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Prof. Dr. Mustafa Şahin Dündar - TOJSAT, Editor Sakarya-Turkey

Message from the Editor-in-Chief

TOJSAT welcomes you. TOJSAT looks for academic articles on the issues of science and technology. TOJSAT contributes to the development of both theory and practice in the field of science and technology and accepts academically robust papers, topical articles and case studies that contribute to the area of research in science and technology.

The aim of TOJSAT is to help students, teachers, academicians, scientists and communities better understand the development of science and technology. The submitted articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to TOJSAT. TOJSAT provides perspectives on topics relevant to the study, implementation of science and technology.

I am always honored to be the editor in chief of TOJSAT. Many persons gave their valuable contributions for this issue. I would like to thank the editor and the editorial board of this issue.

TOJSAT will organize International Science and Technology Conference (www.iste-c.net) in Europe and Harvard University, USA.

For any suggestions and comments on the international online journal TOJSAT, please do not hesitate to contact with us.

July 01, 2017
Editor-in-Chief
Prof. Dr. Aytekin İŞMAN
Sakarya University, Turkey

Message from the Editor

Dear Tojsat Readers,

We have been publishing the Online Journal of Science and Technology since 2011.. Audiences and readers of the journal is widening throughout the World and increasing especially after the conference series of Science and Technology. Tojsat journal is now indexed with Doaj, Dergipark, Cite Factor and Index Copernicus, Google Schoolar and will be cited by Scopus index soon.

The journal favours papers addressed to inter-disciplinary and multi-diciplinary articles shown in the section of scopes. In this issue of on line journal, selected papers such as use of Molten Salt Method in the Synthesis of Metal Hydride Electrode Materials, The reflection of Urban Poverty on Child Poverty, The Neutron Macroscopic Cross Sections Calculation of Some Minerals By Using Fluka Monte Carlo Method, etc. will be published.

I will thank to the readers for their supports by sending their valuable scientific works to publish in this journal.

Prof.Dr. M. Şahin Dündar

Editor

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Sevcan AYTAÇ KORKMAZ

A NEW METHOD IN NDT OF WOOD: THERMAL CONDUCTIVITY

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Abstract: NDT (Non-Destructive Testing) is a analysis technique of materials without causing damage. Common techniques of NDT are ultrasonic, acoustic emission, penetrometer, radiography etc. This methods depends on distinctive features of materials. NDT is used in a variety of settings that covers a wide range of industrial activity, with new NDT methods and applications, being continuously developed. Non-destructive testing methods are routinely applied in industries where a failure of a component would cause significant hazard or economic loss, such as in transportation, pressure vessels, building structures, piping, and hoisting equipment. Thermal conductivity is a inherit feature of wood material and it is related with density. In this study, a developed thermal conductivity based NDT device will be introduced and it's reliability will be exhibited.

Keywords: Non-Destructive Testing, Wood Material, Thermal Conductivity

Introduction

Wood is an engineering material with these known properties; lightweight, durable, easily worked, ecological, stylish, natural, versatile, low-density, cellular, hygroscopic, polymeric, and composite. Thanks to this excellent properties, woodcan potentially be used for a large variety of applications such as traditional buildings, earthquake resistant buildings, flooring, roofing, utensils, indoor and outdoor furniture, boat and shipbuilding, bridges, sport equipment, etc.

The using of wood as construction material is nearly as old as the history of mankind. In addition, wooden houses are already in existence. Wooden houses still subsist and widely preferred especially in many countries in Europe and United States. Turkey has wooden and half-masonry structures built especially during the times of Ottoman Empire. However, only a part of these structures remain standing from past to the present as cultural heritages reflecting the related period. Maintenances and restorations of this structures have a critical importance for their transfer to the next generations. Today, the tests of these structures are performed with visual inspection by the relevant institutions. Recently, in parallel with technological developments, some non-destructive testing methods have been developed for testing the durability of historical wooden house's constructions. The most important methods among them are penetrate, acoustic, microwave, electricity and magnetic assessment methods.

Wood has an historical impact on the life and cultural development process of human (Erdin, 2003). The using of wood material as a construction material has started too many years ago and this process has extended until today with the technological developments (Korkmaz, 2012). In America, especially in California, which is located on the seismic zone, approximately 90% of houses were made of wood (Mcrea et al, 2001). However, some disadvantages of wood, for example, bad dimensional steadiness, relatively low strength,easy worm-eaten and decay, and bad fire resistance, prevent wood extensive usages. These disadvantages limits to expected life of the wood material (Yalınkılıç, 1992).

Non Destructive Testing (NDT) covers a wide group of examination methods used to assess the properties of a material, part, product, weld, or system without causing harm. It is a commonly-used instrument in mechanical engineering, forensic engineering, civil engineering, mechanical engineering, aerospace and aeronautical engineering and medical applications. This term can also be used as Non Destructive Inspection (NDI), and Non Destructive Evaluation (NDE) in literature. Visual assessment and classification of wood which is one of the oldest forms of non-destructive testing needs another method to verify reliability of findings. Visual assessment is totally subjective and directed by the performer. Non-destructive testing methods provide an opportunity to get more reliable results (Bodig and Jayne, 1982). According to Youngquist and Hamilton (1999), NDT is a method which is needed to focus on in the 21 century.

Heat is the total energy of molecular motion in a substance while temperature is a measure of the average energy of molecular motion in a substance. Heat energy relies on the speed of the particles, the quantity of particles (the size or mass), and the kind of particles in an object. Temperature does not rely on the size or type of object. Heat exchange is the transfer of thermal energy between physical systems. The rate of heat exchange is reliant on the temperatures of the systems. The direction of heat exchange is from a region of high temperature to another region of lower temperature. On a microscopic scale, heat conduction occurs as hot, rapidly moving or vibrating atoms and molecules interact with neighboring atoms and molecules, transferring some of their energy (heat) to these neighboring particles. In other words, heat is transferred by conduction when adjacent atoms vibrate against one another, or as electrons move from one atom to another. Conduction is the most significant means of heat transfer within a solid or between solid objects in thermal contact.

Thermal conductivity can be expressed in terms of a coefficient of thermal conductivity (k). According to Fourier's law, in steady state condition, this is the measure of the rate of heat flow through one unit thickness of a material subjected to a temperature gradient, i.e., k is measured in W·m−1·K−1 (Kollmann and Cote 1968; Lienhard IV znd Lienhard V 2011). When heat is applied to a body, the vibratory energy of its molecules in that vicinity is increased. These molecules collide with neighboring molecules and, in so doing, transmit to them a part of their newly acquired energy. These neighboring molecules then in turn transmit a part of their newly acquired energy to still other molecules farther from the center of the disturbance (Brown et al. 1952).Due to the connections between atoms, the displacement of one or more atoms from their equilibrium positions will give rise to a set of vibration waves propagating through the lattice, and heat transfer in a dielectric solid occurs through elastic vibrations of the lattice.

The solid may be a crystal or it may be amorphous, but each atom has afixed equilibrium position, and the thermal vibrations can thus be resolved into normal modes. For a perfect crystal, these normal modes are plane travelling waves. Departures from the perfect lattice result in interactions, which are responsible for the statistical equilibrium between the normal modes. The thermal conductivity at liquid helium temperatures is due solely to phonons of the longitudinal mode of vibration (Debye 1912;Pomeranchuk 1941; Klemens 1951; Stephens 1973; Pohl et al. 1999).Jayne (1959) proposed in his well-known hypothesis for NDE of wood-based materials that energy storage and dissipation properties of wood-based materials are controlled by the same mechanisms that determine static behavior of such materials.

The above differential equation, when integrated for homogeneous material of 1-D geometry between two endpoints at constant temperature, gives the heat flow rate as:

$$\frac{\Delta Q}{\Delta T} = -kA \frac{\Delta T}{\Delta x}$$

Where
A is the cross-sectional surface area,
ΔT is the temperature difference between the surfaces,
Δx is the distance between the surfaces.

Density one of the major factor of the thermal conductivity with material's atoms and molecules are bonded together and their arrangement.

Materials and Methods

In this study, a portable machine which gives an idea about the strength of the wooden material depending on it's the rate of thermal conductivity was used. With the help of this machine, it is aimed to manufacture an alternative portable testing machine to acoustic and microwave testing systems. With this machine, especially in historical wooden houses, acceptable strength values of column-row systems will be determined through thermal conductivity coefficient without damaging the structure. Also, by using this machine it will be provide that defining the thermal conductivity values of facade systems of houses that are being used or ongoing construction. For the determination of strength values, thermal conductivity was defined on same test samples via new designed portable machine.

This machine consists of a terminal board, a heater and a thermo probe. Terminal board communicates with computer by USB serial. Also, the software was developed which process data comes from terminal board. A plate

type sensor board was developed as probe with dimension of 50 mm * 70 mm. This sensor board was connected to terminal board with 3.5 mm jack and supplied with 3.5 V (DC). On the terminal board, Atmega 328 microcontroller was used. Because this microcontroller was used in arduino systems, the software of microcontroller was developed on Arduino platform.

A plate type resistance was used as heater with dimension of 100 mm * 70 mm. This resistance was supplied with 24V (DC) constant supply by a transformator. The surface of heater resistance was packaged with insulation materials to prevent heat escape and to provide reliability in experiments. The surface of sensor board was packaged with insulation materials to provide reliability. In order to measure the heat flow on the wood material, the temperature data were carried to the computer via USB bus using two meter sensor cable. Software of device takes data from sensors placed on the sensor board. This data processed in background and showed on the interface as a curve chart. When the test was finished, the results saved into the CSV file. The testing assembly shown in figure 1.

Figure 1: The testing assembly

In this study, 30 samples with a dimension of 2x5x10 cm obtained from Uludağ fir (*Abies bornmulleriana Mattf.*) wood were used. These samples separated into 3 equal groups. One of these groups was undensified, the others were densified at 25% and %50 ratio. Timbers were supplied as logs from a lumber yard in Düzce, Turkey. The sapwood was cut from the logs with an automatically controlled band saw. Rough-scale planks were formed, the cuts being determined by considering the annual rings parallel to the surface (tangent section) and the sample dimensions. Attention was paid to ensure that no rot, knot, crack, color, or density differences were present in the samples (TS 2470, 1976). The samples were initially subjected to natural drying to approximately 12% moisture content. Before the densification process, the samples were held in a conditioning cabin with a relative humidity of 65 ± 3%, and a temperature of 20 ± 2 °C until they reached a stable weight (TS 2471, 1976).

Results and Discussion

The air-dry density values of samples were determined. The average oven-dry density and air-dry density of Uludağ fir samples were given in Table 1.

Table 1. Oven-dry densities of Uludağ fir samples

Densification	Sample Number									
	1	2	3	4	5	6	7	8	9	10
Undensified	0,4103	0,3952	0,4214	0,4242	0,3856	0,3696	0,4263	0,4010	0,4123	0,4413
25% Densified	0.5715	0,5521	0.5817	0.5762	0.5561	0.5427	0.5884	0.5587	0.5709	0.6123
50% Densified	0.6689	0.5721	0.8121	0.7123	0.7434	0.7929	0.7672	0.8550	0.7659	0.8120

The air-dry thermal conductivity values of samples were determined. The average oven-dry density and air-dry density of Uludağ fir samples were given in Table 1.

