili, öğrencilerin öğrenme bağlamında uyarılara yanıtladığı ve kullandığı tutarlı bir yoldur\*.

Cinsiyetin öğrencilerin öğrenme stillerine anlamlı etkisi incelendiğinde, duyarak ve yaparak öğrenenlerin üzerinde cinsiyetin bir etkisi bulunmazken; görerek öğrenenlerine cinsiyetin etkisi anlamlıdır. Bu etkinin bayan öğrencilerin lehine olduğu görülmüştür. Bu sonuç, başka öğrenme stilleri envanterlerin incelendiği çalışmaların sonuçları ile benzerlik gösterirken (Can, 2011; Deniz, 2011); öğrencilerinin öğrenme stillerinin araştırıldığı başka bir çalışmanın sonucu ile çelişki göstermektedir (Oktar-Ergün, 2010).

Öğrencilerin okuyacakları bölüm ve öğrenme stilleri arasındaki farklılık incelendiğinde, öğrencilerin öğrenme stillerinin okuyacakları bölümlere göre farkın anlamlı olmadığı görülmüştür. Literatürde farklı öğrenme stilleri üzerinde yapılan bazı çalışmalar da bu sonucu desteklerken (Özen ve Eren, 2009); bazı çalışma sonuçları ile çelişmektedir (Kahyaoglu, 2011).

Bölüm ve cinsiyetin öğrencilerin öğrenme stilleri üzerindeki ortak etkisinin anlamlı olmadığı görülmüştür. Benzer olarak, Samancı ve Keskin (2007) tarafından yapılan çalışmada da cinsiyet ve bölümlerin öğrencilerin öğrenme stilleri üzerinde etkinin anlamlı olmadığı belirlenmiştir. Bu sonuçlara göre üniversitede okudukları bölümlerin bayan öğrencilerin ve erkek öğrencilerin öğrenme stillerine etkisi bulunmadığı söylenebilir.

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Students matching dividers isolate common factors (1,2,3,4,6,12). The numbers 36 and 24 without remainder are divided into (1,2,3,4,6,12). Then they determine that 2 is the smallest, and 12 the greatest common divisor, which are divided into 36 and 24.

For the complete formation of their math knowledge (students') the teacher suggests the students to compare the definitions they got with the ones in the school manuals. *The number 12 is the greatest common divisor of 36 and 24, and the number 2 is the smallest common factor of 36 and 24, and its abbreviated GCD (Greatest Common Divisor).* The comparison process knowledge aligned with the knowledge given in the textbook, strengthens students acquired knowledge and leads them to conclude that determining the greatest common divisor, they came to the concept of the least common divisor, which eventually is abbreviated as SCD (Smallest Common Divisor), that students are going to study in upcoming classes. For the development of skills to apply that knowledge in the team students are invited to come up with the natural numbers and determine the greatest common divisor and the smallest short number.

When comparing a constructive approach to learning with the traditional form of knowledge transfer is easy to see that the process of constructing new knowledge is based on prior knowledge and skills. In this process, the student's knowledge on the move, they can easily turn into new knowledge, by adding one element. Consistently built new knowledge, integrating with the previous and subsequent knowledge, provide a comprehensive picture of the action. Interactive learning activities of students combined with mental activity leads to the formation of operational thinking, which results in the conversion of some knowledge to new knowledge.

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## Active front steering system for road vehicle and its limitations

A.K.W. Ahmed, V. Rawat, and R.B. Bhat  
Department of Mechanical and Industrial Engineering,  
Concordia University, Montreal, Quebec, Canada

**Abstract:** Active front steering (AFS) systems for road vehicles are designed to actively alter the steer angle of the front wheels in order to realize a target response for a given driver input at any forward velocity. For a typical vehicle with understeer characteristics, this will demand an increase in the steer angle as the forward velocity is increased. Steering maneuver at high speeds, however, leads to significant load shift from the inner to the outer wheel, which diminishes the ability of the inner tire to develop lateral force even if the steer angle is increased. A four-wheel vehicle handling model equipped with AFS and simple controller is investigated to explore the performance of AFS. The results demonstrate that the AFS can enhance performance in comparison to a conventional system until one of the tires reaches its work load capacity. It is recommended that an AFS system where each wheel steer angle can be altered independently has the potential to overcome the limitation and maximize the performance limit by equalizing the tire work loads of each wheel.

**Key Words:** Vehicle handling, active steering, tire work load.

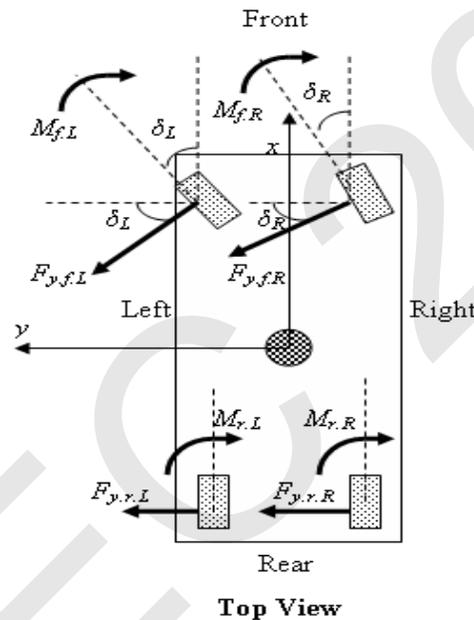
### Introduction

The conventional road vehicle steering mechanism is designed to closely follow the Ackerman steering ratio, which is based on different steer angle required at the inner and outer wheels at low speeds. The dynamics of a vehicle and its influence on the vertical load on each tire, and resulting slip angle, causes the vehicle to follow different paths at different speeds for an identical steering input. This phenomenon due to compliance of pneumatic tires is known as understeer characteristics [Wong, 2008] which can be neutralized by actively controlling or modifying the steer angle at the wheel depending on forward speed. The concept of Active Front Steering (AFS) [Ackerman, et al., 1999] has been explored for several years in the past and has gained a new momentum in recent years [Zhang, et al., 2008]. The strategy in AFS system is to monitor vehicle state parameters, such as longitudinal and lateral velocity, yaw-rate and steering command from the driver, based on which a corrective steer angle is computed and applied to the steer angle at the wheel. Theoretically this can neutralize the understeer effect requiring same steer angle for same turn regardless of speed. This is desirable to reduce driver skill requirements and automation. During turning, a load shift from inner wheels to outer wheels takes place, which can be significant at high speeds. Lower normal load on inner tire not only reduces its ability to generate lateral force, but also decreases the slip angle at which maximum lateral force can be generated [Wong, 2008]. Thus, at high speed turning, frictional force of the inner tire is prone to saturate due to low normal load and high slip angle, while outer tire may still have the ability to generate more lateral force. Hence, inner tire becomes a deciding factor for the amount of active steering control that can be applied. In order to overcome this situation, anti-Ackermann geometry is employed in race cars, where primary concern is higher lateral forces at high speed turning [Gaffney, Salinas, 1997]. For AFS, however, since the corrective input is applied to both the wheels following the Ackerman geometry, it is expected that there will be significant difference in the tire work-load [Velardocchia, et al., 2004] at the inner and outer tires, which is a major concern in vehicle handling safety [Cech, (2000)] and for enhancement of handling limits. A performance parameter, Tire Work-Load [Velardocchia, et al., 2004, Mokhiamar, Abe, (2002)] is used for comparing tire friction force utilization for inner and outer tires. Tire work-load is defined as ratio of total forces being generated from the tire and maximum ability of generating forces at instantaneous normal load. In the present study, tire longitudinal forces are neglected, and both front tires are assumed to have similar lateral-stiffness characteristics and experience similar road conditions. Hence, tire work-load is simplified as ratio of lateral force to normal load. This definition of tire work-load is used throughout this study. It is shown that conventional AFS

techniques risk the inner tire to saturate with high tire work-load and hence introduces severe limitations in its potential performance limits. In order to explore the deficiency of AFS in managing tire work load, it is necessary to use a full vehicle 4-wheel model that includes dynamic loads at each wheel. A comprehensive study of a 4-wheel vehicle model that includes tire non-linearity and vehicle roll load shift was undertaken in [Rawat, (2007)]. This study demonstrated that, in order to neutralize the steering response while equalizing the tire workloads, it is necessary to apply different corrective measures at the inner and outer wheels.

### Four-Wheel Vehicle Model

For the investigation of AFS, a 4-wheel vehicle model is developed that includes roll load shift and nonlinear “magic formula” [Wong, 2008] tire model. For simplicity, however, an in-plane model is retained that neglects bounce, pitch and roll motions of the vehicle. The 3-DOF (longitudinal, lateral and yaw motions) model along with tire lateral forces is shown in Figure 1.



**Figure 1:** Forces and moments acting on the vehicle

The steering command for right ( $\delta_R$ ) and left ( $\delta_L$ ) wheels are based on ideal Ackermann geometry and obtained as a function of driver steering command ( $\delta_{st}$ ) using the following relations [Rawat, (2007)]:

$$\delta_R = \tan^{-1} \left[ \frac{\sin(\delta_{st})}{\cos(\delta_{st}) + \frac{T_f \sin(\delta_{st})}{L}} \right]; \quad \delta_L = \tan^{-1} \left[ \frac{\sin(\delta_{st})}{\cos(\delta_{st}) - \frac{T_f \sin(\delta_{st})}{L}} \right] \quad (1)$$

In the absence of tractive and braking effort, the tire lateral forces are obtained as a function of tire slip angles and normal load using the Magic Formula [Wong, 2008]. The tire normal load includes the static load and lateral load shift due to lateral acceleration  $a_y$ . The tire slip angles are computed from:

$$\alpha_{f.R} = \delta_R - \tan^{-1} \left[ \frac{b \cdot \Omega + V_y}{V_x + T_f \cdot \Omega} \right]; \quad \alpha_{r.R} = \tan^{-1} \left[ \frac{c \cdot \Omega - V_y}{V_x + T_r \cdot \Omega} \right]$$

$$\alpha_{f.L} = \delta_L - \tan^{-1} \left[ \frac{b \cdot \Omega + V_y}{V_x - T_f \cdot \Omega} \right]; \quad \alpha_{r.L} = \tan^{-1} \left[ \frac{c \cdot \Omega - V_y}{V_x - T_r \cdot \Omega} \right]$$
(2)

The final expressions for equations of motions for the 3 DOF yaw plane model are:

$$m a_x = - [F_{y.f.R} \sin(\delta_R) + F_{y.f.L} \sin(\delta_L)]$$

$$m a_y = [F_{y.f.R} \cos(\delta_R) + F_{y.f.L} \cos(\delta_L)] + [F_{y.r.R} + F_{y.r.L}]$$

$$I_z \dot{\Omega} = - \left[ \sum_1^4 M_i \right] + [F_{y.f.R} \{ b \cos(\delta_R) - T_f \sin(\delta_R) \} + F_{y.f.L} \{ b \cos(\delta_L) + T_f \sin(\delta_L) \}] - c [F_{y.r.R} + F_{y.r.L}]$$
(3)

Vehicle trajectory can be drawn using following relations between vehicle co-ordinates and global co-ordinates:

$$X(t) = \int_0^t (V_x \cos \theta - V_y \sin \theta) \cdot dt$$

$$Y(t) = \int_0^t (V_y \cos \theta + V_x \sin \theta) \cdot dt$$
(4)

where  $\theta$  is the yaw angle calculated from the yaw-rate.

## Results

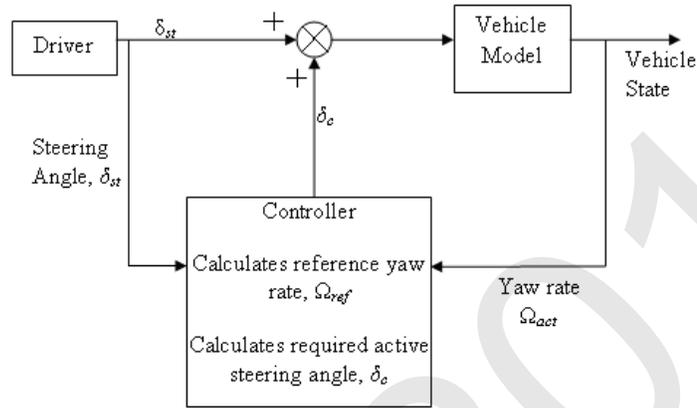
Simulations are carried out for forward speed of 15 m/s using Matlab as well as commercial software CarSim 4.51 in order to validate the model. The parameters for the vehicle used are those shown in Table 1.

**Table 1:** Physical parameters for 4-wheel model

|  |                        |
|--|------------------------|
| Mass of the vehicle, $m$                   | 1530 Kg                |
| Moment of inertia about $z$ axis, $I_{zz}$ | 3500 Kg.m <sup>2</sup> |
| Wheel base, $L$                            | 2.8 m                  |
| Distance of CG from front axle, $b$        | 1.3 m                  |
| Distance of CG from rear axle, $c$         | 1.5 m                  |
| Height of CG from ground, $h_{cg}$         | 0.4 m                  |
| Half Track Width - front axle, $T_f$       | 0.7 m                  |
| Half Track Width - rear axle, $T_r$        | 0.7 m                  |

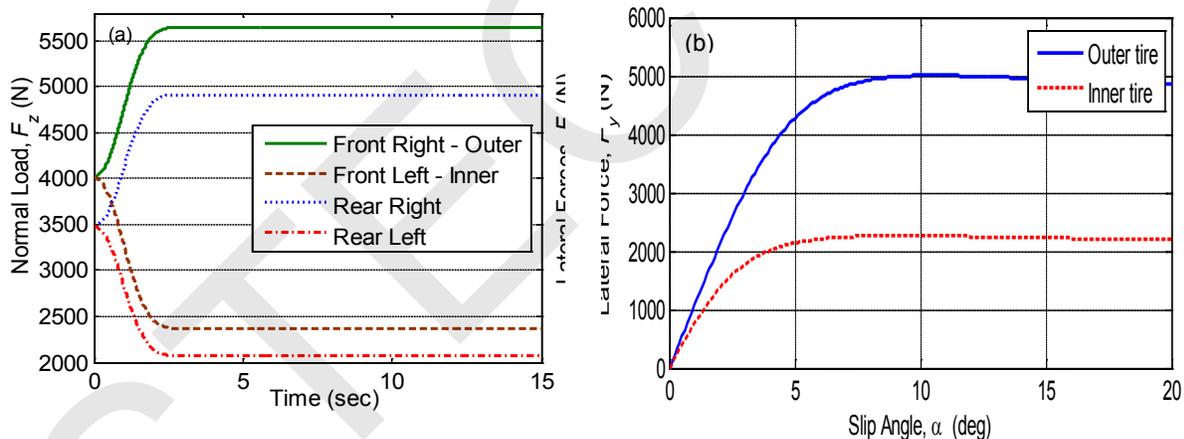
A simple feedback proportional-integral (PI) control strategy is adopted for the control of AFS system as shown in the block diagram in Figure 2. The reference yaw rate is based on a neutral steer response and the corrective steer angle  $\delta_c$  is computed from the error between actual and reference yaw rates. The details of simulations and control

method are presented in [Rawat, (2007)]. The results are obtained for steer angle increase from zero to 0.1 radians in two seconds. Figure 3(a) shows normal force experienced by each tire of the vehicle, while Figure 3(b) shows the capability of front inner and outer tires to generate lateral or cornering forces at these normal loads as a function of slip angle.



**Figure 2:** Block diagram for AFS controller.

In order to realize the target response with this maneuver, the AFS increases the steer angle as shown in Figure 4(a). In doing so the resulting slip angle developed at each of the front tires are shown in Figure 4(b). These results are sufficient to demonstrate the limitation of the AFS system as discussed in the following.