According to Table 1, it can be said that the density values of samples increase with densification. It is expected that this situation affects the thermal conductivity values of samples. For that reason, the thermal conductivity values of samples were measured with designed thermal conductivity testing machine. These results were given in Table 1.

Table 1. Thermal conductivity values of Uludağ fir samples

Densification	Sample Number									
	1	2	3	4	5	6	7	8	9	10
Undensified	0.1216	0.1152	0.1274	0.1282	0.1137	0.1114	0.1238	0.1196	0.1203	0.1312
25% Densified	0.1417	0.1377	0.1521	0.1532	0.1503	0.1522	0.1604	0.1531	0.1590	0.1612
50% Densified	0.1689	0.1621	0.1772	0.1782	0.1743	0.1739	0.1912	0.1735	0.1765	0.1942

According to this results, as would be expected, it can be said that there is a significant interaction between thermal conductivity and density of wood. And this values can be determined with designed device. In the next step of study, obtained data will compare with data will be obtained from QTM 500 Quick Thermal Conductivity Meter. CTC tests have a good potential to be used as an alternative in situ NDE method to assess density and residual strength of wood. CTC test have a good potential to be used as an alternative NDT method to assess density and residual strengt of wood.

Acknowledgements

We would like to thank the Scientific and Technological Research Council of Turkey (TÜBİTAK-1001-114O644) for its financial support.

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BIBLIOMETRIC ANALYSIS ON SCIENTIFIC RESEARCH ON INNOVATION DIFFUSION

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Abstract: Innovation diffusion has become a large and growing field with considerable amount of publications as the pioneering studies have appeared in the literature. In this context, the main purpose of this paper is to analyze the scientific publications on innovation diffusion by providing basic statistics (distributions of publications by document types, publication years, authors' origins, and etc.) and distinct trends in publication topics. With this purpose, a bibliometric analysis will be performed for a total of 900 papers published between January 1, 1981 and December 5, 2013. The findings of the study are expected to be helpful and insightful for understanding the current state and trends of research on innovation diffusion and thereby guiding researchers for their future studies.

Keywords: Bibliometric Analysis, Innovation, Diffusion.

Introduction

Innovation diffusion has generally been defined as *the process by which an innovation is communicated through certain channels over time among members of a social system* (Rogers, 2003). The theory of innovation diffusion simply explains how new ideas, technologies, and practices spread within a social system (Bohlmann, Calantone, and Zhao, 2010, Peres, Muller, and Mahajan, 2010, Valente and Davis, 1999). This theory originates in anthropology and sociology ("The laws of imitation" 2016) with some principles adapted from epidemiology (Bailey, 1975, Valente and Davis, 1999). In time, it has spread to several different research areas.

The modeling and forecasting of the innovation diffusion introduced to marketing area when the pioneering studies of it started to appear in 1960s. After its introduction to marketing, the theory of innovation diffusion has sparked considerable research among consumer behavior, marketing management, and management and marketing scholars (Mahajan, Muller, and Bass, 1990). Several different models for innovation diffusion have been built in order to investigate the diffusion of new ideas, technologies and practices.

In 1969, Bass presented a diffusion model that is one of the most popular diffusion models, has been widely used for investigating the diffusion process of innovation in a social system (Cho and Koo, 2012). Since the publication of the Bass model, the researchers on the modeling of innovation diffusion has set a vast literature consisting of several dozens of articles, books, and assorted other publications (Mahajan, Muller, and Bass, 1990). Correspondingly, innovation diffusion has become a large and growing field by numerous researchers across multiple disciplines with the primary objective of understanding the mechanism that motivate the innovation and diffusion process (Rogers, 2003). In this context, the main objective of the present paper was to perform a bibliometric analysis on the vast bodies of literature of innovation diffusion in order to find the basic statistics (distributions of publications by document types, publication years, author numbers, authors' origins, and research areas) and examine hot topics and trends of them.

For this study, publications on innovation diffusion were collected from Web of Knowledge database. Also, the time period of the publications was restricted from January 1, 1981 through December 5, 2013.
The rest of this paper was structured as follows. Section 2 provided information for used methodology and the data collection process. Section 3 presented the results of the analysis by several dimensions. Lastly, section 4 concluded the present study

Materials and Methods

In this study, a bibliometric analysis was performed for investigating the publications on innovation diffusion. Bibliometric analysis (the quantitative analysis of publications) is particularly an applicable method for the fields with vast bodies of literature which are difficult to analyze by traditional review methods (Belter and Seidel, 2013). This method is a considerable part of reference and research services (Song and Zhao, 2013) and utilizes quantitative analysis and statistics to get the bibliographical works within a given area, topic, and etc. (Wallin,

2005, Jiang Tan, 2014, Zyoud, Al-Jabi, and Sweileh, 2014). It is also a useful method for getting a clear picture of the current state of the scientific researches in particular fields and allocates researchers to recognize and undertake new lines of researches (Battisti and Salini, 2012, Zyoud, Al-Jabi, and Sweileh, 2014). Due to the practicability of the method, it has been used large amounts of publication for several different research topics. Some examples for these studies are given in table 1. In the present study, this method is applied for innovation diffusion topic.

The current analysis focused on the scientific publications on innovation diffusion. For this study, the term "*innovation diffusion"* was searched in the topics of the publications that exist in the Web of Knowledge database. More than 950 papers were found for this search key in the selected database. However, the search was restricted by some criteria. These are given below.

- The papers were restricted by document types. Only articles and proceeding papers were included for the study.
- Publication years of the papers were also limited from January 1, 1981 through December 5, 2013 due to the lack of access to full texts and abstracts for previous papers
- Lastly, the papers that did not have abstracts available, is not included in this study.

Table 1: Examples of bibliometric analysis studies in the literature.

Reference Number	***Title***	***Topic***
(Zyoud, Al-Jabi, and Sweileh, 2014)	Bibliometric analysis of scientific publications on waterpipe (narghile, shisha, hookah) tobacco smoking during the period 2003-2012	Tobacco smoking
(Belter and Seidel, 2013)	A bibliometric analysis of climate engineering research	Climate Engineering
(Fu etc., 2010)	A bibliometric analysis of solid waste research during the period 1993-2008	Solid Waste
(Kim and McMillan, 2008)	Evaluation of internet advertising research: a bibliometric analysis of citations from key sources	Internet Advertising
(Falagas, Karavasiou, and Bliziotis, 2006)	A bibliometric analysis of global trends of research productivity in tropical medicine	Productivity in Tropical Medicine
(Mela etc., 2003)	Radiological research in Europe: A bibliometric study	Radiology

After these arrangements, 900 articles were found and downloaded from the database to analyze for the present study. The document types, publication years, author numbers, countries of author(s), and research areas of the downloaded documents were collected.

Results

This section of the present paper stressed on the general findings of the analysis that was performed for chosen publications. The results of the analysis were presented under the titles of *document types, publication years, research areas, author number, countries of authors,* and *abstracts* respectively.

By Document Types

A total 900 publications were analyzed for document types in this study. The document types of the publications were restricted as only article and proceeding paper at data collection process. Correspondingly, there are only two different types of documents for this analysis. Figure 1 presents the distribution of the analyzed publications according to document types.

The 665 of all publications (74% of all papers) consists of articles while the remaining 235 of the all papers (26% of all papers) were the proceeding papers. As seen in the figure 1, the large amounts of the papers (74% of the analyzed papers) have been prepared as articles. This may show us that researchers generally focus on producing articles for innovation diffusion topic all over the world

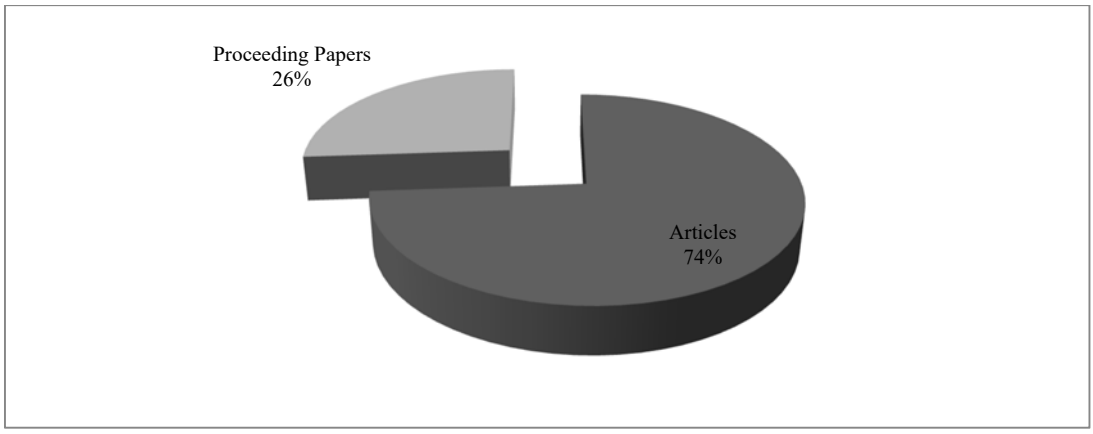

Figure 1. Distribution of the analyzed papers by document types.

By Publication Years

The publication years of the papers were restricted from January 1, 1981 through December 5, 2013. Figure 2 shows the annual distributions of the analyzed publications and figure 3 represents the number of papers in five years ranges. As seen in figure 2, the number of papers published on innovation diffusion was really low at the beginning years of the research time period. For example; only 5 papers were published from the beginning of 1981 to the end of 1985. And all of them were prepared as articles.

From 1986 to 1990, the number of papers increased to 16. Among these papers, there was still no proceeding paper to our knowledge. 59 papers were published on innovation diffusion. One of them was a proceeding paper within the range 1991-1995.

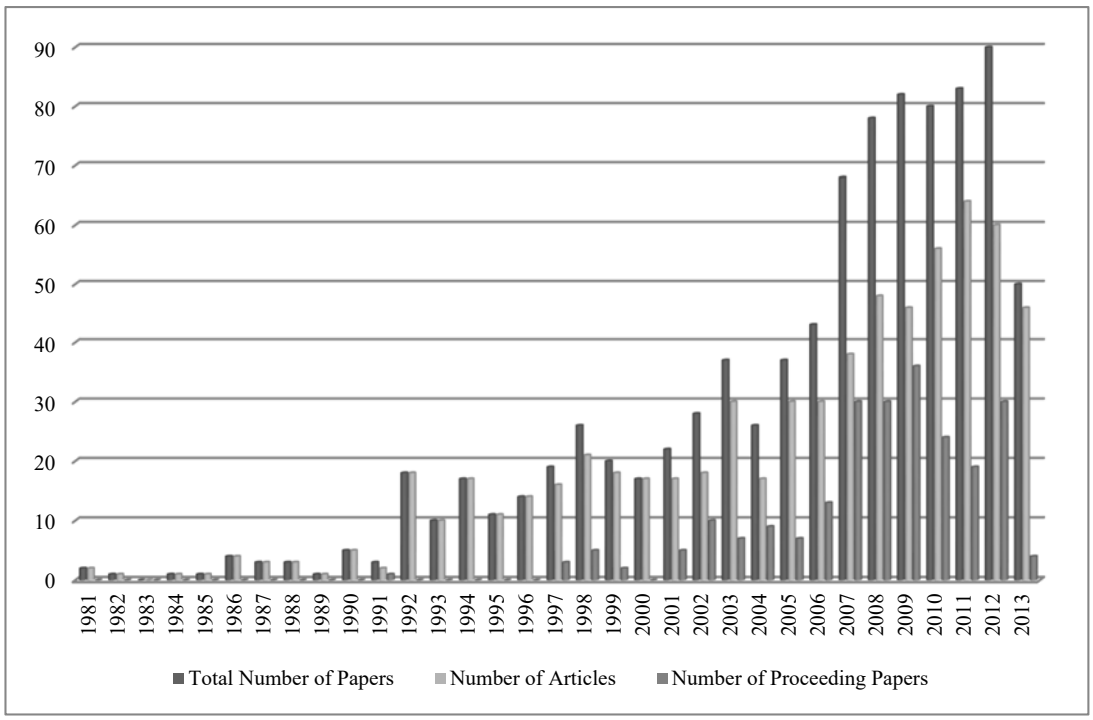

Figure 2. Annual distribution of the papers on innovation diffusion.