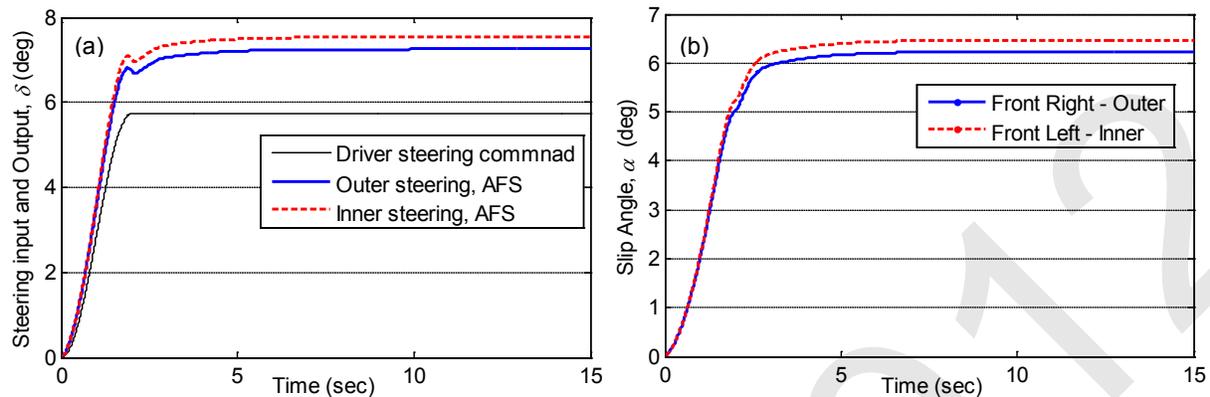


**Figure 3:** Normal load and lateral force generating capability of front tires at given normal load.

## Discussion

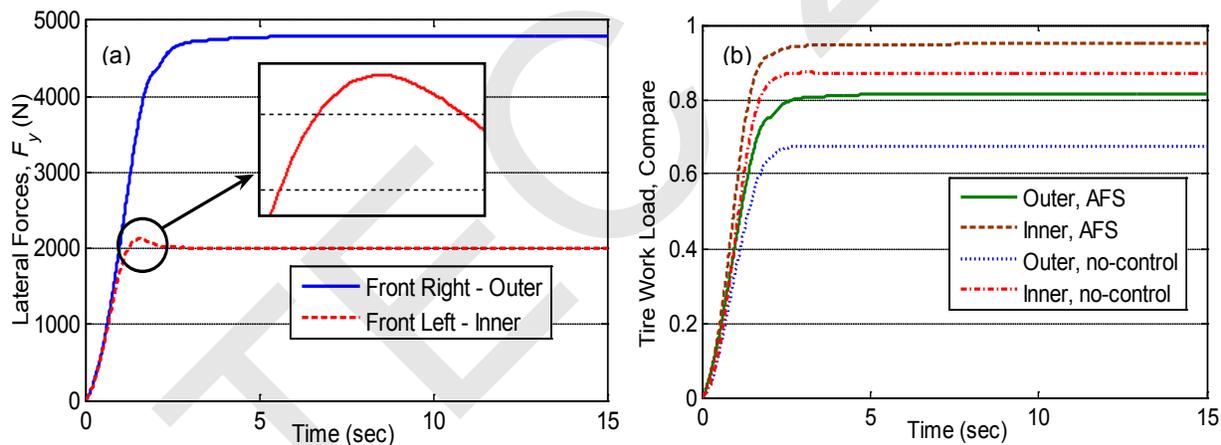
The results shown in Figure 3(a) clearly demonstrate the magnitude of the load shift from the inner to the outer tires during the given turning maneuver. Under these normal loads, the ability of the inner and outer tires to develop cornering force shown in Figure 3(b) indicate that the inner tire will reach saturation around  $5^\circ$  slip angle while the outer tire will saturate near  $10^\circ$ . This also indicates that the outer tire can generate significantly more lateral force than the inner tire if the slip angle is introduced. The results in Figure 4(a) show that in order to realize the target or reference response at the given speed and steer angle, the AFS significantly increases the steer angle while the

Ackerman ratio between the inner and outer wheels is maintained. In doing so, the slip angles just above  $6^\circ$  are generated at the inner and outer tires as shown in Figure 4(b). It is therefore evident that for the given maneuver, the



**Figure 4:** Steering command, AFS corrected steer angle and slip angles at front tires.

inner tire is well beyond its saturation limit of  $5^\circ$  while the outer tire is far from its saturation limit of  $10^\circ$ . The lateral tire forces generated during the maneuver by the AFS system, shown in Figure 5(a) indicate that the inner tire rapidly reached its saturation limit and further increase in slip angle resulted in a decrease in the lateral force generated by that tire. It is thus concluded that the AFS system is incapable of providing desired response at this operating speed. The performance measure defined as tire work load for a similar maneuver is shown in Figure 5(b).



**Figure 5:** Lateral forces and tire work-load for AFS, compared with no-control system.

As stated earlier, the tire work load approaching a value of unity would be an indicator of saturation and would be a good measure of how much work load is imposed on a given tire in relation to its capacity. The results in Figure 5(b) show that in comparison to a uncontrolled conventional system, the AFS increases the work load of inner tire significantly while reduces that of the outer tire even to a greater extent. Such trend is unavoidable due to the fact that there is load shift during turning and the steering correction is carried out while maintaining the Ackerman ratio. The conventional AFS system is although effective until one of the tires reaches saturation; its performance potential has a severe limitation. This limitation can be overcome by an AFS system where the steer angle of each wheel can be steered independently of the other. An AFS system with such capability can be designed to generate corrective steer angle for the inner and outer tires such that the tire workloads are equalized. In doing so, the performance limit of AFS can be maximized to its full potential.

## Conclusions

A detailed study has been carried out to examine the performance of AFS system in realizing handling response in an active manner. The results demonstrate that the design of an AFS system without regard to tire work load severely limits its performance potential. This limitation stems from the fact that there is significant lateral load shift during handling which in turn leads to an increase in inner tire work load while that of outer tire is reduced. This will be more prominent for vehicles with high centre of gravity. This limitation can be overcome by utilizing AFS with independent control capability for different corrective steer angle at the inner and outer tires. It may further require that the steer angle of the inner wheel is reduced while that of the outer wheel is increased under severe maneuver. In doing so, an attempt can be made to equalize the tire work load at each wheel and hence optimize the handling performance. Although steer-by-wire concept can be easily applied for practical implementation of this, a failsafe design of such a system is indeed a challenge that must be met.

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# A Review on Natural Fiber - Epoxy based Composites

Kommula Venkata Parasuram

Faculty of Engineering and Built Environment, University of Johannesburg, Republic of South Africa  
& Mechanical Engineering Department, University of Botswana, Botswana  
Gaborone, Botswana  
[kommula@mopipi.ub.bw](mailto:kommula@mopipi.ub.bw)

K Obi Reddy

Department of Mechanical Engineering Technology, University of Johannesburg  
Johannesburg, Republic of South Africa  
[obisku@gmail.com](mailto:obisku@gmail.com)

Mukul Shukla

Department of Mechanical Engineering Technology, University of Johannesburg, Republic of South Africa  
& Department of Mechanical Engineering, Motilal Nehru National Institute of Technology, Allahabad, India  
[mshukla@uj.ac.za](mailto:mshukla@uj.ac.za); [mukulshukla@mnnit.ac.in](mailto:mukulshukla@mnnit.ac.in)

Tshilidzi Marwala

Faculty of Engineering and Built Environment  
University of Johannesburg  
Johannesburg, Republic of South Africa  
[tmarwala@uj.ac.za](mailto:tmarwala@uj.ac.za)

Natural fibers attracted researchers with their special characteristics of biodegradable nature, good strength per unit weight than most inorganic fillers, lower density and abundance in nature to use them as reinforcements in composites. Potential use of natural fibers as reinforcements in polymers was limited because of their deficiencies such as incompatibility with the hydrophobic polymer matrix, the tendency to form aggregates during processing and poor resistance to moisture. In this work, a review on natural fiber-epoxy based composites carried out, results from literature are summarized and common applications of natural fiber reinforced composites were discussed.

Key words: Reinforcements, Epoxy, Natural fiber.

## Introduction

Natural fibers are renewable resource and their use as reinforcements in composites for various applications is increasing rapidly. Natural fibers are abundant, renewable and their cost is relatively low as compared with other synthetic fibers. Their commercial and research potentials enhanced by their significant advantages are compared with conventional inorganic manmade fibers. Over past few decades researchers tried to substitute glass fiber and other synthetic polymer fibers with natural fibers for diverse engineering applications. Classification of natural fibers is shown in Fig.1 [1–4]. Processing of natural fibers is relatively easy and they possess good properties like low density and relatively high tensile and flexural moduli [5].

Mineral { Asbestos, Fibrous brucite,  
Wollastonite, Inorganic Whiskers

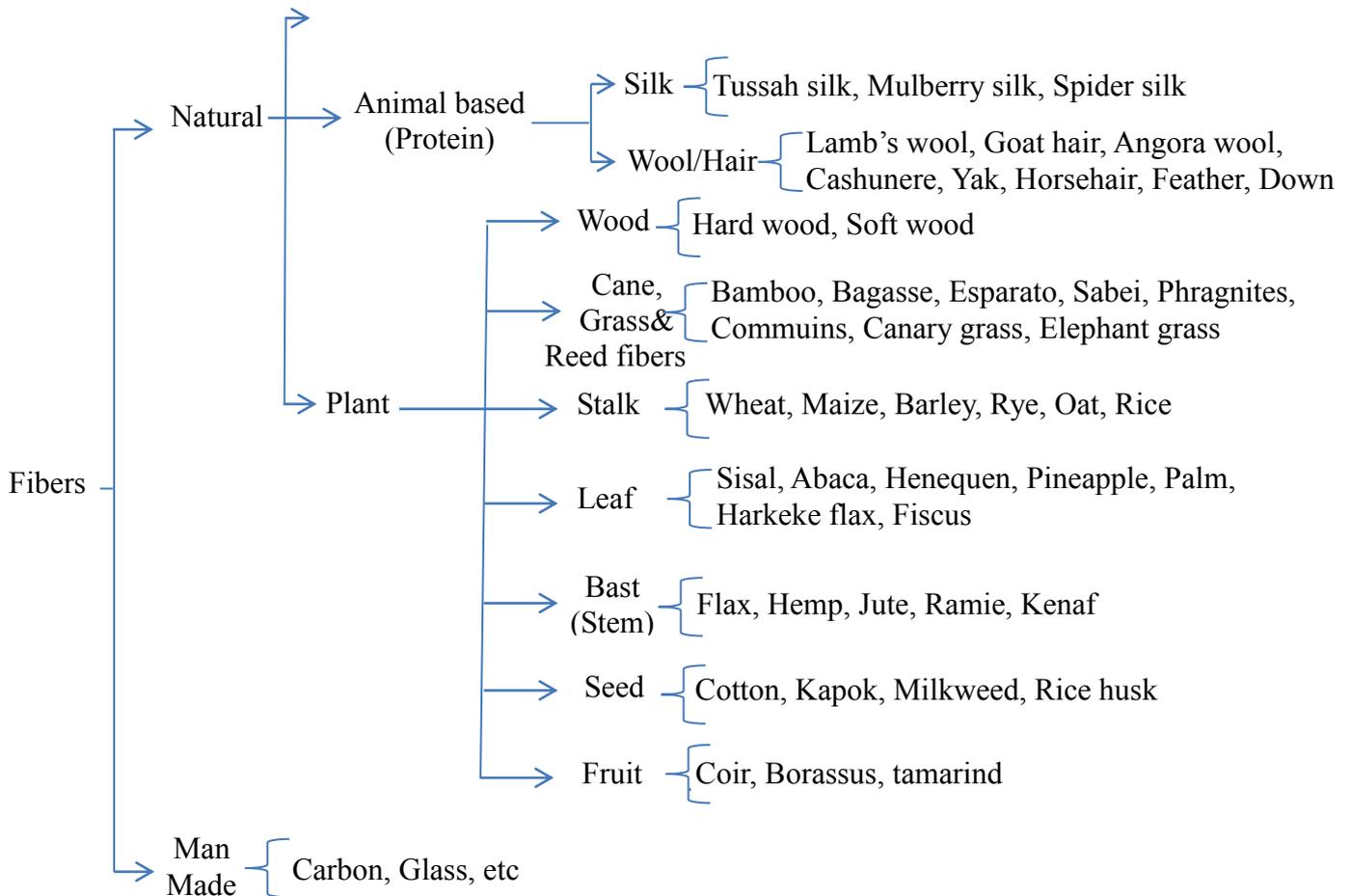
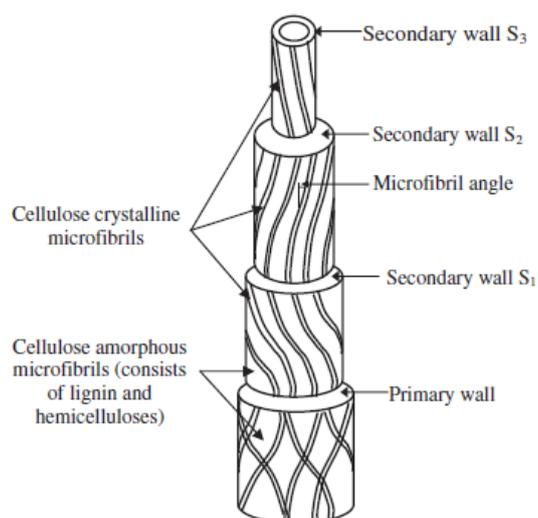


Fig 1: Classification of fibers.

### Structure of Natural Fibers

Basic structure of a natural fiber is presented in Fig. 2 [6]. Each fiber has a complex, layered structure consisting of a thin primary wall, which is the first layer deposited during cell growth encircling a secondary wall. The cell wall in a fiber is not a homogenous membrane [6]. The secondary wall is made up of three layers and the thick middle layer determines the mechanical properties of the fiber. The middle layer consists of a series of helically wound cellular microfibrils formed from long chain cellulose molecules. Micro fibrils have typically a diameter of about 10–30 nm and are made up of 30–100 cellulose molecules in extended chain conformation and provide mechanical strength to the fiber. The amorphous matrix phase in a cell wall is very complex and consists of hemicellulose, lignin, and in some cases pectin. Structural organization of the three major constituents in the fiber cell wall is shown in Fig. 3. The hemicellulose molecules are hydrogen bonded to cellulose and act as cementing matrix between the cellulose microfibrils, forming the cellulose–hemicellulose network, which is thought to be the main structural component of the fiber cell.



**Figure 2.** Structure of natural fiber [6].

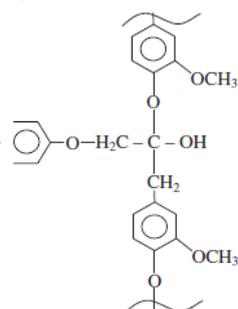
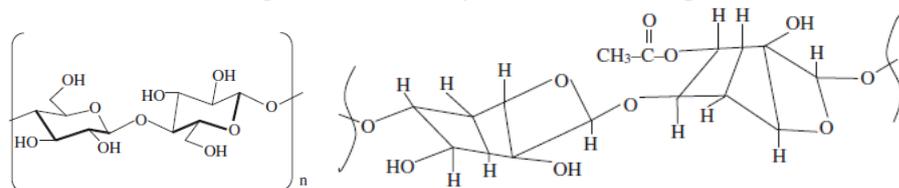


**Figure 3.** Structural organization of the three major constituents in the fiber cell wall [6].

The hydrophobic lignin network affects the properties of other network in a way that it acts as a coupling agent and increases the stiffness of the cellulose/hemicellulose composite.

### CHEMICAL COMPOSITION OF NATURAL FIBERS

The chemical composition of natural fibers varies depending upon the type of fiber. Primarily, fibers contain cellulose, hemicellulose, pectin, and lignin. The properties of each constituent contribute to the overall properties of the fiber. Hemicellulose is responsible for the biodegradation, moisture absorption, and thermal degradation of the fiber as it shows least resistance whereas lignin is thermally stable but is responsible for the UV degradation.



(i)

(ii)

(iii)

**Figure 4.** Chemical structure of (a) cellulose (b) hemicelluloses and (c) lignin [7].

The percentage composition of each of these components varies for different fibers. Generally, the fibers contain 60–80% cellulose, 5–20% lignin, and up to 20% moisture [7]. List of some important natural fibers and their chemical compositions were shown in table 1.

**Table 1.** List of some important natural fibers and their chemical composition [8-10]

| Fiber Source | Species                     | Cellulose<br>(wt %) | Hemicellulose<br>(wt %) | Lignin<br>(wt %) | Waxes<br>(wt %) |
|--------------|-----------------------------|---------------------|-------------------------|------------------|-----------------|
| Flax         | <i>Linum usitatissimum</i>  | 71                  | 18.6-20.6               | 2.2              | 1.5             |
| Jute         | <i>Corchorus capsularis</i> | 61-71               | 14-20                   | 12-13            | 0.5             |
| Sisal        | <i>Agave sisilana</i>       | 65                  | 12                      | 9.9              | 2               |
| Kenaf        | <i>Hibiscus cannabinus</i>  | 72                  | 20.3                    | 9                | -               |
| Hemp         | <i>Cannabis sativa</i>      | 68                  | 15                      | 10               | 0.8             |
| Bamboo       | (>1,250 species)            | 26-43               | 30                      | 21-31            | -               |
| Napier grass | <i>Poaceae</i>              | 40.2                | 23.66                   | 23.65            | 2               |

### Chemical Treatment of Natural Fibers

To improve the bonding between the fiber-matrix interfaces, researchers use various methods to treat the natural fibers. Some of the widely used methods were discussed below.

#### Alkali Treatment

Alkali (mercerization) treatment is the widely used method. Alkali treatment leads to fibrillation of the fiber bundle into smaller fibers by removing impurities present in the fibers. Alkali treatment reduces the fiber diameter, which eventually increases the aspect ratio [11, 12]. Alkali treatment develops a rough surface topography, resulting in better mechanical interlocking and the amount of cellulose exposed on the fiber surface. Increases the aspect ratio leads to better fiber–matrix interface adhesion and an increase in mechanical properties. This increases the number of possible reaction sites and allows better fiber wetting [11]. The important modification occurring in alkali treatment is the removal of hydrogen bonding in the network structure and it is presented in *eq. (1)*.

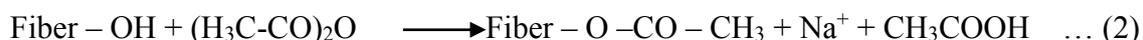


Alkali treatment has lasting effect on the mechanical behavior of fibers, especially on their strength and stiffness. Several studies conducted on alkali treatment reported that mercerization led to increase of the amount of amorphous cellulose at the expense of crystalline cellulose, and removal of hydrogen bonding in the network structure [11, 13].

#### Acetylation

Acetylation is an attractive method of modifying the surface of natural fibers and making it more hydrophobic. The main principle of the method is to react the hydroxyl groups (OH) of the fiber with acetyl groups (CH<sub>3</sub>CO), therefore rendering the fibers surface more hydrophobic. The hydroxyl groups that react are those of the minor constituents of the fiber, i.e. lignin and hemicelluloses, and those of amorphous cellulose [11].

Acetylation is based on the reaction of cell wall hydroxyl groups of lignocellulosic materials with acetic or propionic anhydride at elevated temperature (usually without a catalyst) [Eq. (2)]:



Esterification improves the dispersion of lignocellulosic materials in a polymer matrix, as well as the dimensional stability and interface of the final composites [11, 14, and 15].

### **Graft Copolymerization**

It is also an effective method of surface chemical modification of natural fibers. Optimized vinylgrafted NFs, consisting of orderly arrangement of grafted segments, act as compatible reinforcing fibers with several resin systems to obtain better fiber–matrix adhesion of the resulting eco-composites [11].

### **Processing Techniques**

Processing techniques of natural fiber composites are similar to processing of synthetic fibers. Depending on the length, orientation and type of the fiber, randomly oriented (short), unidirectional (raw and carded) and woven fabrics are used as reinforcements in thermoset and thermoplastic matrices. The basic fabrication method is known as ‘‘hand layup’’ is used for thermoset composites. Hand layup is a manual processing between the fiber and matrix. The uniformity of the composite in terms of thickness, fiber to matrix ratio and void content throughout the sample depends on the workmanship skill in this process.

Another method, vacuum assisted resin transfer molding (VARTM), resin is pulled inside under vacuum pressure and mixed with the fibers/fiber mats. Under this condition, the resin impregnation quality in a composite is much better than that fabricated by the hand layup technique and the void content is minimal. This method provides precise fiber spacing and dimension of the composite. In addition, pultrusion is used for both thermosets and thermoplastics. The composite profile is produced by pulling the reinforcement through a heated die, which is then mixed with matrix.

In thermoset polymers, the fibers are used as unidirectional tapes or mats. These are impregnated with the thermosetting resins and then exposed to high temperature for curing to take place. For the thermoplastic matrix, compression molding (reinforcement is mixed with matrix and pressed with a heated plate) and injection molding (fiber–resin is added as granulate to the machine and melted into fluid mass, then injected under high pressure into the form) are used for composite fabrication [16-18].

### **Fiber–Matrix Interface**

A matrix is a binder material that is used to hold fibers in position and transfer external loads to internal reinforcements. In natural fiber reinforced polymer composites, both thermoset and thermoplastic matrices such as epoxies are widely used for composites applications [14, 15]. These matrices have different chemical structures and undergo different reactivities with the surface molecules of fibers in composites.

The incorporation of hydrophilic natural fibers in polymers leads to heterogeneous systems whose properties are inferior due to lack of adhesion between the fibers and the matrix. Thus, the treatment of fiber for improved adhesion is a critical step in the development of such

composites. The treatment of the fibers may be alkali, grafting of monomers, acetylation, and so on.

### Properties of Natural Fiber Composites

The properties of natural fiber reinforced composites depend on a number of parameters such as volume fraction of the fibers, fiber aspect ratio, fiber–matrix adhesion, stress transfer at the interface, and orientation. Most of the studies on natural fiber composites involve study of mechanical properties as a function of fiber content, effect of various treatments of fibers, and the use of external coupling agents [19–22]. Important Physical properties of various natural fibers are shown in table 2.

**Table 2.** Physical properties of various natural fibers [3, 23-26]

| Fiber Source | Tensile strength (MPa) | Young's Modulus (GPa) | Elongation at Break (%) | Density (g/cm <sup>3</sup> ) |
|--------------|------------------------|-----------------------|-------------------------|------------------------------|
| Flax         | 345-1035               | 27.6                  | 2.7-3.2                 | 1.5                          |
| Jute         | 393-773                | 26.5                  | 1.5-1.8                 | 1.3                          |
| Sisal        | 511-635                | 9.4-22                | 2.0-2.5                 | 1.5                          |
| Kenaf        | 930                    | 53                    | 1.6                     | 1.45                         |
| Hemp         | 690                    | 70                    | 1.6                     | 1.48                         |
| Bamboo       | 140-230                | 11-17                 |                         | 0.6-1.1                      |
| Napier       | 88.4                   | 13.15                 | 0.991                   | -                            |

In improving mechanical properties of the composites, both the matrix and fiber properties are important. The tensile strength is more sensitive to the matrix properties, whereas the modulus is dependent on the fiber properties. To improve the tensile strength, a strong interface, low stress concentration, fiber orientation is required whereas fiber concentration, fiber wetting in the matrix phase, and high fiber aspect ratio determine tensile modulus. The aspect ratio is very important for determining the fracture properties.

In short-fiber-reinforced composites, a critical fiber length is required to develop its full stressed condition in the polymer matrix. Fiber lengths shorter than this critical length lead to failure due to debonding at the interface at lower load. On the other hand, for fiber lengths greater than the critical length, the fiber is stressed under applied load and thus results in a higher strength of the composite. For, good impact strength, an optimum bonding level is necessary. The degree of adhesion, fiber pullout, and a mechanism to absorb energy are some of the parameters that can influence the impact strength of a short-fiber-filled composite. The properties mostly vary with composition as per the rule of mixtures and increase linearly with composition.

**Table 3.** Properties of a typical epoxy polymer used for natural fiber composites [3]

| Density (g/cc) | Elastic Modulus (GPa) | Tensile Strength (MPa) | Compressive Strength (MPa) | Elongation (%) | Cure Shrinkage (%) | Water absorption | Izod Impact Notche |
|----------------|-----------------------|------------------------|----------------------------|----------------|--------------------|------------------|--------------------|
|                |                       |                        |                            |                |                    |                  |                    |

|         |     |        |         |     |     |                    |          |
|---------|-----|--------|---------|-----|-----|--------------------|----------|
|         |     |        |         |     |     | (24 hr @<br>20° C) | d (J/cm) |
| 1.1-1.4 | 3-6 | 35-100 | 100-200 | 1-6 | 1-2 | 0.1-0.4            | 0.3      |

The primary thermoset resins such as polyester, vinylester, and epoxy resins are used today in natural-fiber composites for automotive applications. Properties of a typical thermoset are provided in table 3. In natural fibers, polar groups emanating from hydroxyl groups, acetyl, and ether linkages (CO-C) are the main structural units and the primary contributor to mechanical properties; these also render cellulose more compatible with polar, acidic, or basic groups, as opposed to nonpolar polymers. Epoxy resins offer high performance and resistance to environmental degradation. Typically, the monomer is produced by reacting epichlorohydrin and bisphenol-A with hardeners such as amines or anhydrides common in industry.

Some of the important natural fibers used as reinforcement in composites using epoxy resin as a matrix material are presented in Table 4 [4].

**Table 4.** Epoxy matrix-natural fiber composites.

| Fiber        | Reference   |
|--------------|---|
| Flax         | George, Ivens and Verpoest 1999; Hepworth et al. 2000; Lamy and Baley 2000; Mildner and Bledzki 1999  |
| Jute         | Gassan and Gutowski 2000; Datta, Basu and Benerjee 2002; Mishra et al. 2000; Tripathy et al. 2000; Costa and D’Almeida 1999; Gassan and Bledzki 1997; Gassan and Bledzki 1999 |
| Sisal        | Oksman et al. 2002; Rong et al. 2002  |
| Kenaf        | Zimmerman and Losure 1998   |
| Hemp         | Hughes et al. 2002; Hepworth et al. 2000  |
| Bamboo       | Rajulu, Baksh and Reddy 1998)   |
| Napier grass | Kommula et al. 2012   |

Epoxies have wide appeal in industry, although in the automotive industry epoxies havenot gained broad use due to longer cure schedules and high monomer cost. Vinylester resins, a relatively new addition in the family of thermosetting resins, is usually produced by the reaction between epoxy resin and an ethylenically unsaturated carboxylic acid, with commonly used acids such as acrylic and methacrylic acid. Vinylester resins combine excellent chemical resistance, good thermal and mechanical properties, and the relative ease of processing and rapid cure characteristics of polyester resins. These have better moisture resistance than epoxies when cured at room temperature. Vinylester resins are similar in their molecular structure to polyesters, but differ in that the reactive sites are positioned at the ends of the molecular chains, allowing the chain to absorb energy. This results in a tougher material when compared to polyesters.

**Table 5.** Common applications of natural fiber reinforced composites. [27-29]

| Application | Examples  |
|-------------|---|
| Automotive  | Door panels, seat backs, headliners, dash boards, car door, Transport pallets, trunk liners, Decking , real parcel shelves spare tyre covers, other interior trim, spare-wheel pan, |

|                                  |  |
|----------------------------------|--|
|                                  | trim bin   |
| Aircraft                         | Interior paneling  |
| Construction                     | Railing, bridge, siding profiles   |
| Household products and furniture | Table, chair, fencing elements, Door panels, interior paneling, Window frames, door-frame profiles, food tray, partition |
| Electrical and electronics       | Mobile cases, laptop cases   |
| Sports and leisure items         | Tennis Racket, bicycle, Frames, Snowboards   |

Table 5 shows the potential applications of natural fiber composites in automotive, electrical and electronics, sports and leisure items, construction, aircraft and household products & furniture industries [27–29]. Eco-friendly measures taken by the electronic industry is an important reason for these composites growth in electrical and electronics applications. Many reports have addressed that by using natural fibers as supplement and/or reinforcement of epoxy resin, the amount of Carbon Monoxide provided during fire is less than that of their host materials.

## CONCLUSIONS

Natural fibers are replacing manmade fibers being used as reinforcement in polymer composites due to their commendable mechanical properties, processing advantages and environmental benefits. Natural fiber can be classified for plant-based and animal-based. The selection criteria of natural fibers are highly dependent on their type, application and cost. Chemical treatment is an essential processing parameter to reduce hydrophilic nature of the fibers and thus improves adhesion with the matrix. Significant improvements in the mechanical properties of the composites are reported by using different chemical treatment processes on the reinforcing fiber.

Natural-fiber composites will continue to expand their role in automotive applications only if such technical challenges as moisture stability, fiber polymer interface compatibility, and consistent, repeatable fiber sources are available to supply automotive manufacturers.

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# Conceptual Modeling of Performance Indicators of Higher Education Institutions

Tuba CANVAR KAHVECI<sup>1</sup>, Harun TAŞKIN<sup>1</sup>, Merve CENGİZ TOKLU<sup>1</sup>

<sup>1</sup>Department of Industrial Engineering, Sakarya University, Serdivan, Turkey  
tcanvar@sakarya.edu.tr, taskin@sakarya.edu.tr, mtoklu@sakarya.edu.tr

**Abstract:** Measuring and analyzing any type of organization are carried out by different actors in the organization. The performance indicators of performance management system increase according to products or services of the organization. Also these indicators should be defined for all levels of the organization. Finally, all of these characteristics make the performance evaluation process more complex for organizations. In order to manage this complexity, the process should be modeled at the beginning. The aim of this study is providing the conceptual performance model for higher education institutions to manage this complexity easily and evaluate the higher education institutions from all aspects. The proposed model is also exemplified by using Sakarya University case study.

**Key words:** Performance, modeling, higher education.

## Introduction

All enterprises exist for the achievement of one or more goals and these goals vary depending on the type of organization. The main goal of a manufacturing company can be the realization of maximal profit while the goal of a non-profit organization can be to effectively provide its services. The measuring of performance and results of the enterprise shows the success of the management. Therefore, measuring and evaluating organizational performance plays an important role in turning organizational goals to reality, and the notions of a goal and a performance indicator are essential.

Today organizations need to define and make explicit company-specific performance indicators by using a systematic approach. That's why, it is necessary to formalize the concept of a performance indicator together with its characteristics, relationships to other performance indicators and relations to other formalized concepts such as goals, processes and roles. This study presents a framework of performance evaluation model of higher education institutions by modeling performance indicators and the relationships between them. The contribution of the study can be summarized in the following points:

- i. clarification the required knowledge for performance measuring of higher education institutions by formalizing the concept of a performance indicators,
- ii. formalization of the relationships between performance indicators,
- iii. integration of the concepts of a performance indicator of higher education institutions,
- iv. providing a basis model for application of information technology in a performance measuring system.

## Performance Measurement Systems and Performance Indicators

Performance Measurement (PM) is defined as getting timely information about the operations have to be monitored and measured constantly for heading of company's success (Kanji, 2007). Although the immediate role of any performance measurement system is to check progress towards the established goals, such system fulfills several other purposes in the organization such as decision support, diagnosis, performance evaluation and monitoring effect of strategic plans (Tehhumen et.al, 2002). By implementing PM, an enterprise can have following capabilities (Kanji, 2007);

- ability to identify major improvement opportunities,
- ability to achieve goal congruence and organizational alignment,
- ability to enhance accountability,

- ability to drive future resource allocation decisions
- ability to communicate to each individual how he/she can contribute to the overall strategy and thus to encourage and reinforce certain behaviors and attitude.

A performance measurement system is a set of performance indicators (PIs) to quantify actions. These PIs are the building blocks in a measurement system. In the literature, the PIs can be classified in different ways. For example, the PIs is classified according to its characteristics into hard versus soft PIs. Hard PIs are pure facts that are possible to measure directly whereas soft PIs are intangible metrics that have to be measured indirectly like for instance attitudes (Rolstadas, 1995).

Also, the PIs can be grouped into three groups according to its purposes and time horizons such as achievement, diagnostics and competence PIs. Achievement PIs are direct metrics for actual business achievement such as net profit, return on investment, market share, export share etc. as well as diagnostics PIs are indirect metrics for business achievement. These PIs are critical success factors such as delivery precision, delivery flexibility, product quality, product reliability, lead time on customer request, customer satisfaction, outstanding claims etc. Competence PIs is used to describe how well the company is prepared for the future or to meet new requirements (Rolstadas, 1995).

In the other framework, there are two types of performance measures such as process performance measures and output performance measures. While process performance measures monitor the activities of a process, output performance measures report the results of a process. Process performance measures are used to motivate people within the process as well as output performance measures are used to control resources (Hronec, 1993).

Optimal performance measurement systems would be developed to serve different purposes and provide different time horizons by balancing of various PIs. The best performance measures give balance to the company's operations and are deployed throughout the organization in a way that links strategy to processes and processes to one another. Therefore, developing an objective measurement system and determining accurate performance indicators are a comprehensive and difficult task for any kind of enterprise. There are a number of different performance measurement and analysis systems available for companies. The Balanced Scorecard, the Performance Pyramid System and the Performance Prism are globally known. There are also numerous different implementation processes and practice examples for companies presented in the literature and scientific articles (Tehhunen et.al, 2002).

Using recognized objective indicators and evaluation systems is necessary for a rational justification of higher education institutions. European University Association (EUA) supports and executes the special studies to develop a shared reference system for indicators and evaluation procedures for higher education institutions in Europe. It reported a number of principles that are fundamental to define and use PIs of higher education (Tavenas, 2003):

- HE performance indicators will differ depending on the level of analysis envisaged.
- The statistical indicators of any university activity have to be regarded as elements that support a particular judgment rather than objective facts.
- Indicators have to be used in complementary clusters so as to give a very precise and thorough picture of the activity concerned;
- Indicators should preferably be concerned with the distinctive features of a particular institution or a university sector and enable it to monitor its strategic orientations.
- Analysis of performance indicators at any level (institutional, regional or national) must therefore take information on the variety of academic disciplines in terms of their nature and relative representation fully into account.
- Performance indicators too firmly rooted in the diversity of disciplines may no necessarily do this. By using indicators applicable to the major branches of learning such as natural sciences applied sciences, life sciences, the social sciences and arts, this potential pitfall is largely averted.
- The use of uniform performance indicators in a university system is only justified if all the institutions in this system have similar fundamental goals and responsibilities. If not, the adoption of such indicators carries with it the considerable risk that the system will eventually become uniform and sacrifice its diversity. They should therefore only be used discriminatingly and with the agreement of all concerned.

An establishing a measurement system and determining performance indicators for the higher education institutions is getting difficult because of their inherent complexity. EUA also declined these difficulties in the following points (Tavenas, 2003):

1. An availability, representativeness, and reliability of raw statistical data,

2. A relation between the level at which data are aggregated and their meaning,
3. A diversity of academic disciplines,
4. Possible dangers inherent in using performance indicators to evaluate and finance institutions.

## Conceptual Model of Institutional Performance Evaluation of HEIs

There are various studies about measuring the performance of higher education institutions as well as determining the performance criteria. Most of the studies try to answer what performance criteria should be and how performance criteria can be measured. For example, Centra (1997) determined the university evaluation criteria as classroom teaching, number of publications, quality of publications, research and/or creative activity. Martin (2003) evaluates the performance of 52 departments of Saragossa universities by using the collective model of envelopment analysis with three input variables: human resources, financial resources and equipment (material resources) and two outcome variables: educational and research in a coordinate way. In the other study, Azma (2010) described key performance indicators and presented a conceptual framework for the evaluation of the performance of the universities according to the key performance indicators. According to this study there are ten factors such as area and facilities (cultural area, research area, lab area, office area, education area, sport area), research and scientific journals, processes, education and technology, cultural and social services, faculty members, employees, students and graduates (Azma, 2010). In the other study, Wu et al. (2011) developed a set of appropriate performance evaluation indices mainly based on balanced scorecard for extension education centers in universities by utilizing multiple criteria decision making.

On the other hand, some studies focus on special dimension of the higher education institutions and use the different techniques for selection of the performance indicators. Lee (2010) focused on especially an intellectual capital (IC) and developed IC evaluation model to facilitate the understanding of their contribution to the university performance. He also applied Analytic Hierarchy Process (AHP) to formulate and prioritize the IC measurement indicators for constructing the IC evaluation model. In this study; university evaluation criteria were defined as administration, curriculum, technology transfer, research, teaching and service (Lee, 2010). Ahmadi (2012) aimed that cognition of performance appraisal system of this university and also introduced AHP technique in performance appraisal (Ahmadi, 2012). Kiakojoori et al. (2011) evaluated the performance of each branch of the Azad Islamic University (IAU) in Mazandaran province, determining the role model and reference branches to define the inefficient branches by applying envelopment analysis and ranking the efficient branches of AIU in Mazandaran province by applying Anderson Peterson Method.

After all, the beginning of any study about performance measuring of higher education institutions should be started by designing a reference model. Therefore, this study aims to provide the performance evaluation model for higher education institutions by considering the findings of above mentioned studies and EUS's principles. The proposed model consists of *indicators sub-model* and *measurement process* which are described in detail in the following sections.