By Research Areas

The research areas were categorized in five main groups similar to the categorization of Web of Knowledge in this paper. The areas are: arts & humanities, life sciences & biomedicine, physical sciences, social sciences, technology.

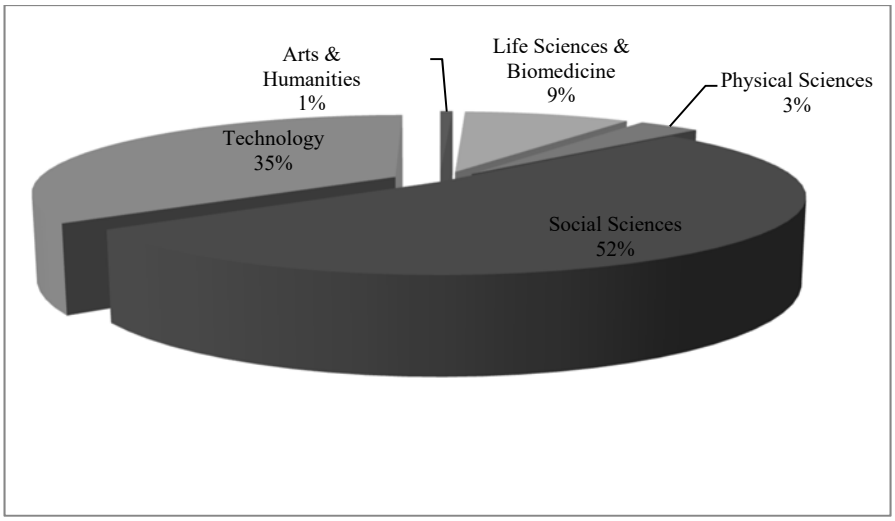

Figure 3. Distribution of the analyzed papers according to research areas.

During data collection process, the research areas of each paper was also recorded from the searched database and analyzed for the given period of time.

Figure 3 presents the distribution of the papers by research areas. As seen in the figure 5, 52% of the analyzed papers were related with social sciences. The social sciences area includes topics like Business & Economics; Psychology; Public Administration; Education; etc. according to the categorization of the selected database. The percentage of the papers for social sciences may show that the innovation diffusion researchers mostly focused on the social sciences areas for the given period.

The researches about technology field followed the social sciences area with 35%. Thus, the largest amounts of the papers were related with social sciences and technology areas with 88%. Apart from these two areas, papers were distributed to life sciences & biomedicine with 9%, physical sciences with 3%, and arts & humanities research areas with 1% of all papers.

By Number of Authors

In this study, the papers were also analyzed for the number of authors. A total of 2136 authors participated in innovation diffusion related studies. The range of the authors was within 1 to 14. Average number of authors per paper is 2,373.

Figure 4 gives the distribution of the papers according to the number of authors. The 343 of the analyzed papers were prepared by two authors. The papers with three authors followed them with 225 of all papers. And, 214 of the papers were made by one author.

The remaining of the papers was prepared by four or more authors. However, the amount of papers with more than three authors showed considerable decrease. Correspondingly, the biggest amount of the papers (86% of all papers) was written one, two, or three author(s).

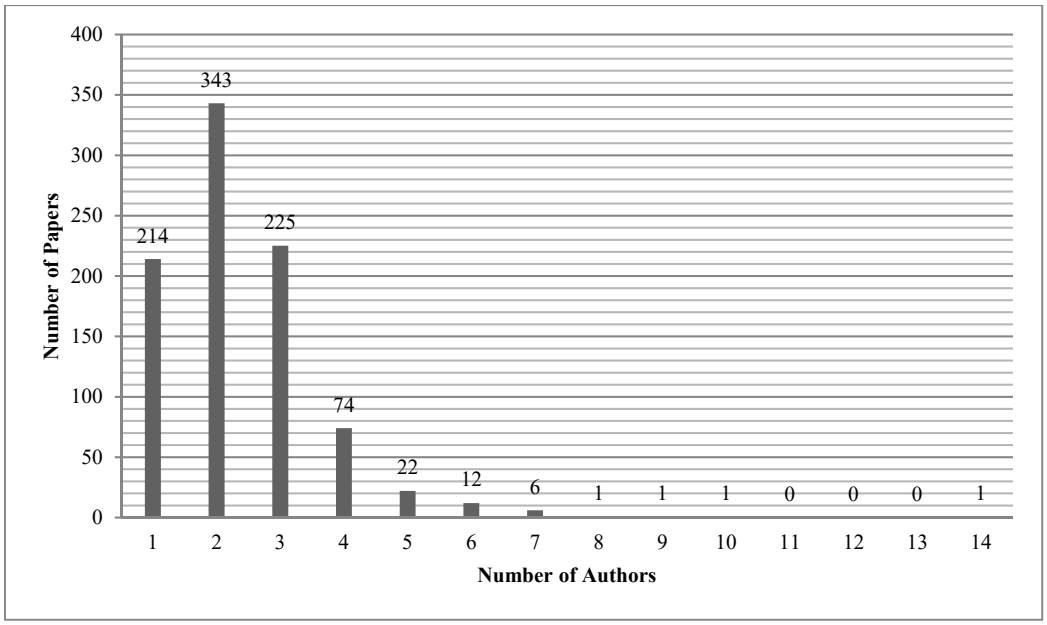

Figure 4. Distribution of the analyzed papers by number of authors.

By Countries of Authors

The analyzed publications were written by a total of 2136 authors from 68 different countries. It should be noted that the country knowledge of the authors were based on the correspondence addresses of the papers. The authors who did not give information about the origin of themselves were accepted as *unknown* in the analysis.

Figure 5 shows the percentage distribution of countries of authors. Authors originating from USA (United States of America) had the largest amount of the publications with 26% (with 568 papers). Authors originating from China ranked as the second with 11% (with 233 papers). Taiwan (Republic of China) had the third place for authors' origins with 9% (with 201 papers). Taiwan was followed by England, Italy, and Australia with 6%, 5%, and 4% respectively. More than the half (52% of all authors) of all authors was from the first four countries: USA, China, Taiwan, and England.

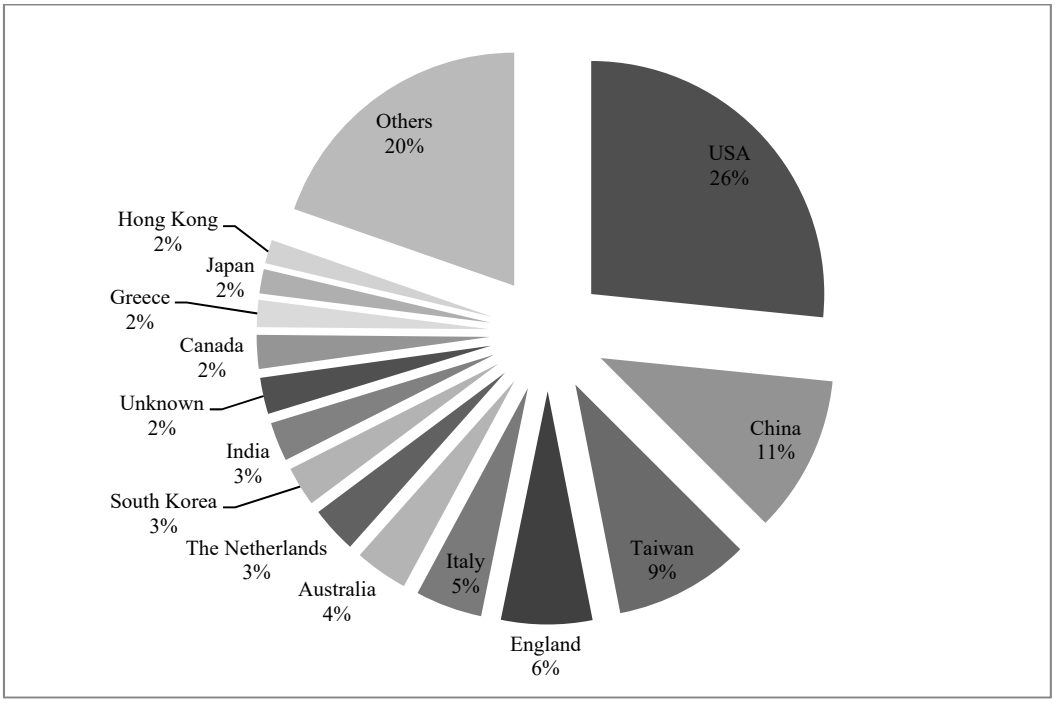

Figure 5. Percentage distribution of country origins of authors.

Conclusion

This paper mainly investigated the statistical distribution of the papers published about innovation diffusion in Web of Knowledge database from January 1, 1981 through December 5, 2013.

A bibliometric analysis was performed in order to compute basic statistics and examining the current state, hot topics and trends of innovation diffusion researches. The main findings of the present work are given below.

- The 665 of all publications (74% of all papers) consisted of articles while the remaining 235 of the all papers (26% of all papers) were the proceeding papers.
- The number of papers published on innovation diffusion was really low at the beginning years of the research time period. It showed a considerable increase at 1992 and fluctuated until 2000. The largest amount of the analyzed papers (724 of 900 papers) was written after 2000. And it peaked at 2012 with 90 papers.
- The biggest amount of the papers (52% of all papers) was related with social sciences research area. The papers related with Technology research area followed it with 35%.
- The biggest amount of the papers (86% of all papers) was written one, two, or three author(s).
- 900 papers were written by 2136 authors from 68 different countries.
- Authors originating from USA (United States of America) ranked to the first place with 26% (568 of all papers). Authors originating from China had the second place with 11% (233 of all papers). Taiwan (Republic of China) had the third place for authors' origins with 9% (201 of all papers). More than the half (52%) of all authors was from USA, China, Taiwan, and England respectively

The findings given in this study present some basic statistics and trends obtained innovation diffusion papers for the given period. However, the analyses in this study were subject to certain limitations. First, the document types of the papers were restricted as articles and proceeding papers. Second, the papers that did not have abstracts available online were not included in this study. Correspondingly, future researches may perform a more detailed study taking these limitations of the present study into account.

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BIODIESEL FUEL OBTAINED FROM SUNFLOWER OIL AS AN ALTERNATIVE FUEL FOR DIESEL ENGINES

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Abstract: In this study, an alternative diesel fuel, of which chemical modification was made by transesterification with short chain methyl alcohols, was produced from sunflower oil, a designated as B100. The modified products were then evaluated according to their fuel properties as compared to diesel fuel. The fuel properties considered were viscosity, pour point, calorific value, flash point, and cetane number in addition to some other properties. The effects of sunflower oil methyl ester (biodiesel) and diesel fuel on a direct injected, four strokes, single cylinder diesel engine performance were studied. The results showed that the performance of the engine using biodiesel fuel differed very little from the engine's using diesel fuel.

Keywords: diesel engine, alternative fuel, biodiesel fuel, performance.

Introduction

The prevalence of internal combustion engines and subsequent developments in engine technology have led to wide spread consumption of the petroleum fuels. Due to the shortage of petroleum products and its increasing cost, many efforts are put on the stage to develop alternative fuels, especially for fully or partial replacement of diesel oil. The high cost of petroleum and petroleum crises have brought much pressure on many countries to re-evaluate their national energy strategies. Thus energy conservation and alternative fuels research are given high priority in energy planning in some countries. Many studies have been performed in developed countries and elsewhere involving vegetable oils as a primary source of energy. Particularly, during the early 1980's, studies on the possibility of using unmodified vegetable oils as a diesel fuel were conducted.

Since the petroleum crises in 1970's and 1980's, rapidly increasing petroleum prices and uncertainties concerning petroleum availability, a growing concern of the environment, and the gases affecting global warming have attracted more interests in the use of vegetable oils as a substitute of diesel fuel. The acceptability of vegetable oils as diesel fuel has been evaluated for the first time in the 70th years because of the well known energy crises. Thus energy conservation and alternative fuel researches are given high priority in energy planning in some countries. Several studies conducted worldwide have shown that vegetable oil, without any modification on diesel engine, can give performances comparable with those of diesel fuels. The most important advantage of vegetable oils is that they are renewable energy sources compared to the limited resources of petroleum. Many of these studies are on vegetable oils to be used in diesel engines (Labeckas et al. 2005), (Ryu et al. 2004), (Rakopoulos et al 1992), (Lapuerta et al 2005), (Huzayyin et al 2004), (Hebbal et al 2006), (Geyer et al 1984), (Yoshimoto et al 2002). It has been found that the vegetable oils are promising fuels because their properties are similar to diesel and can be produced easily from the crops (Jung et al 2004), (Zou et al 2003), (Nagaraj et al 2002).

Vegetable oils are non-toxic renewable sources of energy, which do not contribute to the global CO_2 buildup. Vegetable fuels can be used as an emergency energy source in the event of any petroleum shortage. Extensive studies on alternative fuels for diesel engines have been carried out since the fossil based fuels are limited. Common vegetable oils are sunflower, cottonseed, olive, soybean, corn, nut, leenseed and sesame oils. The most produced ones in Turkey are sunflower, cottonseed, corn, soybean, olive and nut oils.

Sunflower and other vegetable seeds release oil on compression processes. During the processes of compression of these seeds and final storage, many fatty acids are formed (Gunstone et al 2003), (Bikou et al 2003), (Warner et al 1997), (Yücesu et al 2006). These are palmitic, stearic, oleic, lynoleic, arachidic and behenic acids. Sunflower oil also contains some fatty acids like other vegetable oils. The chemical formulations and the percentage of sunflower oil and some other oils fatty acids are given in Table 1.

Table 1. Fatty acid composition of sunflower oil in comparison with other vegetable oils

Component	Chemical Bond	Chemical equation	Sunflower oil	Cottonseed oil	Soybean oil	Corn oil
Palmitic acid	16:0	C16H32O2	23	22	17	12
Stearic acid	18:0	C18H36O2	3	2	3	2
Oleic acid	18:1	C18H34O2	24	25	26	25
Linoleic acid	18:2	C18H32O2	49	50	54	60
Linolenic acid	18:3	C19H32O2	1	1	3	1

The melting point of fatty acids rises with the length of the structural chain of acid. Some vegetable oil contains high concentrations of less common fatty acids. Physical properties of sunflower oil used in this study in comparison with other some vegetable oils are given in Table 2. These oils are almost entirely consumed in foods. The excess of these could be used as diesel fuel besides consuming in foods.

Table 2. Physical properties of sunflower oil in comparison with other some vegetable oils

Properties	Sunflower oil	Cottonseed oil	Soybean oil	Corn oil
Density @ 26ºC (Kg/lt)	0.918	0.912	0.92	0.91
Viscosity(mm^2/s) at 26°C	34	35	34	36
Flash point (°C)	220	210	230	280
Calorific value (kJ/kg)	39500	39450	39600	39550
Setan number	36	42	38	37
Acid value	0.15	0.11	0.20	0.16
Sulphur value (%)	0.01	0.01	0.01	0.01

It has been shown that pure vegetable oils have harmful effects on engine parts and cause a starting up problem (Engler et al 1983), (Schlick et al 1988), (Ramadhas et al 2005), (Muñoz et al 2004), (Bari et al 2002), (Goodrum et al 2005), (Dorado et al 2002), (Krishna et al 2004). The problems due to the viscosity and density of the vegetable oils having different physical and chemical properties from the diesel fuel should be eliminated by making them less viscous. High viscosity of the vegetable oils and its tendency to polymerise within the cylinder are major chemical and physical problems encountered. With this aim, it is necessary to obtain either esters or emulsions of vegetable oils (Bhattacharyya et al 1994), (Agarwal et al 2001), (Barnwal et al 2005), (Schwab et al 1987). Vegetable oils can be used as material to produce methyl or ethyl ester. There are several methods for producing of ester; and the best method is known as transesterification (Freedman et al 1986), (Mittelbach et al 1999), (Schuchardt et al 1998), (Ramadhas et al 2005), (İlkılıç et al 2005), (Megahed et al 2004), (Dorado et al 2004), (Encinar et al 2002), (Noureddini et al 1997), (Ma et al 1999), (Harrington et al 1985).

Experimental procedure

Transesterification is the most frequently applied method of industrial ester production. A strong acid can be used in transesterification process. Vegetable oils' methyl or ethyl ester is considered as a promising alternative fuel for the reduction of pollutant from diesel engines. Biodiesel can be used in any diesel engine in pure form or blended with diesel fuel at any rate. Even a blend of 20% biodiesel and 80% diesel fuel will significantly reduce carcinogenic emissions by 27% and gases that may contribute to global warming up (Petrowski, 2002). Biodiesel fuel production from sunflower oil has been studied as an alternative fuel for compression ignition engines. Detailed reviews about biodiesel fuel production processes are available in the literature. In this study, crude sunflower oil was obtained from the oil processing factory of Karadeniz Birlik, Elazığ, Turkey. Diesel fuel was obtained from a commercial gas station in Elazığ, Turkey. The biodiesel fuel produced by a transesterification technique was further reacted by using a peroxidation process. Physical properties of crude sunflower oil (CSO), Biodiesel (B100) fuel, and diesel fuel are given Table 3.

Table 3. Physical properties of crude sunflower oil (CSO), biodiesel fuel (B100) and diesel fuel

Properties	CSO	Biodiesel	Diesel fuel
Density @ 26°C (Kg/lt)	0.918	0.89	0.84
Viscosity (mm^2/s)@ 26 °C	34	4.5	3.2
Flash point (°C)	220	85	59
Calorific value (kJ/kg)	39342	40565	42980
Setan number	36	74	56
Acid value	0.15	0.13	0.22
Percentage of H (%)	11.67	12.19	15.10
Percentage of C (%)	77.46	76.66	84.90
Percentage of O (%)	10.87	11.15	-

B100 fuel prepared in laboratory conditions was tested in an engine of which technical data is detailed in table 4.

Table 4. Lombardini Diesel Engine Details.

Type	6LD 400 Lombardini
Number of cylinder	1
Cylinder diameter	86 mm
Stroke	68 mm
Clearance volume	395 cm^3
Compression ratio	18:1
Maximum speed	3600 l/min
Maximum power	6.2 kW @ 3600 l/min
Maximum torque	20 N.m @ 2200 l/min
Fuel tank capacity	4.3 lt
Oil consumption	0.0115 kg/h
Cooling	air
Injection timing	30 BTDC
Injection opening pressure	200 kg/cm^2
Starting	by dynamometer
Dry weight	45 kg

Tests were held on a laboratory test bed which consisted of an electrical dynamometer, an exhaust gas analyzer, a data acquisition system and engine mounting elements, as shown in Fig. 1. Diesel fuel and biodiesel fuel were compared for their fuel properties and their engine performance.

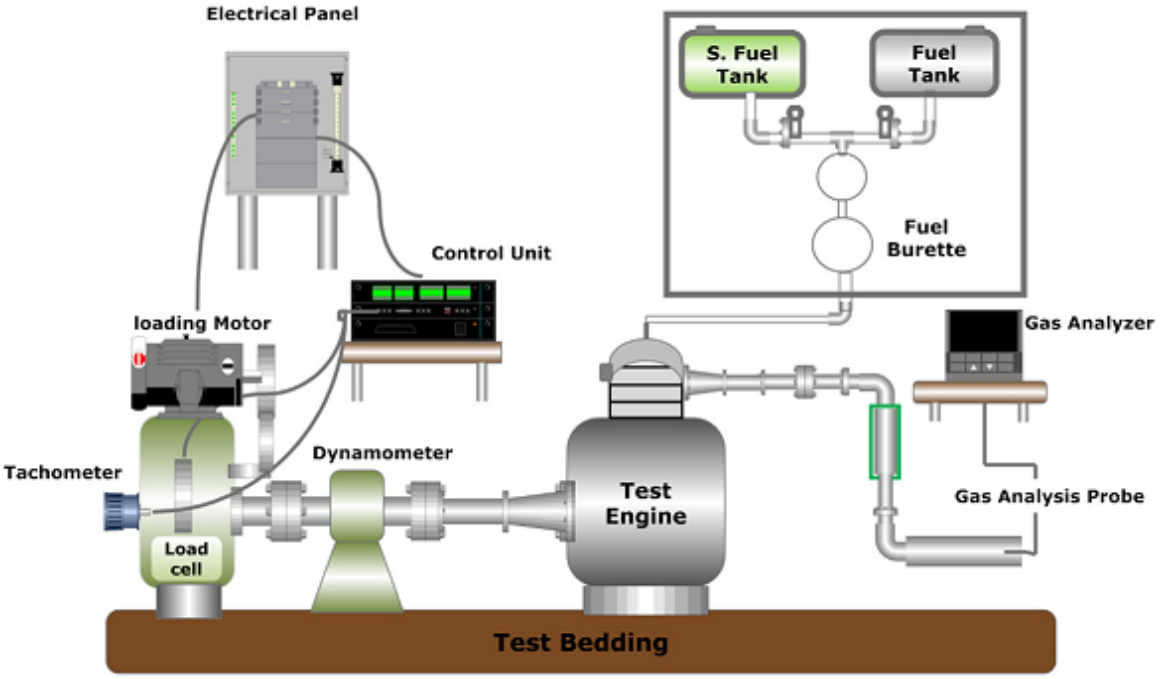

Figure 1. Schematic layout of the engine test system

Results and discussions

The engine power

During the injection period, the injection conditions such as injection pressure, nozzle size, and injection rate may vary. The droplet size distribution in the spray may also change with time during the injection period. The effect of injection pressure has been studied. The injected diesel fuel and B100 fuel are atomised into small drops near the nozzle exit to form a spray. Good atomisation requires high fuel injection pressure small injector nozzle size, optimum fuel viscosity and high cylinder air pressure at the time of injection. The variations of engine power values in relation with the various injection pressures are shown in Fig. 2. The maximum power for diesel fuel and B100 fuel occurred at 200 bar pressure injection. The power output of diesel engine using B100 fuel was lower than the power output using diesel fuel.