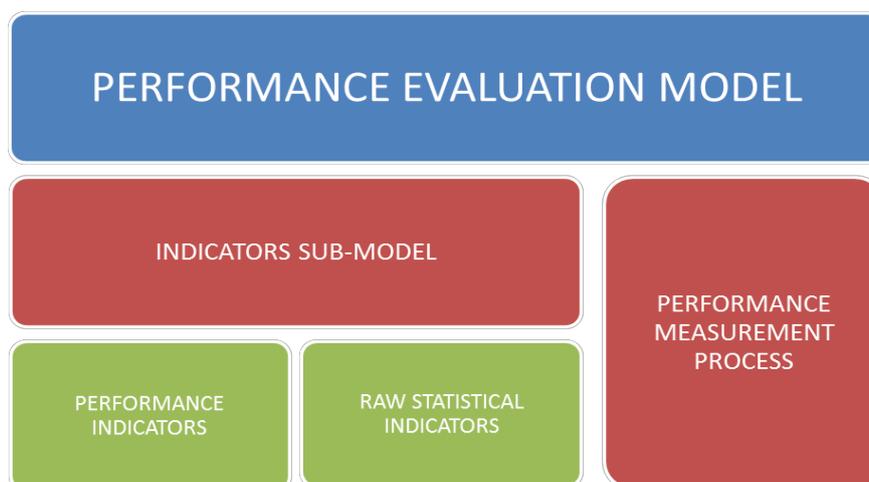


Figure 1: Performance evaluation model for higher education institutions

### 1. Indicators Sub-Model:

The indicators are classified into Performance Indicators and Raw Statistical Indicators in the indicators sub-model. **Raw Statistical Indicators** are the statistical numbers which are not processed and do not give any judgment about the situation. For example, “the numbers of the students of any departments” don’t give any meaning for the situation and performance of this department. Therefore, we need to calculate some data to assess a performance of process or department. Raw Statistical Indicators could be Student Data, Academic Staff Data, Administrative Staff Data, Degree Programs Data, Course Data, Facility Data and Financial Data.

On the other hand, **Performance Indicators** are the calculated numbers about the process or the units in the higher education and can be used directly to evaluate this process or departments. The performance indicators consist of Strategic Performance Indicators and Process Performance Indicators:

- The Strategic Performance Indicators (SPI) are used for measuring the achievement of the institutional targets and they are output PI. Strategic Performance Indicators are grouped into following clusters for higher education institutions:
  - ✓ Education and Training PI
  - ✓ Research and Development PI
  - ✓ Community Services PI
  - ✓ Administrative and Management PI
- The Process Performance Indicators (PPI) can be used to monitor the processes which are executed in the institution, and these processes support the strategies of the HEI by determining the process targets in line with the strategic targets. Process Performance Indicators (PPI) are grouped into following clusters for higher education institutions:
  - ✓ Education and Training Processes PI
  - ✓ Research and Development Processes PI
  - ✓ Services Processes PI
  - ✓ Administrative Processes PI
  - ✓ Management Processes PI

As a consequent, the indicator has two dimensions in the proposed performance indicators sub-model such as:

1. Statistical versus Performance dimensions
2. Strategic versus Process dimensions

This classification also provides that the performance indicators can be differed depending on the level of strategic (institutional) or process analysis. The SPI can be used for strategic analysis, and derived from raw statistical indicators and the PPI which is used for process analysis. For example, “number of published paper” is the indicator of knowledge creation process of higher education institution, and “number of published paper per academicians” is the institutional performance indicators of the higher education from the same dimension.



Figure 2: Relationship between indicators

Following table was constituted by using the Sakarya University’s performance indicators based on the proposed model.

Table 1: Examples of Sakarya University’s based on the model.

| INDICATOR EXAMPLES OF SAKARYA UNIVERSITY |                                |                            |                                  |
|--|--------------------------------|----------------------------|----------------------------------|
| Evaluation Focus                         | Process Performance Indicators | Raw Statistical Indicators | Strategic Performance Indicators |
| Education and                            | Number of revised              | Total number of courses    | Ratio of revised courses (Number |

|                          |  |   |   |
|--------------------------|--|---|---|
| Training                 | courses according to the student surveys                                       |   | of revised courses/Total number of courses)   |
|                          | Number of courses whose materials shared on web                                |   | Ratio of courses material sharing   |
|                          | Number of enrolled students  | Number of expected students               | Ratio of fulfillment of programs  |
| Research and Development | Number of published papers in SCI, SCI-expanded, SSCI and AHCI indexed journal | Total number of faculties                 | Number of published paper per faculty   |
|                          | Number of national projects  |   | Number of national project per faculty  |
|                          | Number of international projects   |   | Number of international project per faculty   |
| Community Services       | Number of supported projects for community                                     | Number of appealed projects for community | Supporting percentage for community services  |
|                          | Number of activity carried with the non-governmental organizations (NGOs)      | Number of total NGOs                      | Effectiveness of collaboration with NGOs (Number of activity carried with the NGOs/ Number of total NGOs) |
|                          | Number of activities carried for social benefit                                | Number of departments                     | Number of activities carried for social benefit per departments   |

## 2. Performance Measurement Process:

The other component of the proposed PI model is the performance measurement process shown in the following figure. This component is to formalize the relationships of PIs and to describe the performance measuring procedure through the higher education institutions. The performance measurement process also links strategies to processes and processes to another.

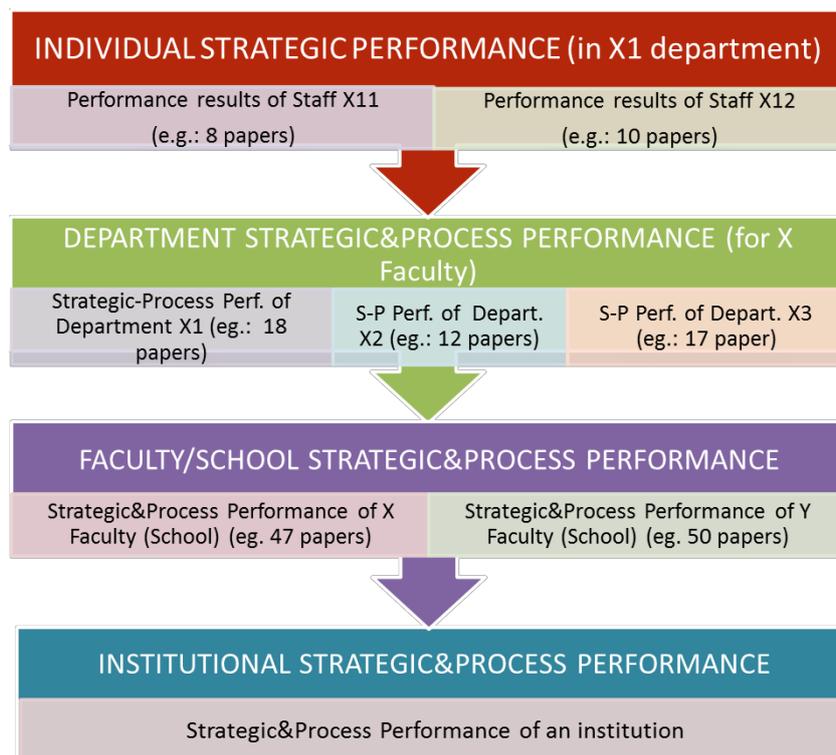


Figure 3: Performance evaluation process of higher education institutions

The performance evaluation process starts with determination the results at the individual level. After that, the department's performance values are calculated from individual results. The faculty's performance results are determined by aggregating performance results of all departments in the faculty and so on, the institution performance is calculated by similar ways from faculty to institution.

## Conclusions

Today, the performance evaluation is essential for any kind of institutions as well as higher education institutions. There are numerous different implementation practices for companies and for higher education institutions in the literature and scientific articles. Especially, EUA's studies about performance indicators and performance evaluation of higher educations are considerable. The aim of this study is to provide the performance evaluation model for higher education institutions by clarifying the required knowledge for performance measuring, formalizing and integrating the concept of performance indicators. This model also provides the knowledge basis for the implementation of information technology in a performance measuring system. The performance evaluation model consists of indicators sub-model which is classified into performance indicators and raw statistical indicators, and performance measurement process.

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# Farklı Çimentolar İle Üretilen Betonların Değişik Kür Koşulları Altında Basınç Dayanım Özelliklerinin İncelenmesi

Mücteba UYSAL, Kemalettin YILMAZ  
Sakarya Üniversitesi Mühendislik Fakültesi, İnşaat Mühendisliği Bölümü,  
Esentepe Kampüsü, 54187, Serdivan/Sakarya  
mucteba@sakarya.edu.tr, kmyilmaz@sakarya.edu.tr

Mansur SÜMER, Ali İhsan GÜNDOĞDU  
Sakarya Üniversitesi Mühendislik Fakültesi, İnşaat Mühendisliği Bölümü,  
Esentepe Kampüsü, 54187, Serdivan/Sakarya  
msumer@sakarya.edu.tr, aigundogdu@sakarya.edu.tr

**Özet:** Betonun ana bileşenlerinden biri olarak çimento günümüzün en önemli yapı malzemelerden biridir. Çimento, su ile reaksiyonu sonucunda hem havada hem de su altında katılaşabilen ve sertleşebilen bir hidrolik bağlayıcı olarak farklı amaçlara yönelik olarak değişik türlerde üretilmektedir. Bu çalışmada CEM I 42.5, CEM II/A 32.5, CEM II/B 32.5, CEM IV/A 32.5 ve CEM III/A 32.5 çimentoları kullanılarak üretilen betonların yaz ve kış olmak üzere iki dönem periyodunda üç değişik kür koşullarında saklanması sonucu basınç dayanımlarındaki değişim incelenmiştir. Kür yöntemleri olarak standart olarak kabul edilen  $20 \pm 2$  °C'de kirece doymun su içerisinde kürlenme, açık havada aralıklarla düzenli olarak kürlenme ve açık havaya maruz bırakma şeklindeki kür koşullarında bekletilen numuneler üzerinde 3, 7, 28 ve 60 günlük basınç dayanımı deneyleri yapılmıştır. Böylelikle, kür koşullarının farklı tür çimentolar kullanılarak üretilen betonlar üzerindeki etkileri en temel parametre olarak basınç dayanımı deneyleri ile belirlenmeye çalışılmıştır. Deney sonuçları değerlendirildiğinde kür koşullarına karşı en az hassas olan çimento türünün CEM I 42.5 çimentosu olduğu, açık havaya maruz bırakılan numuneler içinde CEM III/A 32.5 çimentolu betonların kış periyodunda standart küre kıyasla daha az dayanım kazandığı görülmüştür.

**Anahtar Kelimeler:** Beton, Basınç dayanımı, Kür koşulları.

**Abstract:** The cement is one of the most important building materials which is main component of concrete. Cement is produced with various purposes in different types as a hydraulic binding material is hardened both in air and under water as a result of reaction with water. In this study, it was investigated the variation of compressive strength test results which the concretes were cured in two different periods both the winter and the summer with three different curing conditions by using CEM I 42.5, CEM II/A 32.5, CEM II/B 32.5, CEM IV/A 32.5 and CEM III/A 32.5 types of cements. As curing conditions, some of the specimens were placed in water at  $20 \pm 2$  °C and some of them were kept in laboratory environment without placing in water ( $20 \pm 2$  °C and % 68 RH) and the rest of the specimens were cured discontinuously in laboratory environment. In hardened concrete testing, compressive strength test was performed at 3, 7, 28 and 60 days for concrete specimens. Thus, the effects of curing conditions on the different types of cements, the compressive strength tests were performed as the most basic parameters. When the test results are evaluated CEM I 42.5 type of cement was less sensitive to curing conditions among the different cements, CEM III/A 32.5 type of cement showed less compressive strength values was cured in laboratory environment without placing in water compared to standard curing in the winter period.

**Keywords:** Concrete, Compressive strength, Curing conditions.

## 1 Giriş

Beton; çimento, su, agrega ve gerektiğinde katkı maddelerinin belirli oranlarda homojen olarak karıştırılmasından oluşan, istenilen şekil ve boyutta kalıp içerisine boşluksuz olarak yerleştirilebilen ve uygun bakım koşulları altında zamanla katılaşıp sertleşerek dayanım kazanan önemli bir kompozit malzemedir (Uysal, 2010).

Günümüzde çimento standartlarının gelişmesiyle beraber, artış gösteren farklı talepleri karşılayabilmek için beton teknolojisine katkı sağlayan bağlayıcı kombinasyonlu malzemeler yaygın olarak kullanılmaktadır (Domone ve Chai, 1996).

Yüzyılı aşkın süredir katkılı veya puzolanik çimentolar hem bilimsel hem de teknolojik açıdan önemli derecede ilgi görmektedir (Mehta, 1983; Sersala, 1983; Aitcin ve diğ., 1983). Aslında katkılı çimentolar modern toplumun ihtiyaçlarını karşılayan temel bir malzeme olarak tanımlanmaktadır. Katkılı çimentolar hem normal portland çimentosunda olmayan performans özelliklerine sahip olmakta hem de termik santral, demir-çelik ve silikon metalinin üretimi esnasında atık olarak elde edilen mineral katları beton üretiminde değerlendirerek ekonomiye faydalı bir şekilde kazandırılmasına olanak sağlamaktadır. Ancak, değişik kimyasal bileşenlere sahip katkı malzemelerinin çimentoya ilavesi çimento sisteminde önemli ölçüde farklılıklara neden olmaktadır. Böylece, farklı çimentolarla üretilen betonların farklı özelliklere ve performansa sahip olması kaçınılmaz olacaktır.

Yalnız başına bağlayıcılık özelliği olmayan fakat kireç veya çimento ile karıştırıldığı vakit su ile yaptığı reaksiyon sonunda bağlayıcı madde özelliği kazanan maddelere puzolan denilmektedir. Bu maddelerin içinde dazla miktarda kolloidal halde silis ve alümin bulunmaktadır. Bu maddelerin yani silis ve alüminin kireçle yaptığı reaksiyon sonunda puzolan bağlayıcılık kazanmaktadır. Bir puzolana portland çimentosu karıştırıldığı vakit çimentonun hidrasyonu sonunda meydana gelen  $\text{Ca(OH)}_2$  ile  $\text{SiO}_2$  ve  $\text{Al}_2\text{O}_3$  arasında meydana gelen reaksiyon sonunda puzolan yine bağlayıcılık özelliğine sahip olmaktadır. Bu reaksiyonlar sonunda  $\text{Ca(OH)}_2$  tespit edilir yani çözünmez olmaktadır.

Bir portland çimentosu ve puzolan karışımı reaksiyona girdiği zaman, bu reaksiyon, sönmüş kirecin ve alkalilerin, ( $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ ) oksitleri ile asit-baz reaksiyonu biçiminde tepkimeye girmesiyle oluşmaktadır. Bu aşamada iki olay gerçekleşmektedir: birincisinde, serbest sönmüş kireç miktarı zamanla azalmaktadır, ikincisinde de, portland çimentosunun hidrasyonu esnasında ortaya çıkanlara benzer biçimde, C-S-H (kalsiyum-silikat-hidrat) ve kalsiyum-alüminosilikat miktarlarında artış olmaktadır. Çimento hamurunda gözenek yapısındaki iyileşme (azalma) biçiminde fiziksel olarak kendini gösteren puzolanik reaksiyon, kimyasal dayanıklılık ve mekanik dayanımdaki artışın esas nedeni olsa gerektiği belirtilmektedir (ACI 232 1R-94, 1994). Portland çimentosu ve puzolan karışımları, ekonomik sebeplerle birlikte enerji ihtiyacını azaltmaya yardım etmek ve bazı önemli teknik yararlar elde etmek amaçlarıyla beton üretiminde kullanılmaktadır. Ekonomik kazanç sağlamak veya erken hidrasyon ısısını azaltmak, ileri yaşlardaki dayanımı arttırmak, alkali-agrega reaksiyonunun zararlarına veya sülfat tahribatına direnci arttırmak, geçirimsizliği sağlamak ve parçalayıcı sıvı çözeltilerin beton içine sızmasına direnci arttırmak amaçları için portland çimentosuna veya katkılı portland çimentosuna, uçucu kül, doğal puzolanlar, öğütülmüş yüksek fırın cürufu, ve silis dumanı gibi maddeler belirli oranlarda karıştırılabileceği belirtilmektedir. Kısaca, betonda puzolanların kullanımının yararları, ileri yaşlarda artan dayanım, çevresel yönden zararlı ortamlarda sağlanan kalıcılık şeklindedir (Karahana ve diğ., 2005).

Beton üretiminin en önemli aşamalarından birisi de betonun kür edilmesi ve bu süreci tamamlayan işlemlerdir. Genel anlamıyla kür; betonun dayanım kazanması için çimento hidrasyonunu ilerletmek amacıyla kullanılan yöntem ve yapılan uygulamalara verilen isimdir ve sıcaklık ile nemin kontrolünü kapsamaktadır. İyi bir beton elde etmek için iyi bir karışım ve yerleştirmenin yanı sıra dayanım kazanma evrelerinde betonun uygun bir ortamda kürü gerekmektedir. Bununla birlikte, kürün amacı çimentonun hedeflenen miktarı hidrasyonu sağlayınca kadar betonu suya doymuş veya neredeyse suya doymuş ortamda bulundurmaktır (Akakin, 2001).

Bu çalışmada beş farklı çimento türünü kullanarak üretilen betonların yaz ve kış olmak üzere iki dönem periyodunda üç değişik kür koşulunda saklanması sonucunda basınç dayanımlarındaki değişim incelenmiştir. Bu sayede, kür koşullarının farklı tür çimentolar kullanılarak üretilen betonlar üzerindeki etkileri en temel parametre olarak basınç dayanımı deneyleri ile belirlenmeye çalışılmıştır.