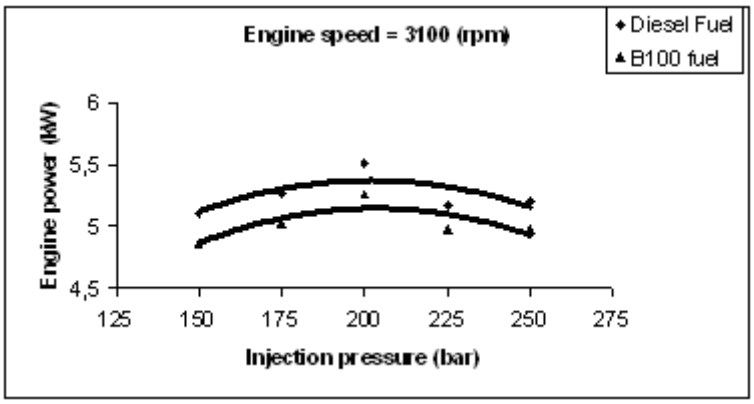

Figure 2. The variation of the engine power at the various injection pressure.

The maximum power obtained by diesel fuel was 5.51 kW while 5.26 kW by B100 fuel at 200 bar injection pressure. This was due to an increase in fuel consumption with an increase of injection pressure. The difference in power outputs was caused by the difference between the calorific values of the fuels. The power increases from 5.11 kW to about 5.51 kW when the injection pressure is increased from 150 bar to 200 bar for diesel fuel. From injection pressure of 150 to 200 bar the power increases from 4.86 kW to about 5.26 kW and then decreases slowly the other injection pressures for B100 fuel. From injection pressure of 200 to 250 bar the power decreases from 5.51 kW to 5.21 kW for diesel fuel and from injection pressure of 200 to 250 bar the power increases from 5.26 kW to 4.97 kW for B100 fuel. The maximum power between diesel fuel and B100 fuel represents a difference of 5% of the 200 bar injection pressure. The small difference was mainly a result of reduction at heating value of diesel fuel due to the lower heating value of B100 fuel.

3.2. Engine torque

The variation of engine torque by injection pressure for the two fuels was shown in Fig. 3.

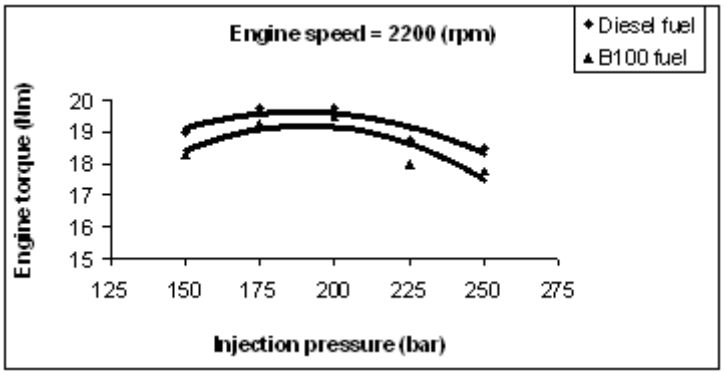

Figure 3. The variation of the engine torque at the various injection pressure

The torque decreased with increase of injection pressure for the two fuels. Up to a pressure of 200 bar the engine torque is about constant and then it is decrease slowly for diesel fuel and B100 fuel. The torque increases from 19 Nm to about 19.75 Nm when the injection pressure is increased from 150 bar to 200 bar for diesel fuel. From injection pressure of 150 bar to 200 bar the torque increases from 18.25 Nm to about 19.50 Nm and then decreases the other high injection pressures for B100 fuel. From injection pressure of 200 bar to 250 bar the power decreases from 19.75 Nm to 18.50 Nm for diesel fuel and from injection pressure 200 bar to 250 bar the power increases from 19.50 Nm to 17.50 Nm for B100 fuel.

Specific fuel consumption

Figure 4 showed the specific fuel consumption (SFC) for the two fuels. Specific fuel consumption increased with increase of injection pressure. The specific fuel consumption of B100 fuel was higher than of diesel fuel. This was due to the calorific value of B100 fuel being lower than that of diesel fuel. But the density of the B100 fuel was higher than that of diesel fuel so their calorific value by volume was relatively close. In addition, B100 fuel contains a certain amount of oxygen and the high viscosity. B100 fuel may also provide a good sealant between the piston rings and cylinder wall. The utilization ratio of energy can be raised so the fuel consumption rate was higher than diesel fuel. Because of the lower calorific value, with an increase in B100 fuel, the specific fuel consumption of B100 fuel was a little higher than that of diesel fuel.

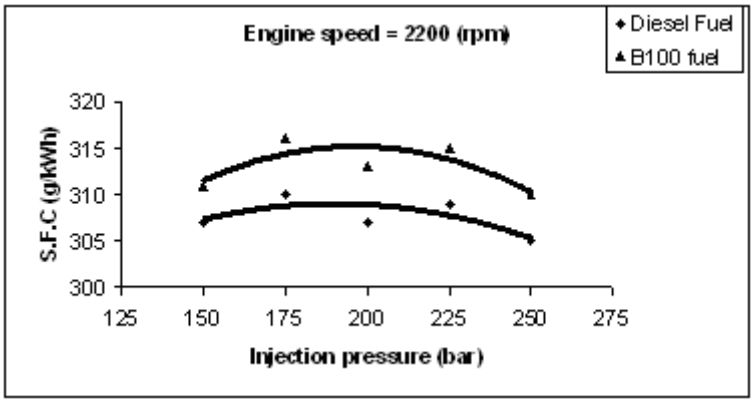

Figure 4. The variation of the engine specific fuel consumption (SFC) at the various injection pressure

Up to a pressure of 225 bar SFC is increased and then it is decreased slowly for diesel fuel. The SFC increases from 307 g/kWh to about 309 g/kWh when the injection pressure is increased from 150 bar to 225 bar for diesel fuel. From injection pressure of 150 bar to 200 bar the SFC increases from 311 g/kWh to about 313 g/kWh and then decreases the other high injection pressures for B100 fuel. From injection pressure of 225 bar to 250 bar the SFC decreases from 309 g/kWh to 305 g/kWh for diesel fuel and from injection pressure 200 bar to 250 bar the specific fuel consumption decreases from 313 g/kWh to 310 g/kWh for B100 fuel. The largest effect of high injection pressure is the state of the fuel as it passes through the nozzle. The injection pressure can be reduced slightly leave the fuel emerging from the nozzle in mostly vapour state. The question that remains is the increase

in the specific fuel consumption at the high engine injection pressure due to the deacrease in drop size and the calorific value or some other factors.

Conclusions

Engine tests have been conducted with the aim of obtaining comparative measures of torque, engine power, specific fuel consumption to evaluate and compare the behaviors of the direct injected diesel engine running by diesel fuel and B100 fuel. Diesel fuel and B100 fuel was compared and its physical and chemical characteristics were determined. Fuel characterization data showed some similarities and differences between diesel fuel and B100 fuel. From the results obtained in this study it can be concluded that;

- The physical properties of diesel and B100 fuel are not very different. While the density and viscosity of B100 fuel decreased from 0.92 kg/lt to 0.88 kg/lt and from 33.98 mm^2/s to 4.5 mm^2/s respectively at 26^oC, the heat capacity increased from 39342 kJ/kg up to 40565 kJ/kg. Viscosity considerably decreased as a result of esterification.
- Flash point, density, cetane number and viscosity of B100 fuel were higher than those of diesel fuel. Calorific value of B100 fuel was lower about 6% than diesel fuel. Engine performance and exhaust gas emission of B100 fuel are comparable with diesel fuel. When the engine performance is considered, there are slight decreases in the engine torque and power with respect to diesel fuel. Thus B100 fuel is technically feasible in diesel engine.
- The high fuel consumption of B100 fuel at all injection pressure will compensate for the lower heating values such that the engine consumes equal amount energy.
- B100 fuel doesn't affect engine and bearing components seriously. It doesn't degrade lubricating oil and produces comparable amount of carbon deposit.
- Vegetable oils and biodiesel hold great promise as substitutes of diesel in existing diesel engines without any modification. Edible and non-edible oil and animal fats can be used to produce biodiesel. Non-edible or crude oils offer great promise as biodiesel, and hence there is a need to grow high yielding non-edible oil seed crops.
- Vegetable oils are renewable in nature and can be produced locally and environmentally friendly as well. They have no sulfur content and have excellent lubrication properties. Moreover, trees yielding vegetable oils absorb carbon dioxide from the atmosphere during their photosynthesis. Vegetable oil plants that produce oils used for making biodiesel draw CO_2 from the atmosphere to build stems, leaves, seeds and roots.

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COMPARATIVE EVALUATION OF REPLACEMENT FOUNDRY SAND WITH MINERAL FINE AGGREGATES ON HMA PROPERTIES

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Abstract: In this study the influence of using waste foundry sand (WFS) as replacement for mineral fine aggregates on the Hot Mix Asphalt (HMA) properties is evaluated. An experimental program was conducted on the asphalt concrete samples prepared with 5% replacement of mineral fine aggregates. HMA samples, made of WFS and conventional mineral aggregate, were compared in terms of their Marshall Stability, Flow, Bulk Specific Gravity, Void in Mineral Aggregates and Voids Filled with bitumen in the total mixture properties. The results obtained from the experiments indicate that the replacement of WFS with mineral fine aggregate has a significant potential to use in bituminous hot mixtures.

Keywords: Foundry sand, HMA Properties

Introduction

One of the waste materials having that has a possibility to be used in road construction is waste foundry sand. For metal casting process to make molds and cores, uniform silica sand is used. Usability of foundry sands as an aggregate in road construction field gives the engineers the ability to construct better sustainable structures which is important to reduce their environmental pollution. Recently waste foundry sand has been used as a partial replacement for aggregate in bituminous asphalt mixture. Some states in USA have reported that the use of 8 to 25 % foundry sand is possible HMA to replace conventional aggregate (FHA 2004).

Use of waste foundry sand has a great potential in HMA for positive performance. Especially, the mixture stability, moisture resistance with waste foundry sand can be higher than HMA with conventional sand. In addition, some studies reported that foundry sand added samples demonstrated have increased rutting resistance (Delange et al 2001).