## Deneysel çalışmalar

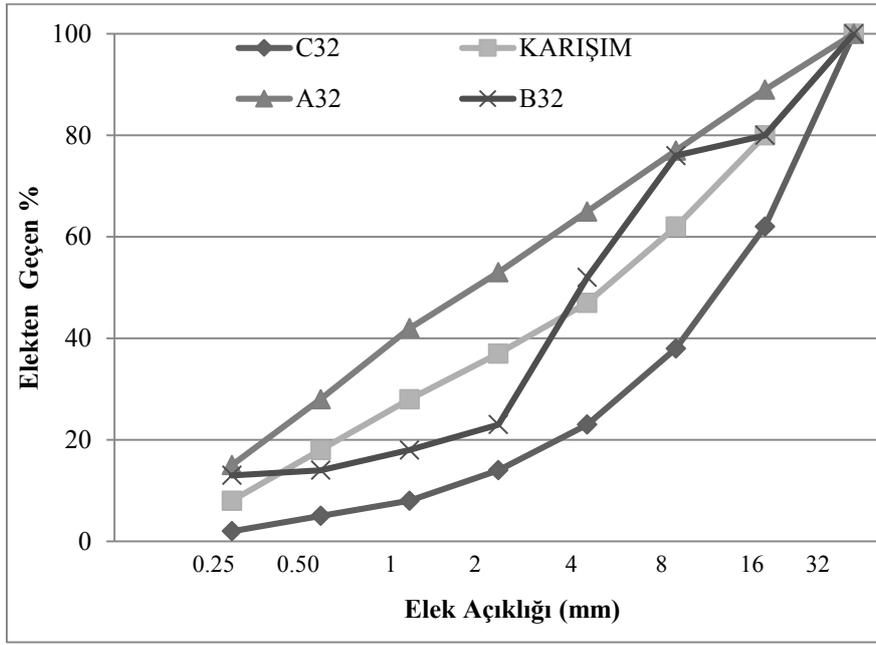
Deneylerde agrega olarak doğal kum ile maksimum tane boyutu 16 mm olan ve Sakarya-Geyve yöresinden elde edilen kalker agregası ve çimento olarak da beş farklı çimento türü olarak CEM I 42.5, CEM II/A 32.5, CEMII/B 32.5, CEM IV/A 32.5 ve CEM III/A 32.5 tipi çimentolar kullanılmıştır. Kullanılan çimentolara ait kimyasal bileşimler ve bazı fiziksel ve mekanik özellikler Tablo 1’de verilmiştir.

Tablo 1 Farklı tür çimentoların kimyasal mekanik ve fiziksel özellikleri.

| <b>Kimyasal Bileşim (%)</b>           |                   |                      |                     |                       |                      |       |
|---------------------------------------|-------------------|----------------------|---------------------|-----------------------|----------------------|-------|
| <b>Bileşen Adı</b>                    | <b>CEM I 42.5</b> | <b>CEM II/A 32.5</b> | <b>CEMII/B 32.5</b> | <b>CEM III/A 32.5</b> | <b>CEM IV/A 32.5</b> |       |
| SiO <sub>2</sub> Çözünen              | 21.05             | ---                  | ---                 | 27.90                 | 7.48                 |       |
| Çözünmez kalıntı                      | 1.49              | ---                  | ---                 | 1.50                  | 1.71                 |       |
| Al <sub>2</sub> O <sub>3</sub>        | 3.71              | ---                  | ---                 | 9.01                  | 8.05                 |       |
| Fe <sub>2</sub> O <sub>3</sub>        | 4.29              | ---                  | ---                 | 3.62                  | 3.68                 |       |
| CaO                                   | 66.2              | ---                  | ---                 | 52.50                 | 48.36                |       |
| MgO                                   | 1.28              | ---                  | ---                 | 1.90                  | 1.15                 |       |
| SO <sub>3</sub>                       | 1.54              | 2.07                 | 1.97                | 3.20                  | 1.76                 |       |
| Kızdırma Kaybı                        | 2.80              | ---                  | ---                 | 2.50                  | 2.65                 |       |
| Cl <sup>-</sup>                       | ---               | ---                  | ---                 | ---                   | ---                  |       |
| Tayin Edilemeyen                      | ---               | ---                  | ---                 | ---                   | ---                  |       |
| Serbest CaO                           | 0.81              | 0.63                 | 0.58                | 0.48                  | 0.96                 |       |
| Na <sub>2</sub> O                     | ---               | ---                  | ---                 | ---                   | ---                  |       |
| K <sub>2</sub> O                      | ---               | ---                  | ---                 | ---                   | ---                  |       |
| <b>Fiziksel ve Mekanik Özellikler</b> |                   |                      |                     |                       |                      |       |
| Özgül ağırlık                         | 3.11              | 2.93                 | 2.96                | 2.98                  | 2.85                 |       |
| İncelik (Blaine, cm <sup>2</sup> /g)  | 2842              | 3147                 | 3670                | 3115                  | 3678                 |       |
| Basınç Dayanımı (MPa)                 | 2-Gün             | 14.9                 | 7.56                | 7.56                  | 11.15                | 13.85 |
|                                       | 7-Gün             | 43.8                 | 24.58               | 23.78                 | 21.09                | 27.96 |
|                                       | 28-Gün            | 58.3                 | 41.59               | 47.95                 | 38.47                | 36.17 |

Numunelerin hazırlanmasında beş farklı çimento türü kullanılmış ve C20/25 sınıfında dizayn edilen numuneler 15x15x15 cm küp olarak üretilmiştir. Değişik çimentolar kullanılarak üretilen betonlarda çökme değerinin 10 cm olmasını sağlayacak şekilde dizayn sabit tutulmuş normal akışkanlaştırıcı kimyasal katkı tercih edilmiştir. Üretilen numunelere kalıptan alındıktan sonra yaz ve kış olmak üzere iki dönem periyodunda üç değişik kür koşulunda saklanmıştır. Kür yöntemleri olarak standart olarak kabul edilen 20±2 °C’de kirece doymun su içerisinde kürlenme, açık havada aralıklarla düzenli olarak kürlenme ve açık havaya maruz bırakma şeklindeki kür koşullarında bekletilen numuneler üzerinde 3, 7, 28 ve 60 günlük basınç dayanımı deneyleri yapılmıştır. Üretilen betonlarda kullanılan agregaların granülometrik analizi TS 3530’a göre yapılmış ve Şekil 1’de gösterilmiştir (TS 3530, 1980).

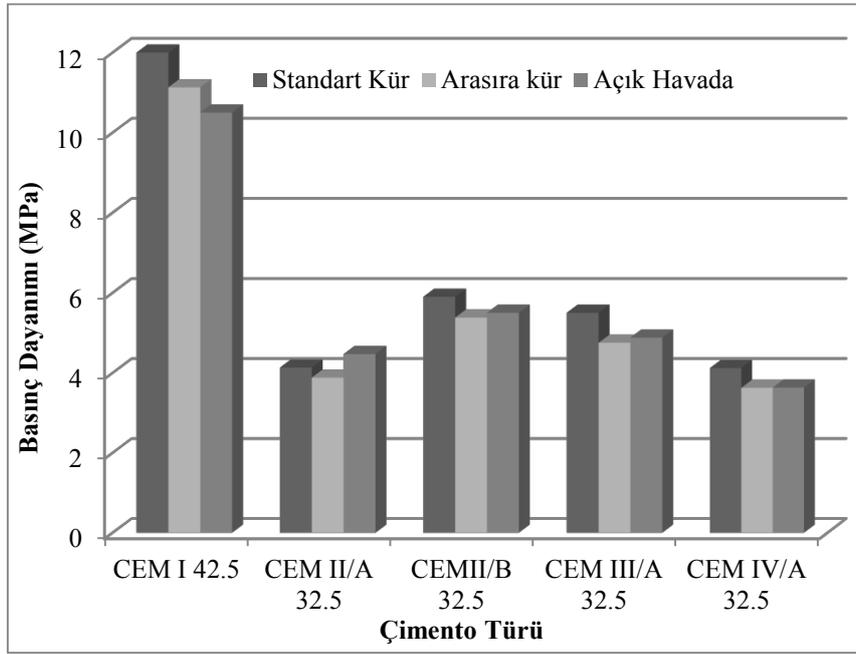
Deneyler yaz ve kış olmak üzere iki farklı dönemde yapılmıştır. Her çimento türünden hem yaz hem de kış döneminde aynı dozajda çimento ve agreganın kullanıldığı ve aynı çökme değerinin elde edildiği betonlar üretilmiştir. Her dönemde bir çimento türünden elde edilen numuneler üç gruba ayrılmış; birinci grup su içerisinde kür (20±2 °C’de kirece doymun suda), ikinci grup açık havada normal hava koşullarında her gün aynı saatlerde ıslatılarak küre tabi tutulmuş ve üçüncü grup ise yine açık havada fakat ıslatılmadan ayrı bir yerde muhafaza edilmiştir. Deney numuneleri üzerinde 3, 7, 28 ve 60 günlük basınç dayanımı deneyleri hem yaz hemde kış döneminde tekrarlanmıştır. Böylelikle, bir çimento türü ile altı değişik kür koşulunun bu betonların basınç dayanımı özellikleri üzerindeki etkisi incelenmiştir.



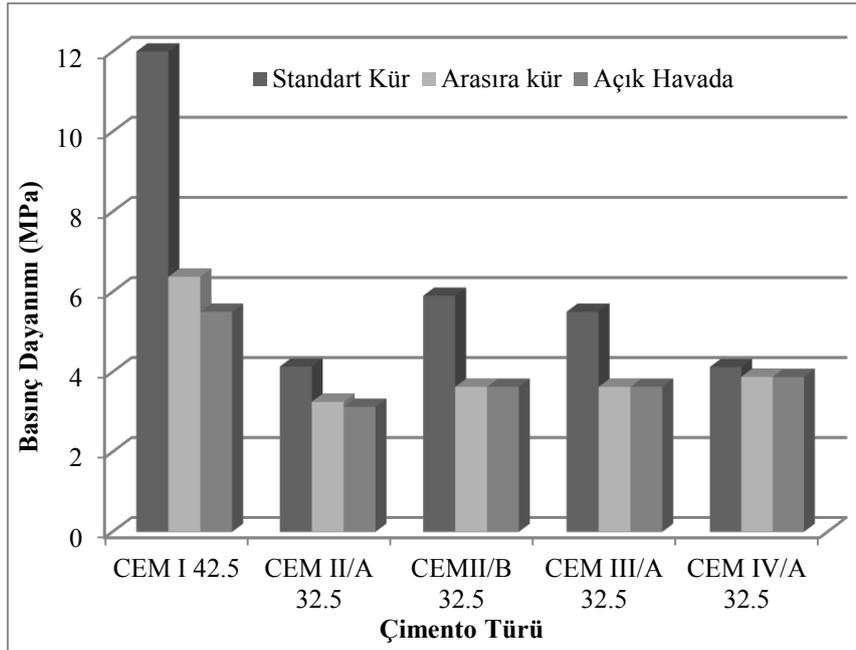
Şekil 1 Agregaların elek analizi.

## Deney Sonuçları ve İrdeleme

Değişik çimentolar kullanılarak farklı kür ortamlarında muhafaza edilen 4 farklı yaş grubundaki numuneler üzerinde yapılan basınç dayanımı deneyi sonuçlarından ilki olarak 3 günlük basınç dayanımı sonuçları yaz ve kış dönemi olmak üzere Şekil 2-3'te verilmiştir. Şekil 2-3'te görüldüğü üzere farklı çimentolu betonların 3 günlük basınç dayanımı sonuçları değerlendirildiğinde katkı çimentolar CEM I 42.5 çimentosuna kıyasla oldukça düşük basınç dayanımı sonuçları vermiştir. Bu durum puzolanların erken yaşta etkin olamamasına bağlanabilir. Standart küre tabi tutulan CEM I 42.5 çimentolu beton aynı kür ortamındaki CEM II/A 32.5 çimentosuna kıyasla 3 günlük basınç dayanımı olarak % 66.2 daha yüksek basınç dayanımı sonucu vermiştir. Şekil 2 ve Şekil 3 kıyaslandığında ise yaz döneminde açık havada ve arasıra küre tabi tutulan numuneler beklendiği üzere kış döneminde muhafaza edilen numunelere göre daha yüksek basınç dayanımı sonuçları vermiştir. Yaz döneminde muhafaza edilen numuneler genel olarak değerlendirildiğinde kış döneminde muhafaza edilen numunelere göre ortalama olarak % 20.17 daha yüksek basınç dayanımı sonuçları vermiştir. Bu durum standart küre tabi tutulmayan kış dönemindeki numunelerin soğuk havanın etkisiyle yavaşlayan hidrasyonlarına bağlanabilir.



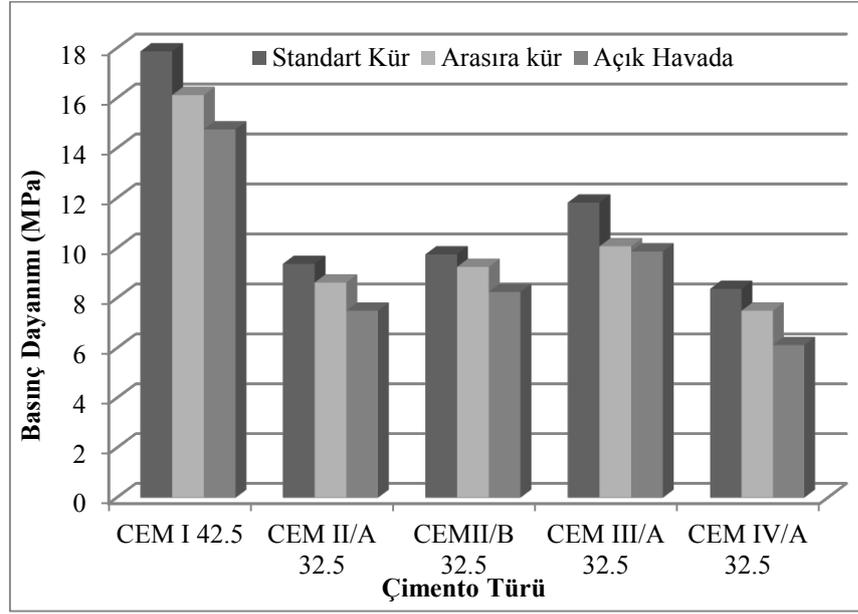
Şekil 2 Farklı kür ortamlarında bekletilen numunelerin yaz dönemi 3 günlük basınç dayanımı sonuçları.



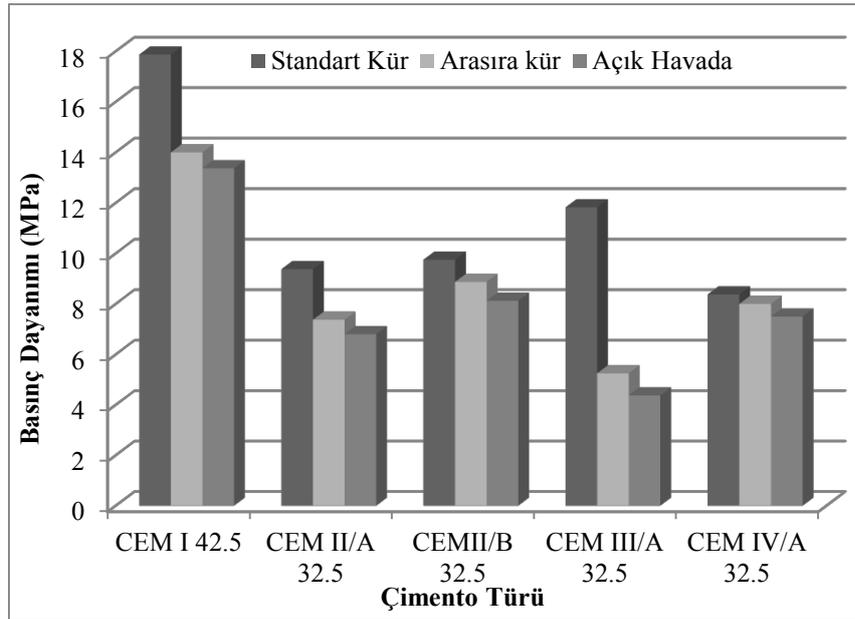
Şekil 3 Farklı kür ortamlarında bekletilen numunelerin kış dönemi 3 günlük basınç dayanımı sonuçları.

Farklı çimentolu betonların üç değişik kür ortamında yaz ve kış dönemleri olmak üzere 7 gün süreyle bekletilmeleri sonucunda elde edilen basınç dayanımı sonuçları Şekil 4-5'te verilmiştir. Standart küre tabi tutulan CEM III/A 32.5 çimentolu beton aynı kür ortamındaki CEM I 42.5 çimentosuna kıyasla 7 günlük basınç dayanımı olarak % 35 daha düşük basınç dayanımı sonucu vermiştir. Farklı çimentolu betonların 7 günlük basınç dayanımı sonuçları ile 3 günlük basınç dayanımı sonuçları kıyaslandığında CEM I 42.5 çimentolu betonlar ile katkı çimentolu betonlar arasındaki basınç dayanımı farklılıkları azalma eğilimi göstermiştir. Şekil 4 ve Şekil 5'te yaz döneminde muhafaza edilen numuneler genel olarak değerlendirildiğinde kış döneminde muhafaza edilen numunelere göre ortalama olarak % 14.69 daha yüksek basınç dayanımı sonuçları vermiştir. Ayrıca, yaz ve kış dönemlerinde farklı kür koşulları birarada değerlendirildiğinde beklendiği üzere en yüksek

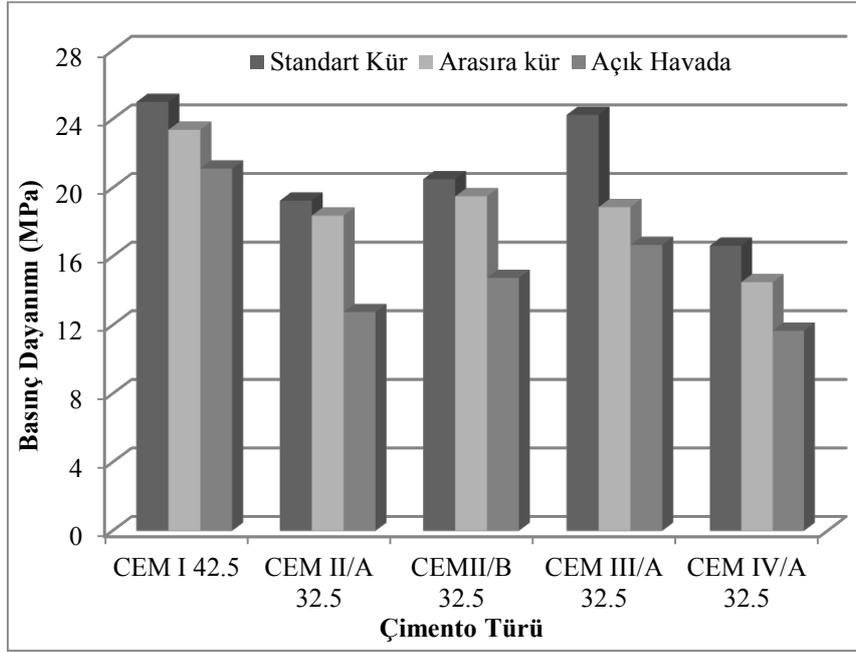
basınç dayanımı sonuçları standart küre tabi tutulan numunelerde daha sonra arasıra küre tabi tutulan numunelerde ve son olarak da açık havada bekletilen numunelerde elde edilmiştir.



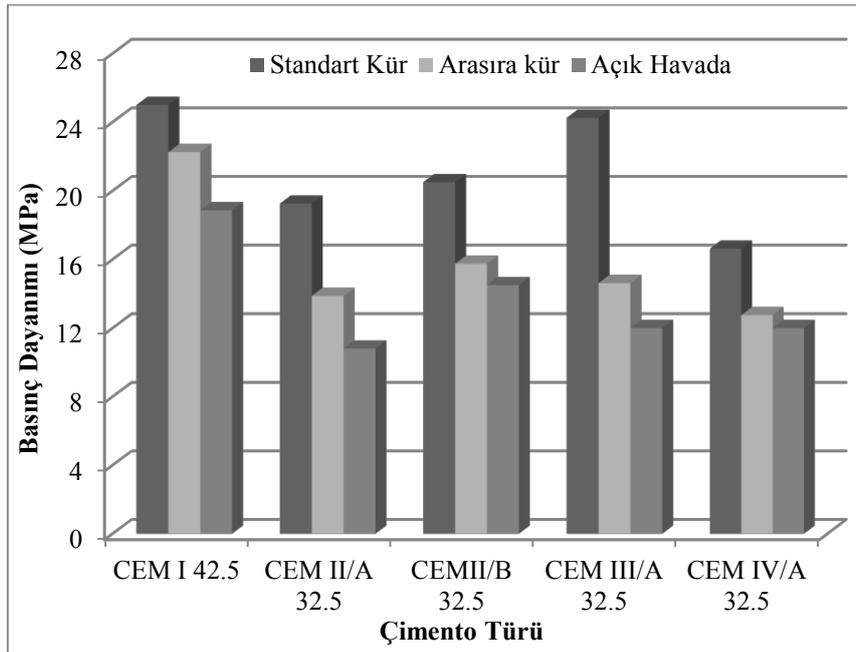
Şekil 4 Farklı kür ortamlarında bekletilen numunelerin yaz dönemi 7 günlük basınç dayanımı sonuçları.



Şekil 5 Farklı kür ortamlarında bekletilen numunelerin kış dönemi 7 günlük basınç dayanımı sonuçları.



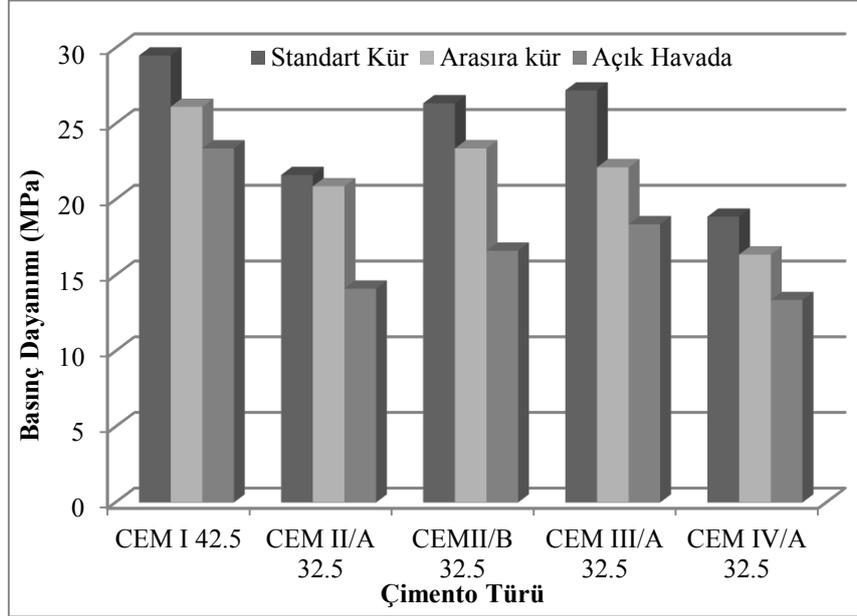
Şekil 6 Farklı kür ortamlarında bekletilen numunelerin yaz dönemi 28 günlük basınç dayanımı sonuçları.



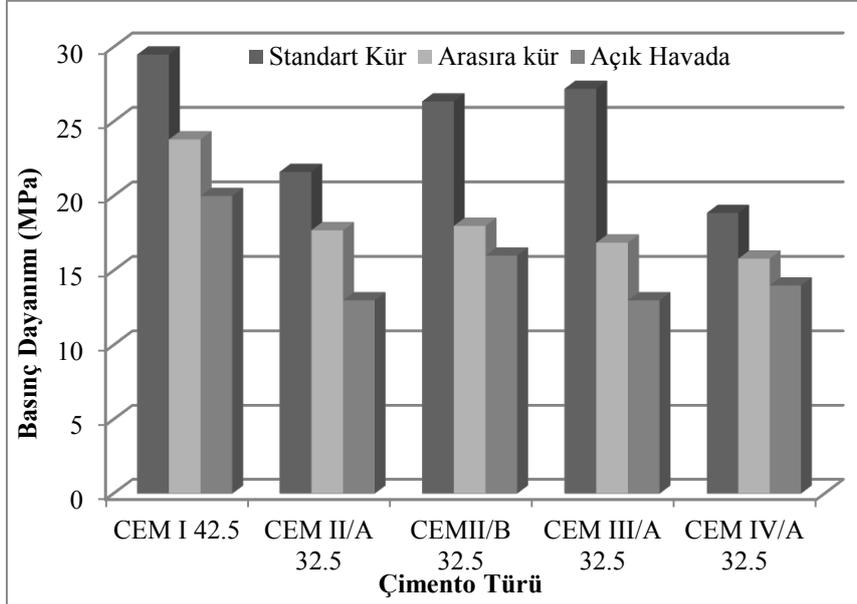
Şekil 7 Farklı kür ortamlarında bekletilen numunelerin kış dönemi 28 günlük basınç dayanımı sonuçları.

Üç değişik kür ortamında yaz ve kış dönemleri olmak üzere 28 gün süreyle bekletilen farklı çimentolu betonlar üzerinde elde edilen basınç dayanımı sonuçları Şekil 6-7'de verilmiştir. Standart küre tabi tutulan CEM III/A 32.5 çimentolu beton aynı kür ortamındaki CEM I 42.5 çimentosuna kıyasla 28 günlük basınç dayanımı olarak % 3.18 daha düşük basınç dayanımı sonucu vermiştir. Şekil 6 ve Şekil 7'de yaz döneminde muhafaza edilen numuneler genel olarak değerlendirildiğinde kış döneminde muhafaza edilen numunelere göre ortalama

olarak % 14.22 daha yüksek basınç dayanımı sonuçları vermiştir. Katkılı çimentolu betonların bünyesinde yer alan farklı tür puzolanların çimentonun hidratasyonu sonunda meydana gelen  $\text{Ca(OH)}_2$  i bağlayarak ikincil hidratasyonları başlatması neticesinde ilave bağlayıcılık özelliğine sahip olması sonucu katkı çimentolu betonlar ile CEM I 42.5 çimentolu betonlar arasındaki dayanım farklılıkları 28. günden itibaren hissedilir şekilde ortadan kalmaya başlamıştır.



Şekil 8 Farklı kür ortamlarında bekletilen numunelerin yaz dönemi 60 günlük basınç dayanımı sonuçları.



Şekil 9 Farklı kür ortamlarında bekletilen numunelerin kış dönemi 60 günlük basınç dayanımı sonuçları.

Farklı çimentolu betonların üç değişik kür ortamında yaz ve kış dönemleri olmak üzere 60 gün süreyle bekletilmeleri sonucunda elde edilen basınç dayanımı sonuçları Şekil 8-9'da verilmiştir. Standart küre tabi tutulan CEM III/A 32.5 çimentolu beton aynı kür ortamındaki CEM I 42.5 çimentosuna kıyasla 60 günlük basınç dayanımı olarak % 7.19 daha düşük basınç dayanımı sonucu vermiştir. Farklı çimentolu betonların 60 günlük basınç dayanımı sonuçları birarada değerlendirildiğinde CEM I 42.5 çimentolu betonlar ile CEM II/B 32.5 ve CEM III/A 32.5 çimentolu betonlar arasındaki basınç dayanımı farklılıkları ciddi manada azalma

göstermiştir. Şekil 4 ve Şekil 5'te yaz döneminde muhafaza edilen numuneler genel olarak değerlendirildiğinde kış döneminde muhafaza edilen numunelere göre ortalama olarak % 13.62 daha yüksek basınç dayanımı sonuçları vermiştir.

## Sonuçlar

Yapılan deneysel çalışmadan elde edilen sonuçlar aşağıdaki gibi özetlenebilir;

- CEM I 42.5 çimentolu betonların erken yaş basınç dayanımı sonuçları, CEM II/A 32.5, CEMII/B 32.5, CEM IV/A 32.5 ve CEM III/A 32.5 çimentolu betonlarla karşılaştırıldığında katkı çimentoların bünyesinde yer alan puzolanların erken yaşlarda etkinlik gösterememesi nedeniyle katkı çimentolu betonlara göre daha yüksek elde edilmiştir.
- Standart küre tabii tutulan CEM I 42.5 çimentolu beton aynı kür ortamındaki CEM II/A 32.5 çimentosuna kıyasla 3 günlük basınç dayanımı olarak % 66.2 daha yüksek basınç dayanımı sonucu vermiştir. Benzer şekilde, CEM III/A 32.5 çimentolu beton aynı kür ortamındaki CEM I 42.5 çimentosuna kıyasla 7 günlük basınç dayanımı olarak % 35 daha düşük basınç dayanımı sonucu vermiştir. Ayrıca, CEM III/A 32.5 çimentolu beton aynı kür ortamındaki CEM I 42.5 çimentosuna kıyasla 28 günlük basınç dayanımı olarak % 3.18 daha düşük basınç dayanımı sonucu vermiştir. Son olarak, CEM III/A 32.5 çimentolu beton aynı kür ortamındaki CEM I 42.5 çimentosuna kıyasla 60 günlük basınç dayanımı olarak % 7.19 daha düşük basınç dayanımı sonucu vermiştir. Bu sonuçlar ışığında beton yaşı ilerledikçe katkı çimentolu betonlar ile CEM I 42.5 çimentolu betonlar arasındaki dayanım farkında azalmalar görülmüştür.
- Dört farklı beton yaş grubu birarada değerlendirildiğinde yaz döneminde muhafaza edilen numuneler kış döneminde muhafaza edilen numunelere göre ortalama olarak % 16.89 daha yüksek basınç dayanımı sonuçları vermiştir.

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## APPLICATION OF POLYVINYL ALCOHOL IN THE DYEING OF COTTON WITH DIRECT DYES

<sup>1</sup> S. M. Gumel , <sup>1</sup> S. Habibu , <sup>2</sup> A. H. Birniwa\* , <sup>2</sup> S. S. Abdullahi , & <sup>1</sup>M.Ladan

<sup>1</sup>Department of Pure and Industrial Chemistry, Bayero University, Kano P.M.B. 3011, Kano, Nigeria

<sup>2</sup> Hussaini Adamu federal Polytechnic, Kazaure, P.M.B 5004 Jigawa state, Nigeria

Corresponding Author address: [birniwa01@yahoo.com](mailto:birniwa01@yahoo.com), Tel. +2348065496007

**Abstract**--Conventional Polyvinyl Alcohol and cross linked Polyvinyl Alcohol (produced from the reaction of polyvinyl alcohol (PVA) with glutaraldehyde and glyoxal) were used as after-treatment to improve the wash fastness of direct dyes on cotton. The dyed cotton fabric samples were treated with PVA and cross linked PVA with cross linking process carried out prior and after the application respectively. The washing and light fastness of the samples were determined using standard methods. The after-treatments generally showed improvements in fastness properties, with treatment involving cross-linking exhibiting a better improvement than those heat-treated and air-dried. Wash fastness improved from 2 for the non after-treated sample to 4 for the cross linked PVA treated dyed cotton samples. Other properties such as smoothness and tensile strength also improved.

**Keywords**-- After treatment, Glutaraldehyde, Glyoxal, Polyvinyl Alcohol

### INTRODUCTION:

Cotton fabric is the most widely used textiles in the world, accounting for more than 50% of the total consumption, which is mainly made up of cellulose (Wang, H. F, 2003). The cellulose chains in cotton is composed of micro fibrils which have only hydrogen bonds between them, this means covalent cross links to force the cellulose to return to their original position when deformed by wrinkling or laundering is absent.

Several classes of dyes can be used to dye cellulosic fibers, namely vat, direct, reactive, sulphur colorants, the different classes varying in terms of factors such as their cost, ease of application, fastness properties, e.t.c. Characteristically, direct dyes furnish a wide range of shades at low cost but with poor wet fastness. The poor wet fastness of direct dyes is a great technical defect, of which it becomes necessary to improvise means of improving its fastness properties (Nkeonye, P. O. 1987). Therefore, cross linking agents should be used to improve the fastness properties of direct dyes on cotton fabrics. Formaldehyde- based resins were used for such treatments but usually ended up losing the strengths of the fabrics (American Chemical Society, 2004)

### EXPERIMENTAL

#### MATERIALS

The polyvinyl alcohol (87-89%) was obtained from Sigma Aldrich. Glutaraldehyde (25%) and glyoxal (40%) were obtained from British Drug House (BDH). All other reagents used were of analytical grade and were used as received.

#### DISSOLUTION OF POLYVINYL ALCOHOL

The Polyvinyl Alcohol used is a partly hydrolyzed grade and is liable to form lumps when added to water; grades with high degree of polymerization are especially prone to this. To avoid this, and to obtain rapid and easy solution, temperature and rate of addition were carefully controlled especially with high concentrations. The water temperature were kept at 25<sup>o</sup>C, the charging rate was kept as low as possible within the permissible time of operation. The polyvinyl alcohol was agitated for 10-15 minutes without raising the temperature. The temperature was later increased to about 90-95<sup>o</sup>C in order to reduce the dissolving time. However, those with low degree of polymerization dissolve at a lower temperature (Finch, C. A. 1973).

#### METHOD USED FOR HEATING THE POLYVINYL ALCOHOL

Ideally, the best source of heat is low pressure steam at 15-25 ibf/in (1.0-1.5 atm). Steam may be discharged directly in to the solution to increase thermal efficiency of the mixer and to shorten the time of heating. Indirect jacket heating prolongs the heating time, although it allows simpler regulation of the concentration of the polyvinyl alcohol solution, since no condensate is added. The fact that steam is not available; other form of heating was used which is the used of hot plate with magnetic stirrer (Finch, C. A. 1973).

### SYNTHESIS OF CHEMICALLY CROSS LINKED POLYVINYL ALCOHOL

The two cross linked polyvinyl alcohols were synthesized using similar procedure reported by (Audebert, R. et al, 1998) A solution of 24g (0.000192 mol) of polyvinyl alcohol in 576g of water was prepared and heated to 60 °C. 2 ml (0.0212 mol) of 25% solution of glutaraldehyde was added and the solution was stirred for 30 minutes. While stirring, 15 ml of 0.1 M HCl was added. After stirring for about 1 hour, 50 ml of 0.1 M NaOH was added. The formation of minutes micro gels in a less viscous solution of the polyvinyl alcohol confirms the cross linkage. Same procedure was used for glyoxal.

### CHARACTERIZATION TECHNIQUES

The polyvinyl alcohol Cross linked with glutaraldehyde and glyoxal were characterized in relation to the conventional PVA for the following;

The infra-red spectra of the samples were obtained using a thin film of the polymer samples with PERKIN ELMER model. All the spectra were recorded over the range of 4000-400cm<sup>-1</sup>, as a preliminary survey of the spectra has shown that all the reliable structural data are covered in this region (Audebert, R. et al, 1998).