Foundry sands added HMA mixtures have good durability characteristics for weather affect. (Emery 1993). The same equipment and methods are used for foundry sand added HMA production. Regarding to HMA production at the plant, if the foundry sand has less than 5% moisture, it can be dispatch directly into a batch plants pug mill. Likewise, it can also dispatch through a recycled asphalt feed for drum plants where the foundry sand can be further dried, by the already heated conventional aggregates. Generally, foundry sand should be clean of thick coatings of burnt carbon, binders, and mold additives. It can be adhesion problem between the asphalt cement binder and the foundry sand. Clay clumps also can be removed by screening and/or washing. To remove iron and rubbish from the foundry sand, magnets and/or hand separation can be used (D'Allesandro et al 1990). At the drying process the presence of organic binder and bentonite materials can increase the time required. Also, this can increase the load on the hot mix plant dust collection system (Bradshaw et al. 2010).

The aim of this paper is to determine the general mechanistic characteristics of HMA that were made replacement foundry sand with mineral fine aggregates by measuring essential Marshall properties and by performing various laboratory tests. Marshall Stability, Flow, Bulk specific gravity (G_{mb}), Void in Mineral Aggregate (WMA) and Voids Filled with bitumen (VFA) were determined on the Marshall samples made with waste foundry sand and with conventional mineral aggregate added samples.

Materials and Methods

Mineral Aggregates

As a mineral aggregate a type of crushed dolomite was used for the coarse and fine aggregates for the asphalt concrete production. The crushed aggregates were produced in the Kayseri, Turkey. The quarry was made the aggregates in fractions 0/5, 5/9.5, 9.5/12.5 and 12.5/19.5 mm.

Waste Foundry Sand

The grain size of waste foundry sand has very uniform distribution. According to sieve analysis 88% percent of waste foundry sand that used in this study is in between #10 (2 mm) and # 200 (0.075 mm) sieve sizes. 11 percent of foundry sand is smaller than #200 sieve size. Particle shape of the foundry sand is typically sub angular to rounded. Foundry sand consists primarily of silica sand which has more than 80% silicon dioxide, coated with a thin film of burnt carbon and residual binder (Du et al 2002). Figure 1 shows a view of foundry sand used in this study.

Figure 1. A picture of waste foundry sand used in mixtures

Experimental Work

Marshall Test

Foundry sand passing through a #4 sieve were added 5% to mixture instead of mineral aggregates of the same size to evaluate the usability of foundry sand in the binder course of HMA. For each mixture were designed according to Turkish General Directorate of Highways (KTŞ 2016) and the Marshall Mix design (ASTM D 6927) was carried out. Asphalt mixtures with mineral aggregate and foundry sand were prepared with a 3.5, 4.0, 4.5, 5.0, 5.5 and 6.0 percent rate of bitumen content for each dry mixture. Then, the Marshall Stability and flow tests were conducted.

Asphalt mixes with waste foundry sand are designed using standard HMA design method. In this study 50/70 penetration grade asphalt were used with dolomite and foundry sand aggregates for the fabrication of asphalt concrete specimens. The asphalt cement binder was provided from TUPRAS Company in Turkey. The physical properties of the bitumen were determined and controlled according to ASTM standards. Asphalt cement that is used in this research has a penetration grade of 55 (0.1 mm at 25 °C, 100 g & 5 s) and 1.025 g/cm^3 specific gravity. The aggregate gradation for two mixtures was selected in accordance with the guidelines specified by the Turkish General Directorate of Highways, as can be observed from Fig. 2. The total weight of aggregate for the standard Marshall specimens was prepared at 1150 g. and 75 blows were applied on each side to compact the specimens.

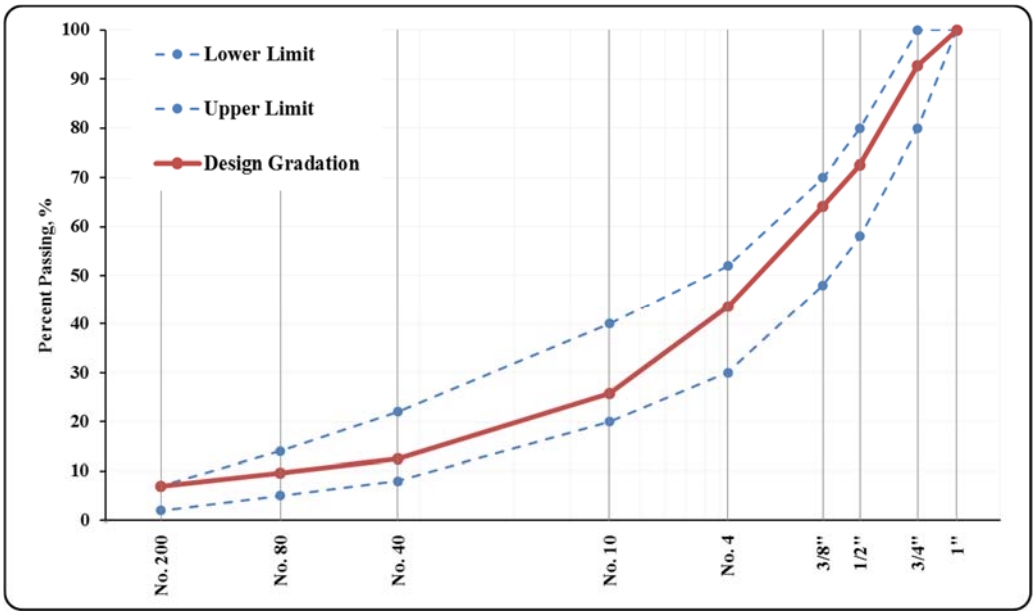

Figure 2. The aggregate gradation for the mixtures

Results

Marshall samples were compacted and tested by employing the asphalt cement content corresponding to maximum stability, maximum Gmb, median of designed limits of percentage air voids in the total mix and median of designed limits of percentage voids filled with bitumen in the total mix. In order to determine the optimum bitumen content for the mix design, the bitumen content corresponding to median of designed limits of percentage air voids is taken.

Fig. 3 shows the Marshall Stability and flow results of HMA made with foundry sand added and mineral aggregates. Structural strength of the compacted HMA determined by Marshall stability. Aggregate properties and gradations affect this strength in the first order with binder. When Fig. 3 is observed, it can be clearly seen that the asphalt concrete stability with foundry sand is higher than the samples which were produced with mineral aggregates at the optimum binder content. Also, the Marshall Stability values of each asphalt concrete sample passed the 750 kgf that is the minimum limit for Turkey roads. The flow value of asphalt concrete is important due the fact that it reflects the plasticity properties and asphalt mixtures flexibility under traffic loads. The Marshall samples corresponding to the deformation of the load are broken; this represents a measure of the flow and flow with the value of the internal friction. Flow has a linear inverse trend relationship with internal friction (Brawn E.R. et al. 2009). Fig 3. Shows the relationship between flow and bitumen content for all mixtures. The results showed that the specimen flow results of the foundry sand added samples are lower than the control samples. Asphalt concrete samples containing waste foundry sand yielded better stability and flow resistance performances.

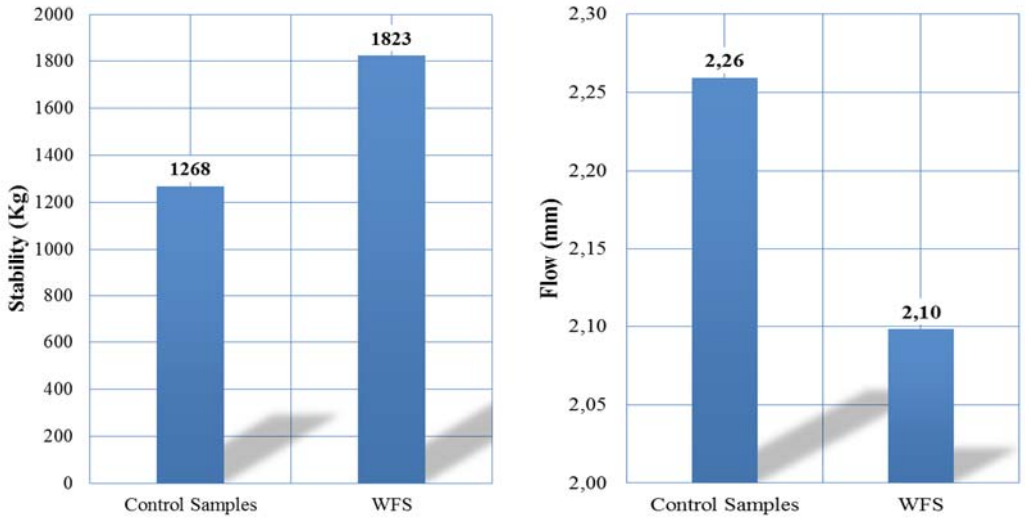

Figure 3. Marshall stability and flow values of asphalt samples at optimum binder content

Figure 4 shows the results of the optimum bitumen content, Gmb, VFA, and VMA of the specimens with foundry sand used and control mixtures. According to these results, it can be seen that the optimum bitumen content of WFS added samples is lower than the control samples. Also, bulk specific gravity increased with the WFS adding to mixture. Regarding to Vf and WMA, it also can be seen that they are slightly decreased with WFS added samples.

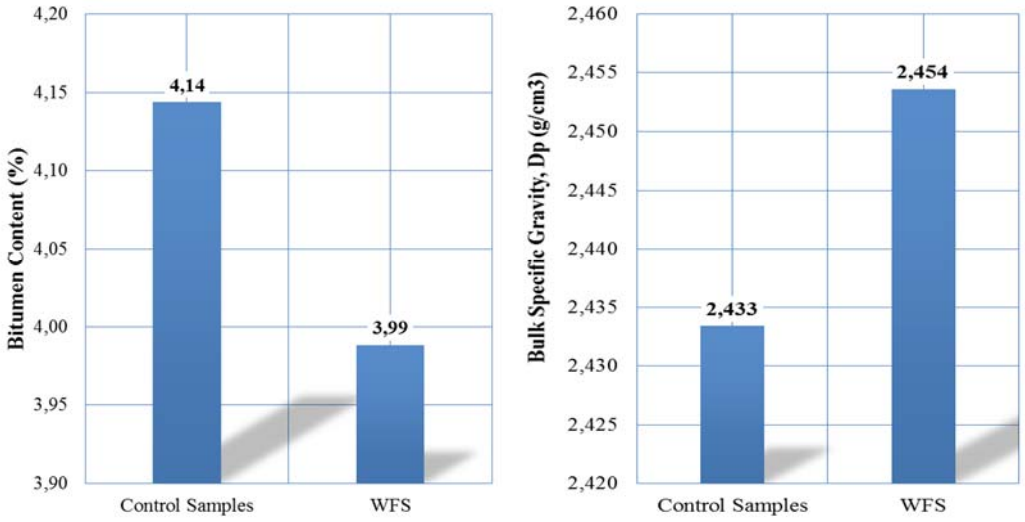

Figure 4a. Bitumen Content and Gmb results of the samples.

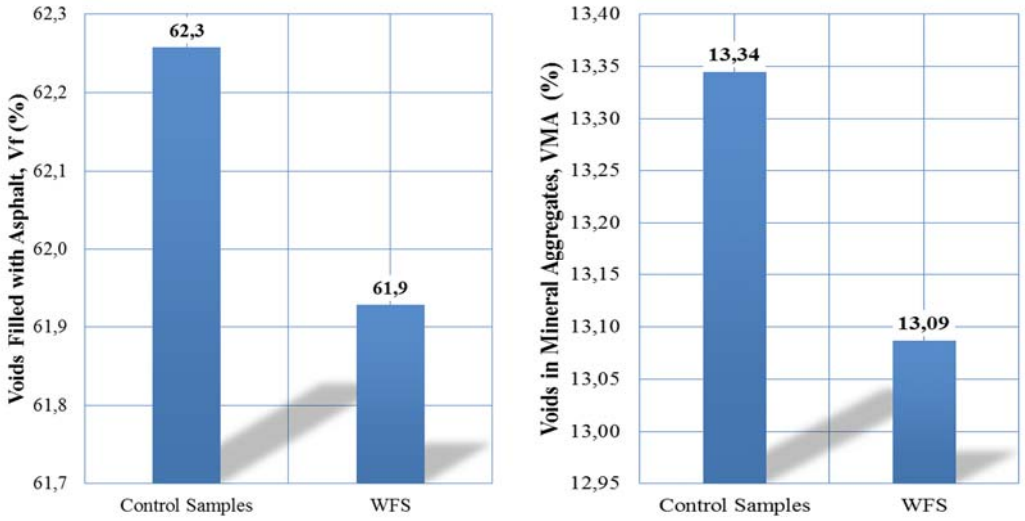

Figure 4b. Vf and VMA results of the samples.

Conclusions

This study aims to compare and evaluate the influence of using waste foundry sand as a replacement of mineral aggregate in HMA. At the laboratory Marshall tests performed to determine the characteristics of HMA with various bituminous rate. According to the results derived from the laboratory test data, these conclusions can be report: Marshall Stability values significantly increase with WFS addition in the mixture replace of mineral aggregate for optimum bitumen content. Both mixtures pass the Turkish Highway standard criterion (750 kgf) for binder course. Regarding to flow resistance of the samples, asphalt concrete samples containing WFS demonstrated better flow resistance than the control samples. Another important result of this study is optimum binder content decreased with the WFS adding. This study shows that there is high possibility to use waste foundry sand in HMA binder course. Performance tests such as rutting, creep test, dynamic modulus tests etc. would be very beneficial to understand successfully influence of this material in the mixture.

Acknowledgement

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COMPARATIVELY USE OF TIME SERIES AND ARTIFICIAL INTELLIGENCE METHODS IN THE PREDICTION OF AIR POLLUTANTS

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Abstract: Air pollution is a continuing environmental problem in many part of world which affects welfare adversely. Air pollution monitoring data can thus be used to forecast concentrations of air pollutants for short-term using time series and artificial intelligence approaches. In this paper, time series modelling techniques, auto regressive integrated moving average model and another type of it with exogenous variables (ARIMA and ARIMAX), and artificial neural networks (ANNs) have been comparatively used to model particulate air pollution (PM_{10}) for predicting one-hour ahead concentration of particles in the air. An hourly based data for the years 2015-2016 was composed with including meteorological factors and air particulate concentration. The models were structured with inputting external parameters to simulate air pollution better. ARIMAX(3,1,2) model with R^2 of 0.667 and ANN(5-13-1) model with R^2 of 0.857 produced reasonable predictions over hourly dataset. The best fitting model among these models have been chosen in further tests in the prediction of one-hour ahead PM_{10} concentrations.

Keywords: Air pollution, Time Series Methods, Artificial Neural Networks.

Introduction

Air pollution problem due to particulate matter (PM) is caused by a mixture of organic and inorganic particles which are solid and liquid phase spreading out from variable sources (WHO, 2006; Sfetsos and Vlachogiannis, 2010.) These particles with an aerodynamic diameter less than or equal to 10 µm, namely PM_{10}, arise in the atmosphere mainly from the fuel combustion (Aneja et al., 2001; Kampa, M. and Castanas, 2008; Vahlsing and Smith, 2012). The highest PM_{10} levels are associated to stable meteorological conditions with thermal inversion in urban and industrial areas. Epidemiological studies showed a close relationship between outdoor particulate matter concentration and increased mortality and morbidity (Shang et al., 2013; Pope and Dockery, 2006). High levels of these pollutants can be harmful for goods, and also decrease visibility. The air quality standards are thus set for PM_{10}, declaring hourly, daily and annual limits. According to EU standards for PM_{10}, the annual average limit value of 40 $\mu g.m^{-3}$ and 24-h limit value is declared as 50 $\mu g.m^{-3}$, and also the limit values should not be exceeded by the specified number of times in a year (EC, 2008).

Elevated levels of air pollutants in the air may cause acute or chronic health effects, and even cause premature deaths in the elderly people. The air quality forecasting studies is an important research topic in air pollution science for public health. Many functional alert systems were employed by utilizing statistical and hybrid models, to take precautions before and during air pollution episodes. In this scope, long-term or short-term air pollution forecasting models have been used as an aid for air quality management. Time series models, artificial neural networks (ANNs), multiple linear regression (MLR) and hybrid models are mostly preferred approaches in air quality forecasting researches (Schlink et al., 2003; Niska et al., 2004; Perez and Reyes, 2000). With nonlinear simulation and learning abilities, ANNs, are powerful tools for regression and pattern recognition problems. A real-life problem such as short-term air pollution prediction, covering complex nonlinear relations with meteorological factors, can be handled by ANN models very well. ANNs consist of neurons that are interrelated connections artificial processing units and they can process information by error minimization within a finite computation loop. ANNs can thus be trained to learn a complex relationship between two or more variables recorded in training datasets. Among the available ANNs, the feedforward error backpropagation neural networks are the most employed ANN types, of which inputs has a nonlinear transfer function. By this means, they have been used in many successful studies in local air pollution modelling for forecasting pollutants NO_2, O_3, SO_2, CO and PM_{10} (Kukkonen et al., 2003; Kurt et al. 2008).

Time series modeling approaches for short-term air pollution prediction phenomena are also employed, of which results are comparable to other artificial intelligence methods. They mostly applied on continues time series datasets. These datasets include some degree of randomness, for example, random changes in meteorological parameters due to atmospheric events during diurnal changes and seasonal variations. Some studies have revealed that the air quality data are stochastic time series by making short-term estimations possible by exploring historical data patterns (Kao and Huang, 2000; Horowitz and Barakat, 1979). The most widely employed time series models (TSMs) are the non-seasonal and seasonal autoregressive integrated moving average and a type of them with external parameter models (e.g. ARMA, ARIMA, ARIMAX) in time series analysis (Goyal et al., 2006; Kumar and Goyal, 2011). In the case of conventional air pollutants non-seasonal and seasonal time series models have been successfully applied to monitored datasets that are based on mostly daily or monthly averaged values (Modarres and Dehkordi, 2005, Jian et al., 2012). Generally, the quality of models can vary on individual experience of issue, knowledge of time series analysis methods in the model identification stage. The visualization of time series forecasting plots leads to establish several models for the same dataset and most stable one can used in tests further.

In the present study, an air pollutant, PM_{10}, one-hour ahead concentration prediction of PM_{10} using ARIMA, ARIMAX and ANN based models were studied for the period of 2015-2016. Well-tuned models were then applied in short-term predictions of PM_{10} to determine a model best explains the variance in data with reduced inputs.

Materials and Methods

2.1 Data with explanatory statistics

An hourly dataset for Düzce province in Turkey was composed containing information about local meteorological parameters such as air temperature (AT, °C), wind direction (WD), wind speed (WS, m/s), relative humidity (RH, %) and mass concentration of particulate matter (PM_{10}, $\mu g/m^3$) for the period of 2015-2016. The meteorological data was taken from the General Directorate of Meteorological Affairs of Turkey and PM_{10} data was taken from the Ministry of Environment and Urban Planning, using the online web service of the National Air Quality Monitoring Network of Turkey. Table 1 shows the descriptive statistics of these variables and Fig. 1 visualizes an hourly time series plot for PM_{10} over air temperature.

Table 1: Descriptive statistics of hourly dataset (2015-2016) used for investigation.

	Valid (N)	Min.	Max.	Mean	Median	Mode	Freq. of Mode	25% Perc.	75% Perc.	Range	Std.Dev.
PM_{10}	8782	98.41	60.00	37	121	0.00	891	39	104	891	112.81
AT	8926	16.02	17.00	22	383	-13.00	42	8	23	55	9.82
WD	8926	192.29	201.00	182	71	0.00	359	123	268	359	92.79
WS	8926	0.62	1.00	1	5568	0.00	1	0	1	1	0.48
RH	8926	79.95	88.00	103	1563	12.00	103	63	100	91	22.78

In the hourly dataset, one step forward-lagged set of these variables were constructed for including the prior data from one-hour before. The peak levels of PM_{10} can be seen during winter due to residential heating by fossil fuels such as coal, lignite and wood, particularly at least five months from October to March in contrast to the levels observed during the summer periods. PM_{10} and temperature values were ranged in [0-891] $\mu g/m^3$ and [–13-42] ^0C, respectively. The mean and 75% percentile of PM_{10} level were 98.41±112.81 and 104 $\mu g/m^3$, respectively, however, which is higher than the acceptable limit of 90 $\mu g/m^3$ declared in National Air Quality Standard of Turkey. The statistics showed that the atmosphere over Düzce is highly polluted by particulate matter and the pollution episodes particularly during winter periods can affect human health adversely. Therefore, air pollution forecasting models can serve a tool in identifying emergency periods and short-term pollutant levels.

2.2. Modeling by Time Series Methods and ANNs

By analyzing patterns in historical data, such as trend, seasonality and noise, one can construct regressive models for predicting future data points. TSMs in forecasting are constructed based on historical data pattern in the series. Widely used kinds of TSMs are AR, ARMA, ARIMA, etc. and their multivariate forms such as ARMAX and ARIMAX (Taşpınar et al., 2013; Ibrahim et al., 2009; Suganthi and Samuel, 2012).