### DYEING OF UNTREATED SAMPLE

Dyeing of well prepared cotton fabric was carried out according to the method adopted by (Nkeonye, P. O. 1987) 0.2g of the dye is added in a well dissolve condition to the dye bath. 2.01g of common salt (NaCl) was added. 20g of the fabric was then introduced to the bath at 40-50 °C. The temperature of the bath was then raised over 30 minutes to boil, and the dyeing was continued at this temperature for 50 minutes. The fabrics were then rinsed squeezed and dried at ambient temperature.

### AFTER TREATMENT

The after treatments employed were used in two different conditions; treatment that involves air-drying only and a treatment that involved little air-drying and curing depending on the strength of the fabric.

After treatment of the dyed cotton fabric with PVA/GA cross linked polymer

The method adopted was the modification of the one reported by (Nkeonye, P. O. 1987), and (William, H. B. and et al. 1998).

- a. a cut sample was coated with the cross linked polymer and allowed to air-dried. It was later damped to condition for 2 hours, then calendared using a conventional pressing stone.
- b. A. cut sample was coated with the cross linked polymer and allowed to air-dried for 3 minutes and cured for 3 minutes at 140 °C. It was also damped and allowed to condition for 2 hours and finally calendared.

The same procedure was adopted for PVA/GLY cross linked polymer.

*After treatment of the dyed cotton fabric PVA/GA cross linked polymer*

A cut sample was coated first with a conventional polyvinyl alcohol that contains 1% of the cross linking agent, then 1% of a 30% acetic acid was spread throughout the coated sample and heated at 80 °C for 30 minutes.

The same procedure was used for PVA/GLY cross linked polymer.

### DETERMINATION OF FABRIC PROPERTIES

Cotton fabrics were tested for tensile strength, as well as colour fastness properties. The methods reported by the Nigerian Industrial Standard (Logue, B. T, 1994) were used to evaluate the colour fastness properties.

### RESULTS AND DISCUSSION

The cross linking between polyvinyl alcohol/glutaraldehyde and polyvinyl alcohol/glyoxal yielded the formation of micro gels structure resulting from the action of the cross linking agents on a diluted solution of PVA. Another important parameter was that the size of the micro gels formed as a result of cross linking PVA/GA was found to be larger and more than the micro gels formed with PVA/GLY. This is possibly due to the fact that cross linkers are available with different spacer arm lengths. Cross linkers with a long spacer arm and some with a short spacer arm (Nigerian Industrial Standard 26, 1973).

### INFRA-RED SPECTROSCOPY

The results of the assignment are shown in the table below:

**Table i: " Infra-red spectra of the polymer samples"**

| Group     | CPVA                     | CPVA/GA                  | CPVA/GLY                 |
|-----------|--------------------------|--------------------------|--------------------------|
| O-H       | 3353.71 cm <sup>-1</sup> | 3432.64 cm <sup>-1</sup> | 3614.63 cm <sup>-1</sup> |
| C-O       | 1094.3 cm <sup>-1</sup>  | 1092.65 cm <sup>-1</sup> | 1091.38 cm <sup>-1</sup> |
| C-H       | 2936.83cm <sup>-1</sup>  | 2935.11 cm <sup>-1</sup> | 2935.13 cm <sup>-1</sup> |
| Tacticity | 919.24 cm <sup>-1</sup>  |                          |                          |

From the typical spectra for the conventional PVA, the band at 919.24 cm<sup>-1</sup> is related to the syndiotactic structure of the polymer. Strong O-H stretching at 3354.71 cm<sup>-1</sup> is related to the strong O-H bands for free alcohol. An important peak at 1094.3 cm<sup>-1</sup> is assigned to C-C and C-O stretching, which is an assessment tool of PVA structure because; it is a semi-crystalline synthetic polymer.

Band at 1715.58 cm<sup>-1</sup> was due to C=O which is a result of the residual acetate group in the PVA (19.5-22.7). There is also a strong C-H alkyl stretching at 2936.83 cm<sup>-1</sup> (Wollensak, G, 2003)

By cross linking PVA with GA, the O-H stretching vibrations peak at 3432.64 cm<sup>-1</sup> was reduced when compared with pure PVA. C-O stretching at approximately 1094.30 cm<sup>-1</sup> in pure PVA is replaced by a broader absorption band at 1092.65 cm<sup>-1</sup>, which can be attributed to the ether (C-O) and the acetal ring (C-O-C) bands formed by the cross linking reaction of PVA with GA.

By cross linking with GLY, band at 3614.63 cm<sup>-1</sup> which is due to -OH groups was reduced when compared with the pure PVA. C-O stretching at approximately 1094.30 cm<sup>-1</sup> in pure PVA is replaced by a broader absorption band at 1092.65 cm<sup>-1</sup> which can be attributed to the ether (C-O) and the acetal ring (C-O-C) bands formed by the cross linking reaction PVA with GA.

Bands at 1423.05 cm<sup>-1</sup> and 1270 cm<sup>-1</sup> related to similar bands were reported in the literature of the spectrum of polyvinyl formate (i.e. PVA cross linked with formaldehyde). As mentioned, cross linking PVA with GA, the band at 3614.63 cm<sup>-1</sup> which is due to -OH group was reduced when compared with pure PVA. C-O stretching at approximately 1094.30 cm<sup>-1</sup> in pure PVA was also replaced by a broader band at 1091.38 cm<sup>-1</sup> similarly, the bands at 1420.60 cm<sup>-1</sup> and 1267.15 cm<sup>-1</sup> were found in literature of the spectrum of polyvinyl formate which is also a product of acetalization.

### DENSITY

The densities of the two cross linked PVAs and the conventional PVA are shown in the table below:

**Table ii: " Density of the polymer samples"**

| Sample   | Density |
|----------|---------|
| CPVA     | 0.99034 |
| CPVA/GA  | 0.9957  |
| CPVA/GLY | 0.99288 |

The density of the PVA in solution is very near to that of water (1.0017 gcm<sup>-3</sup>). Thus, from the above table, it is clearly seen that the density of CPVA/GA is the highest, followed by CPVA/GLY, then the CPVA. This is due to the formation of micro gels which left the solution with more water than that of the conventional PVA (Yano, S. 2003).

### DYED COTTON FABRICS

The cotton fabrics dyed with direct dye (yellow HE 6G) gave medium yellow shade and it leveled very well. The same leveling was also observed for the direct dye (Turquine blue).

### AFTER-TREATED FABRICS

The after treatment maintained the strength of the colour of the dyed fabrics, only that little yellowing was seen in the fabrics that were cured (those dyed with blue dye). This could be due to the yellowing of the polyvinyl acetal gels when dehydrated (James. J, 2008). And (Redmond, W.A 2007)

### FASTNESS PROPERTIES

#### WASHING FASTNESS

To qualify for a label 'fast to washing' a minimum rating of 3 in the scale 1-5 is required for the change in colour. Below are the results obtained from the visual assessment of change in colour using the grey scale that includes half steps.

**Table iii: "Washing fastness"**

| Specimen             | Fastness | Specimen             | Fastness |
|----------------------|----------|----------------------|----------|
| FAA                  | 2        | FBA                  | 2        |
| FAB                  | 2-3      | FBB                  | 3        |
| FAC                  | 3-4      | FBC                  | 4        |
| FAD                  | 3        | FBD                  | 3-4      |
| PVA-GA <sub>1</sub>  | 2-3      | PVA-GA <sub>2</sub>  | 2-3      |
| PVA-GLY <sub>1</sub> | 2-3      | PVA-GLY <sub>2</sub> | 2-3      |

From the above table, it is seen that the treatment has generally improve the washing fastness of the fabrics, but those cured-treated fabrics exhibited better washing fastness than those that were not cured. While those treatments that involved cross linking within the fabric were not fast to washing but better than the untreated. However, the best wash fastness fabric was the one cross linked with *glutaraldehyde*. This could be attributed to the formation of large molecular size, low water-solubility thin gels situated at the surface of the dyed substrate which physically resist diffusion of the dye from the dyed fabric during washing (Pritchard, J. G. 1969).

#### LIGHT FASTNESS

For a sample to qualify to the label 'fast to light' a minimum rating of 5 in the scale 1-8 is required. The result obtained from the light fastness test is shown in the table below:

**Table iv: Light fastness**

| Specimen             | fastness | Specimen             | Fastness |
|----------------------|----------|----------------------|----------|
| FAA                  | 4        | FBA                  | 4        |
| FAB                  | 4        | FBB                  | 4        |
| FAC                  | 5        | FBC                  | 4        |
| FAD                  | 5        | FBD                  | 4        |
| PVA-GA <sub>1</sub>  | 6        | PVA-GA <sub>2</sub>  | 6        |
| PVA-GLY <sub>1</sub> | 6        | PVA-GLY <sub>2</sub> | 6        |

It can be seen that the samples generally show moderate light fastness including the untreated once. However, those specimens with low washing fastness were found to have improved light fastness.

#### TENSILE STRENGTH

The means of various force applied and length extended by the specimens are summarized in the table below:

**Table v (a) Tensile strengths for warp specimens**

| Specimen For warp | Force Applied (N) | Length (mm) | Specimen For weft | Force Applied (N) | Length (mm) |
|-------------------|-------------------|-------------|-------------------|-------------------|-------------|
| FAA               | 81.188            | 12.502      | FAA               | 85.592            | 12.492      |
| FAB               | 121.172           | 6.3476      | FAB               | 108.972           | 12.454      |
| FAC               | 139.552           | 4.407       | FAC               | 128.052           | 8.4012      |
| FAD               | 146.332           | 5.6294      | FAD               | 115.772           | 8.9778      |
| PVA-GA1           | 131.827           | 7.8142      | PVA-GA1           | 128.727           | 11.514      |
| PVA-GLY1          | 133.564           | 7.0326      | PVA-GLY1          | 142.742           | 10.262      |

**Table v (b) Tensile strengths for weft specimens**

| weft specimens | Force Applied (N) | Length (mm) | Specimen For weft | Force Applied (N) | Length (mm) |
|----------------|-------------------|-------------|-------------------|-------------------|-------------|
| FBA            | 118.687           | 9.561       | FBA               | 113.607           | 13.62       |
| FBB            | 126.447           | 7.8936      | FBB               | 117.647           | 11.316      |
| FBC            | 134.744           | 8.1206      | FBC               | 87.914            | 9.859       |
| FBD            | 108.484           | 8.4464      | FBD               | 106.576           | 8.8368      |
| PVA-GA2        | 108.976           | 7.5778      | PVA-GA2           | 103.676           | 9.5452      |
| PVA-GLY2       | 94.0160           | 10.7272     | PVA-GLY2          | 78.7544           | 12.16       |

From the above tables, we can observe general increase in tensile strengths going from the untreated to treated specimens. This may be due to the higher force needed for the rupturing of the treated specimen than that of the untreated, which is in line with the fact that tensile strengths of materials are the resistance of materials to tensile forces that tend to pull it apart (Kazuhiro, K. I, et al. 2004)

#### CONCLUSION

Generally, fabric treated showed improvements in properties when compared to the untreated once, and the results also showed that those samples cured were better in performance than those air-dried. On the other hand, the treatments involving cross linking within the fabrics also showed improvements, only that it shows lower washing fastness. Therefore, the use of cross linked polyvinyl alcohol as an after treatment for cotton fabrics is a better means of treating cotton because of its soft texture which tend to impart fastness, smoothness and, at the same time retain softness of cotton fabric. In addition, cross linked PVAs are inert and harmless when compared with urea-formaldehyde because; release of formaldehyde is undesirable particularly, in an enclosed environment.

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# DİVRİĞİ KALESİ: HASAR DEĞERLENDİRME VE GÜÇLENDİRME ÖNERİLERİ

Zeki ÖZCAN  
Sakarya Üniversitesi  
Mühendislik Fakültesi  
İnşaat Mühendisliği Bölümü  
Türkiye  
[ozcan@sakarya.edu.tr](mailto:ozcan@sakarya.edu.tr)

**Özet:** Bu çalışmada Sivas ili, Divriği ilçe merkezinde yer alan, bir ortaçağ savunma yapısı olan Divriği Kalesi için hasar değerlendirmesi ve güçlendirme önerileri sunulmuştur. Kale Mengücekoğulları döneminde (1080-1228) Ahmet Şah tarafından yenilenen Paulikian-Bizans kalesidir. Kale, şehrin doğusundaki tepeye yaklaşık 55000 m<sup>2</sup> alana, oval formda planlı, çoğunlukla kesme taşla inşa edilmiş, askeri amaçlı kurulmuş bir yapıdır. Kale surlarının izi bütün kale çevresinde belirgin şekilde görülmekle birlikte beden duvarlarının önemli bir kısmı tahrip olmuştur. Sur duvarlarının yüksekliği 14 m ye kadar ulaşmaktadır. Kale surlarında gözlenen hasarlar insan eli ile yapılan müdahaleler ve çevre/iklim şartlarından kaynaklanan hasarlar olarak iki grupta toplanmıştır. Kale beden duvarlarının onarım ve güçlendirilmesinde uygulanacak yöntemler belirlenen hasar türleri için ayrı ayrı verilmiştir. Yapılan bu çalışma ile tarihi kalenin restorasyonu sırasında sur duvarlarının hasarlı ve eksik bölgelerine yapılacak müdahale yöntemleri belirlenerek uygulamaya yönelik yöntemler verilmiştir. Kale içinde Cumhuriyet Üniversitesi tarafından yürütülen arkeolojik kazılar devam etmektedir.

**Anahtar Kelimeler:** Divriği Kalesi, Hasar Belirleme, Onarım ve Güçlendirme, Röleve ve Restorasyon

## 1. Giriş

Yurdumuz dünyanın en eski ve zengin kültür mirasının bulunduğu bir coğrafyada bulunmaktadır. Bu topraklarda birçok topluluk yaşamış ve eserler inşa etmişlerdir. Bu eserlerden biri de Divriği kalesidir. Anadolu'da ki ilk Türk eserlerinden olan ve günümüze kadar ulaşan nadir eserlerden biridir. Ancak bakımsızlıktan ve kötü kullanımdan dolayı yok olmaya yüz tutan Sivas Divriği Kalesi esaslı bir restorasyona ihtiyaç duymaktadır. Son yıllarda yaygınlaşan tarihi yapıların restorasyonu ve kullanımına açılması çalışmaları çok sevindiricidir. Bu kapsamda yapılan röleve, hasar belirleme, restorasyon ve bunlara bağlı olarak önerilen onarım güçlendirme ile Divriği kalesi aşındırıcı, bozucu iklim şartlarına karşı daha dayanıklı hale getirilmiş olacaktır. Ziyaretçilere ve turizme açılması, tahribatın durdurulması ve gelecek kuşaklara ulaşması da böylece mümkün olacaktır.

Taş yığma yapıların basınç dayanımı oldukça yüksek olmasına karşın çekme dayanımları oldukça düşüktür. Bu yüzden, yığma yapılarda çekme bölgeleri özenle incelenmelidir. Tarihi yığma yapıların davranışı üzerine pek çok araştırmacı tarafından çalışmalar yapılmaktadır (Ural 2008), (Doğangün 2012), (Branco 2011) (Senthivel & Lourenço 2009) ve (Betti 2011)

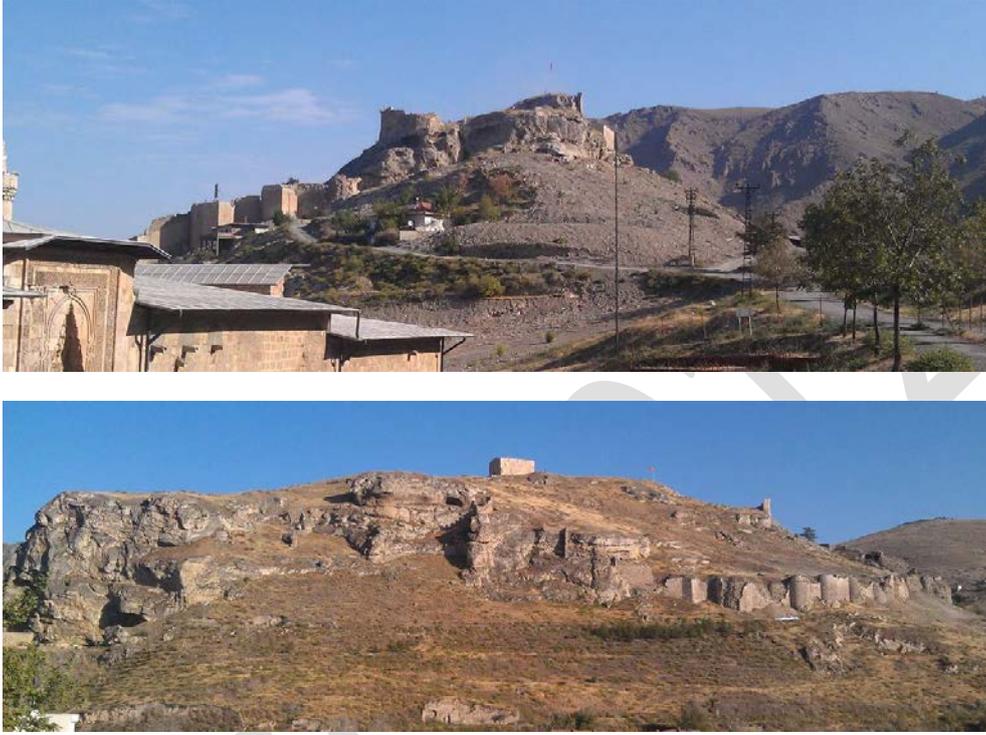
## 1. Divriği Kalesinin Konumu

Divriği Kalesi, Sivas ili, Divriği ilçe merkezinde yer alan bir ortaçağ savunma yapısıdır. Mengücekoğulları dönemine (1080-1228) kadar eski Paulikian-Bizans kalesi olarak korunmuştur. Moğol istilasından korunmak için surlar ve iç kale Ahmet Şah tarafından yenilenmiştir. Kale, şehrin doğusundaki tepeye askeri amaçlı kurulmuş olmakla birlikte 1880'lere kadar sivil yerleşim yeri olarak da kullanılmıştır. (Şekil 1).

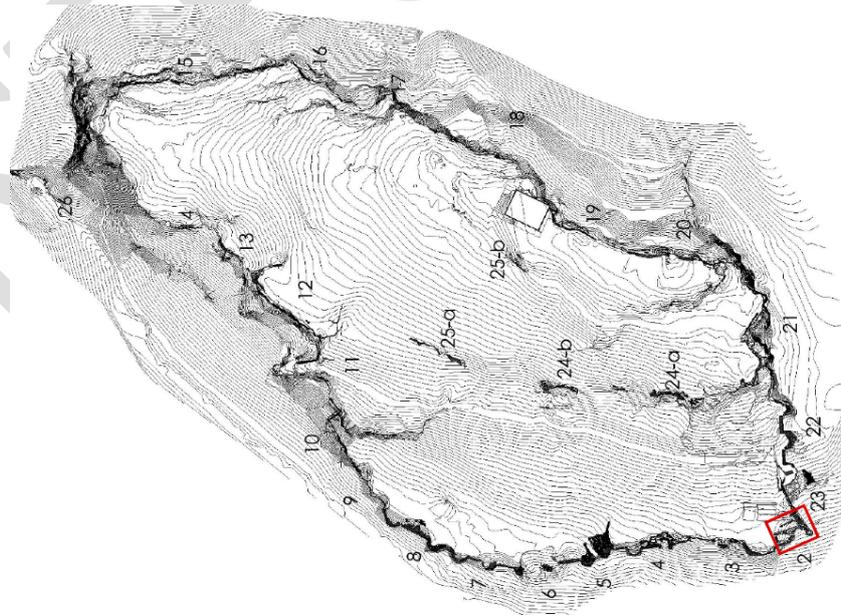
Kale 200m genişliğinde, 450m uzunluğunda oval formda bir plana sahiptir. Kalenin çevresi yaklaşık 1200m olup çoğunlukla kesme taşla inşa edilmiş beden duvarları ile sarılmıştır. Kuzey ve doğu cepheler dik

uçurumlar halinde Çaltı Vadisi'ne indiğinden kalede barınanların can güvenliği için yer yer basit duvarlar örülmüştür.

Kale sur duvarları içinde kalan alan yaklaşık 55000 m<sup>2</sup>, kale alanının en düşük ve en yüksek kotları arası 90m dir (Şekil 2) (ASIR PROJE). Günümüzde kale alanında herhangi bir yerleşim bulunmamaktadır. Kale içinde Cumhuriyet Üniversitesi tarafından yürütölen arkeolojik kazılar devam etmektedir.



Şekil 1. Kalenin güney-batı ve kuzey-batı cephelerden görünüşü



Şekil 2. Sivas, Divriği Kalesi planı (ASIR PROJE)

## 2. Sur Duvarları:

Kale surlarının izi bütün kale çevresinde belirgin şekilde görülmekle birlikte beden duvarlarının önemli bir kısmı tahrip olmuştur. Tahribatlar insan eli ile yapılan müdahalelerden ve tabiat şartlarından kaynaklanmaktadır. Kalenin bulunduğu Divriği ilçesi, Deprem Bölgeleri Haritasında 3. Derece deprem bölgesinde yer almaktadır. Kale çevresinde ve sur duvarlarında depremden kaynaklanan önemli bir bulguya rastlanmamakla birlikte zaman içinde olan depremlerden de etkilendiği ve olacak depremlerden etkileneceği açıktır. Kalenin inşa edildiği yükselti çoğunlukla kayalardan oluştuğu için beden duvarlarında zeminden kaynaklanan eşit veya farklı temel oturması, heyelan veya toptan göçme görülmemiştir.

Sağlam bir kaya tabakası üzerine inşa edilen kale duvarlarının dış yüzleri düzgün kesme taşlarla örülmüş arka yüzleri ise genellikle kireç harcı ve moloz taş/iri çakıl kullanılarak dolgu yapılmıştır (Şekil 3). Yapılan dolgunun malzeme ve bağlayıcı kalitesi oldukça yüksektir. Bundan dolayı sur duvarlarına dolgu tarafından etkilenen yatay toprak basıncı oldukça düşük seviyelerdedir. Surların bazı bölümlerinde dış yüzeydeki kesme taşların alt bölgeleri boşalmasına rağmen dolgu ve üst bölgelerin stabilitesini koruduğu gözlenmektedir. Surların bir kısmında ise dolgularda yüzeye yakın bölgelerde ayrışmalar gözlenmiştir. Kullanılan blokların yüksekliği 40-50 cm, derinlikleri ise 50-70cm arasında değişmektedir. Sur duvarlarının yüksekliği 14 m ye kadar ulaşmaktadır.



Şekil 3. Sur duvarları ve dolgular

## 3. Sur Duvarlarında Gözlenen Hasarlar:

Sur duvarlarındaki hasar incelendiğinde homojen bir dağılımın olmadığı, çok farklı seviyelerde hasarlar olduğu gözlenmektedir. Bunun nedeni olarak, kalenin yapımından buyana farklı zamanlarda onarım ve yenilemelerin yapıldığı şeklinde değerlendirilebilir. Kale surlarında gözlenen hasarları insan eli ile yapılan müdahaleler ve çevre/iklim şartlarından kaynaklanan hasarlar olarak iki grupta toplamak mümkündür.

Kale duvarlarındaki kesme taşların zaman içinde bina temeli veya yeni bina inşa etmek için sökülmesi, buluntu aramak için yapılan bilinçsiz, kaçak kazılarda yapılan tahribatlar, iyi niyetle fakat tekniğine uygun

olmayan onarım müdahaleleri ve ziyaretçiler tarafından yapılan resimler ve yazılar insan eli ile yapılan tahribatlar olarak sıralanabilir (Şekil 4).



Şekil 4. Sur duvarlarına yapılan yanlış müdahaleler

Kale duvarlarında çevre şartlarından meydana gelen bozulmalar daha çok iklim şartlarına ve malzeme yapısına bağlı olarak gelişmektedir. Isınma-soğuma, yüzeysel suların bünyeye girmesi ve donma-çözülme gibi dış etkenler ile taş ve bağlayıcı malzemenin kimyasal ve fiziksel özelliklerine bağlı olarak sur duvarlarında bozulmalar meydana gelmektedir. Bu hasarlar; toptan veya kısmi göçme, düşey çatlaklar ve ayrılmalar, yatay derzler boyunca hareketler ve malzeme kayıpları şeklinde gruplandırılabilir.

Hasarların belirlenmesi ve sınıflandırılmasında ICOMOS International Scientific Committee for Stone (ISCS) tarafından hazırlanan “*Illustrated glossary on stone deterioration patterns*” de verilen tanımlamalar ve sınıflandırmalar kullanılmıştır (ICOMOS-ISCS, 2008).

### 3.1. Toptan veya kısmi göçme

Çevre şartlarının etkisi ve insanlar tarafından yapılan değişik amaçlı müdahaleler sonucunda ortaya çıkan sur duvarlarının dış yüzeyinin kısmen veya tamamen bozulmasıdır (Şekil 2 ve 3). Sur duvarları tabanında yapılan kazılar, duvar gövdesinden taş alınması, yağmur ve kar sularının duvar içinde ilerlemesi, özellikle kış aylarında tekrarlı donma ve çözülme ile ortaya çıkan basıncın taş örgüyü ve bağlayıcı malzemeyi bozması gibi etkenler duvarların stabilitesini kaybetmesine ve arkasındaki dolguların bozulmasına yayılmasına neden olmaktadır. Yapıda duvar ile dolgu arasına giren yüzeysel suların tahliyesi için bir drenaj sisteminin düzenlendiği anlaşılmaktadır. Ancak bu sistemin zaman içinde bozulduğu ve işlevini yitirdiği

değerlendirilmiştir. Şekil 5 de duvar içinde biriken suların tahliyesi için düzenlenmiş az sayıdaki barbakandan biri görülmektedir.



Şekil 5. Duvar temeline yakın düzenlenmiş barbakan

### 3.2. Düşey çatlaklar ve ayrılmalar

Dış etkenlere bağlı olarak dolgu tabakalarında oluşan basıncın etkisi ile beden duvarlarında düşey doğrultuda milimetre boyutunda çatlaklar yer yer de santimetre boyutuna yaklaşan ayrılmalar gözlenmektedir. Bu ayrılmalar düşey derzleri takip ederek ortaya çıktığı gibi düz bir doğrultu boyunca taşları keserek ilerlediği de görülmektedir (Şekil 6).

### 3.3. Yatay derzler boyunca hareketler

Beden duvarlarının bağlı yatay hareketi az olmakla birlikte temele yakın bölgelerde rastlanmaktadır. Duvar temelinde meydana gelen yer değiştirmeler ve zayıf derzler hareketlenmenin nedenleri olarak değerlendirilmiştir (Şekil 7).

### 3.4. Derz boşalması

Derz boşalması en çok rastlanan hasar türlerinden biridir (Şekil 3, 4, 7 ve 8). Donma-çözülme gibi iklim şartları ve taş blokların yatay/düşey hareketleri sonucunda ortaya çıkmaktadır. Oluşan boşluklar sebebi ile düşey yönde kuvvet aktarılamamakta ve yapı stabilitesi bozulmaktadır.

### 3.5. Malzeme kayıpları

Malzeme kayıpları, taş bloklarda iç basıncın aşırı artması sonucu birbirine temas eden köşelerde veya kenar boyunca taş parçalarının yonga şeklinde koparak ayrılması (kesit azalması) olarak gözlenmiştir. 150-200 mm derinliğe varan kayıplar tespit edilmiştir. Bu hasar türü taş bloğun örgü şekline ve dayanımına bağlı olarak ortaya çıkmaktadır (Şekil 9).

Ayrıca malzeme kayıpları taş yüzeyinde düzensiz şekil ve farklı boyutlarda yerel boşlukların (alveoller) oluşması şeklinde de gözlenmiştir (Şekil 10). Boyutları 50-80mm derinliğe kadar giden malzeme kayıpları, aşınmalar tespit edilmiştir. Aşınma/erozyon taşın fiziksel ve kimyasal özelliklerindeki heterojen (homojen olmayan) dağılımdan ortaya çıkan bir ayrışma türüdür. Bu olgu daha çok sert ve boşluklu alanları birlikte bünyesinde barındıran heterojen yapıdaki kaya bloklarında (sedimanter ve volkanik kayalar) ortaya çıkmaktadır. Kurak iklimlerde metre boyutunda görülebilir.



Şekil 6. Sur duvarlarında gözlenen düşey çatlaklar ve ayrılmalar



Şekil 7. Sur duvarlarında gözlenen yatay hareketlenmeler ve ayrılmalar



Şekil 8. Sur duvarlarında gözlenen derz ve temel boşalmaları



Şekil 9. Taş bloklarda gözlenen malzeme kayıpları (kesit azalmaları)



Şekil 10. Taş bloklarda gözlenen farklı boyut ve türlerde malzeme kayıpları (erozyon)

## 4. Yapının Onarım ve Güçlendirilmesi

Bu bölümde kale beden duvarlarının onarım ve güçlendirilmesinde uygulanacak yöntemler sunulmuştur. Daha önce belirlenen hasar türlerinin onarım ve güçlendirilmesinde hangi yöntemin kullanılacağı aşağıda ayrı ayrı verilmiştir.

### 4.1. Yeni yapım

Toptan göçme hasarların belirlendiği bölgelerde yeni beden duvarları inşası yoluna gidilmelidir. Bu uygulamada duvar gövdesi sağlam kaya zemine oturtularak, mevcut beden duvarları ile uyumlu boyutlarda kaya bloklar kullanılarak inşa edilmelidir. Laboratuvar deneyleri için mevcut yapıdan alınan taş ve bağlayıcı numuneleri üzerinde yapılan deney sonuçları ile uyumlu bağlayıcı kullanılmalıdır. Duvar imalatı sırasında mevcut moloz dolgu ile duvar arasında kalan boşluklar harçlı moloz ile doldurulmalıdır. Kısmi göçme veya boşalma olan bölgelerde de gereken temizlik yapıldıktan sonra kaya bloklar yerleştirilip boşluklar Bölüm 4.2. de verilen enjeksiyon uygulaması yapılarak doldurulmalıdır. Daha sonra yüzey derzleri yapılmalıdır. Yüzey derzleri hidrolik esaslı bağlayıcı veya taş malzemenin bünyesi ile uyumlu genişleyen tamir harcı ile yapılabilir.

### 4.2. Enjeksiyon uygulaması

Enjeksiyon işlemi yapıya özgün mekanik özelliklerini kazandırmak için çatlak/boşluk içine uygun fiziksel ve kimyasal özellikte sıvı malzeme enjekte etmekten ibarettir. Enjeksiyon ile duvar içerisinde bulunan boşlukların ve çatlakların doldurularak duvar kesitinin sürekliliği sağlanır. Böylece duvar yükleri kesintisiz olarak temellere aktarılır ve olası dökülmeler ve kayıplar engellenmiş olur. Kullanılacak enjeksiyon malzemesi yapıyı oluşturan mevcut malzemelerle uyumlu olmalıdır. Hidrolik kireç esaslı enjeksiyon malzemeleri çatlak onarımları için en uygun ürünlerdir. Duvar içindeki boşlukları doldurabilmek için kullanılan malzemenin inceliği ve akışkanlık özellikleri gelişmiş olmalıdır. Mekanik özellikleri iyi olan ancak çözünmeyen tuzlar içeren ve yüksek hidrasyon sıcaklığında çimento şerbeti ya da epoksi reçinelerinin kullanılması açıklanan ilkelere uygun olmadığı için bu uygulamalardan kaçınılmalıdır.

Bu yöntem, bu yapı için 10 mm den küçük kaya çatlakları için uygulanacaktır. Bununla birlikte büyük boyutlarda oluşan derz boşluklarını doldurmak için koyu kıvamlı enjeksiyonlar da uygulanabilir. Bölüm 3.4 de “Derz boşalması” olarak tanımlanan hasar türü de bu uygulama ile onarılmalıdır. Mevcut duvar içinde değiştirilmesi gereken kaya blokların bağlanması için de bu yöntemden faydalanılabilir.

### 4.3. FRP (Lifli Polimer) çubuk uygulaması

Bu yöntemde duvar derzlerinde 40-50 mm derinlikte boşluklar açılarak bu boşluklara özel reçine ya da kireç esaslı harçlar kullanılarak FRP karbon çubuklar yerleştirilir (Şekil 11). FRP çubuklar ile duvar yüzeyinde oluşan çekme gerilmeleri karşılanmış olur. FRP çubuklar çelik donatılara göre çok yüksek mekanik dayanımlara sahip ve korozyona dayanıklı olmaları nedeniyle çok uzun ömürlüdürler. Çubuk çapları 5-12 mm arasında değişen daire kesitli veya 1.4x10 mm ölçülerinde dikdörtgen kesitli olarak üretilmektedir (BASF).



Şekil 11. FRP çubuk ve kireç esaslı harçla duvar derzlerinde yapılan güçlendirme (BASF)

Bu yöntem, bu yapı için beden duvarlarında düşey doğrultuda meydana gelen 10 mm den büyük çatlakların onarım ve güçlendirilmesinde uygulanacaktır. Yatay derzler boyunca 90-100 cm aralıklarla veya her iki yatay derzde bir olacak şekilde düzenlenecektir. Çapları 10 mm olan FRP çubukların boyları çatlak bitiminden itibaren 1 m daha uzatılarak belirlenecektir. Yerleştirme işleminden sonra FRP çubuğun üzeri derz dolgusu ile tamamen kapatılacaktır. Bu yöntem ile Bölüm 3.2 de “Düşey çatlaklar ve ayrılmalar” ve Bölüm 3.3 “Yatay derzler boyunca hareketler” de tanımlanan hasarların onarım ve güçlendirilmesinde uygulanmalıdır.

## 5. Malzeme kayıplarının onarımı

Bölüm 3.5 de “Malzeme kayıpları” olarak tanımlanan hasar türlerinin onarımı için Bölüm 4 de verilen yöntemler birlikte veya ayrı ayrı uygulanabilir. Malzeme kaybının olduğu durumlarda çatlaklı yada serbest parçalar temizlendikten sonra boşluğa uygun yeni kesme taş blok kesilerek yerleştirilmeli, enjeksiyon yöntemi ile derzleri doldurulmalıdır. Gerekli durumlarda FRP çubuklar kullanılarak da güçlendirme yapılabilir. Etrafındaki boşluklar enjeksiyon yöntemi ile doldurulmalıdır.

## 6. Sonuç:

Anadolu’daki en eski kültür varlıklarımızdan biri olan Sivas Divriği Kalesi bakımsızlıktan ve kötü kullanımdan dolayı yok olmaya yüz tutmuştur. Divriği kalesi için yapılan rölöve, hasar belirleme, restorasyon ve bunlara bağlı olarak önerilen onarım güçlendirme yöntemlerinin uygulanması ile kalenin yapısal güvenliğinin sağlanması, aşındırıcı, bozucu iklim şartlarına karşı daha dayanıklı hale getirilmesi sağlanmış olacaktır. Ziyaretçilere ve turizme açılması, tahribatın durdurulması ve gelecek kuşaklara ulaşması da böylece mümkün olacaktır.

## 7. Teşekkür:

Yazar, kale planları için “Divriği kalesi rölöve restorasyon ve restitüsyon projesi” müellifleri Mimar Hasan Fevzi ÇÜGEN ve Y. Mimar, Restorasyon Uzm. Mehmet Emin YILMAZ’a teşekkür eder.

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