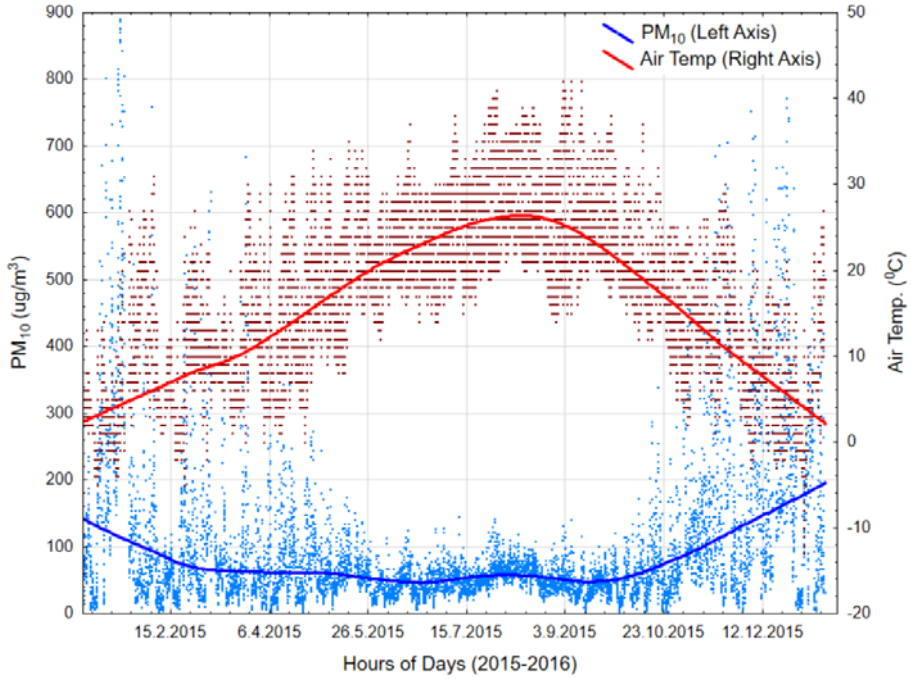

Figure 1. Hourly time series plots of PM_{10} and air temperature for 2015-2016 period.

In order to model one-hour ahead PM_{10} level, ARIMA and ARIMAX models with meteorological factors (AT, WS, WD, RH) were applied on hourly dataset. Based on these variables, the models ARIMA(p,d,q) and ARIMA[X](p,d,q) were examined. The non-negative integer elements p, d and q used in the non-seasonal models refer to the order of autoregressive part (AR(p)) and the order of differencing (I(d)) and moving average (MA(q)) parts of the models, and X refers to exogenous variables such as AT or WS used in this study, respectively. In the construction of models, the order of the model is selected by plotting the autocorrelation function (ACF) for determining the value of q used in MA(q) model and partial autocorrelation function (PACF) for determining the value of p used in AR(p) model. ARIMA model with a single variable and ARIMAX model with multi input-variable can be represented by the following equations, respectively:

$$\hat{y}_t = \mu + \phi_1 y_{t-1} + \ldots + \phi_p y_{t-p} - \theta_1 e_{t-1} - \ldots - \theta_q e_{t-q} \quad (1)$$

$$\hat{y}_t = \beta_0 + \beta_1 X_{1,t} + \beta_2 X_{2,t} + \ldots + \beta_k X_{k,t} + \frac{(1 - \theta_1 B - \theta_2 B^2 - \ldots - \theta_q B^q)}{(1 - \varphi_1 B - \varphi_2 B^2 - \ldots - \varphi_p B^p)} \varepsilon_t \quad (2)$$

where y_t is the t-th observation of the dependent variable, $X_{1,t}$, $X_{2,t}$, …, $X_{k,t}$ are the corresponding observations of the explanatory variables, β_0 is a constant, β_1, β_2, .. , β_k are the parameters of the regression part, and B is the backshift operator ($By_t = y_{t-1}$, $B^2y_t = y_{t-2}$), ε_t is error residuals ($\sim N(0,\sigma^2)$), $\varnothing_1$, $\varnothing_2$, …, $\varnothing_p$, and θ_1, θ_2,..., θ_q are the weights for the non-seasonal autoregressive and moving average terms, respectively. In order to test the lack of fit of time series models, the Ljung-Box test was applied in model diagnostic and the most suitable model was selected according to normalized Bayesian information criteria (NBIC) (Salcedo et al., 1999; Ljung and Box, 1978).

The artificial neural networks are adaptive nonlinear systems capable to approximate any function. ANNs are used in regression and classification studies in general, in which the inspired model that does not have a clear relationship between its inputs and outputs (Rumelhart et al., 1986). ANNs are built on a network of simple processing elements, namely neurons, that exhibit complex global behavior determined by the connections between the processing elements and element parameters. Generally, ANNs are made up of a number of layers with neurons. The ANN neurons are located in input, hidden and output layers, which is thus called as multi-layer perceptron (MLP) ANN in general (Fig. 2).

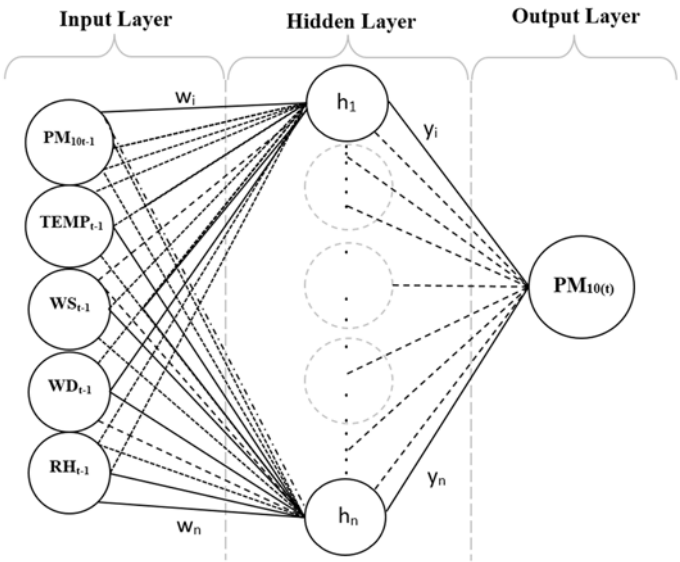

Figure 2. General structure and inputs of ANN model used in hourly PM_{10} modeling

The first layer corresponds to the input variables to the problem with one node for each input variable. The second layer used to capture nonlinear relationships among variables by interconnections. The third layer provides the predicted values. All weights are usually initialized with random values drawn from a standard normal distribution. During an iterative training process, ANN calculates an output o(x) for given inputs and current weights. If the training process is not yet completed, the predicted output (o) will differ from the input (y). An error function, like the root mean squared error (RMSE) which measures the difference between predicted and observed output. Finally, the process stops if a pre-specified criterion is fulfilled such as checking early stopping conditions by calculating global error. A single neuron processes multiple inputs applying an activation function on a linear combination of the inputs as follows:

$$y_i = f\left(\sum_{q=1}^{l} w_{iq} . f\left(\sum_{j=1}^{m} (v_{qj} x_i + b_j)\right) + b_q\right) \tag{3}$$

where x_j is the set of inputs, w_{iq} and v_{qj} ate the synaptic weights connecting the q_{th} input to the j_{th} neuron, b is bias term, f is the activation or transfer function, and y_i is the output of the i_{th} neuron. Weights are the knowledge base of the ANN system, which represents the non-linear properties of the neuron by its activation function. The activation function is usually non-linear, with a sigmoid shape such as logistic or hyperbolic tangent function, respectively, as follows:

$$sig(x) = \frac{1}{1+e^{-X}} \tag{4}$$

$$tanh(x) = \frac{1-e^{-2X}}{1+e^{-2X}} \tag{5}$$

Generally, feedforward MLP networks are trained using error back propagation (BP) algorithm (Lahmiri, 2011), which covers heuristic and numerical optimization algorithms. Heuristic techniques include gradient descent and the resilient algorithm (Dong and Zhou, 2008). So, some parameters such as learning rate, learning momentum, hidden layer neuron count etc. have been determined before training stage and then ANN model should be constructed. The inputs to the ANN models also have to be selected appropriately to better simulate the problem under consideration. Later, these parameters were determined by testing several ANN models on the same dataset.

2.3. Data feature extraction and pre-processing

Time series dataset covering the variables PM_{10}, AT, WD, WS and RH were pre-processed prior to use in the models. Firstly, it's applied to a list-wise local linear regression to fill the missing values up to six cells by columns, but, the bigger missing areas were remained. Thus, the average valid data was about 91% of the entire dataset. When inputting to ANN models, the blank inputs can be skipped, however, TSMs need fully-filled input data. Hence, to execute TSMs on entire dataset, all the blank cells after missing value analysis were filled by the mean of the actual variable. The parameter WD is also converted to wind direction index (WDI) to avoid the discontinuity according to the following expression:

$$WDI = 1 + \sin\left(\mathrm{WD} + \frac{\pi}{4}\right) \tag{6}$$

In order to make input variables intercomparable before executing on the modelling framework, the variables were normalized in the range of 0.05-0.95 using min-max normalization given in Eq. (7) as follows:

$$y' = 0.05 + \frac{(y - y_{\min})}{(y_{\max} - y_{\min})} * 0.95 \tag{7}$$

where y' is the normalized value, y_{min} is minimum value, y_{max} is maximum value and y is the actual value.

Results and Discussion

Time Series Models and Performance Evaluation

Time series model for predicting one-hour ahead PM_{10} level is somewhat difficult comparing to ANN models. Because, tested TSMs are all hourly based which is difficult to handle in determining input lags of external variables. In fact, this problem is valid for ANN models, however, training an ANN model is much more fast and easy over a huge dataset like this.

In order to construct TSMs using ARIMA and ARIMAX methods, firstly ACF and PACF graphs were plotted for at least twenty lags of PM_{10} data. These plots were shown in Fig. 3. ARIMA model that is based on only PM_{10} data is firstly constructed. Since, the data used is based on hourly values, the periodicity is set to 24 in this case.

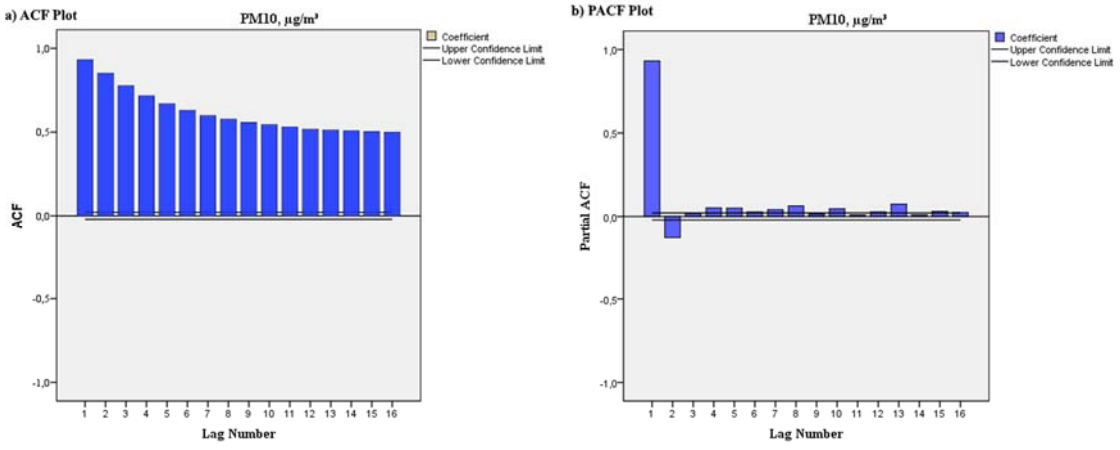

Figure 3. a) ACF and b) PACF plots for hourly PM_{10} data.

In ACF plot given in Fig. 3(a) an exponential decay with many lags over indicates moving average part in the data. PACF plot shows a significant lag at first which is an indication of AR process. Furthermore, the data is nonstationary considering high order lags in ACF plot. Thus, a non-seasonal differencing can be applied, setting parameter d to 1. So, ACF and PCAF plots for one lag non-seasonal differenced data was given in Fig. 4.

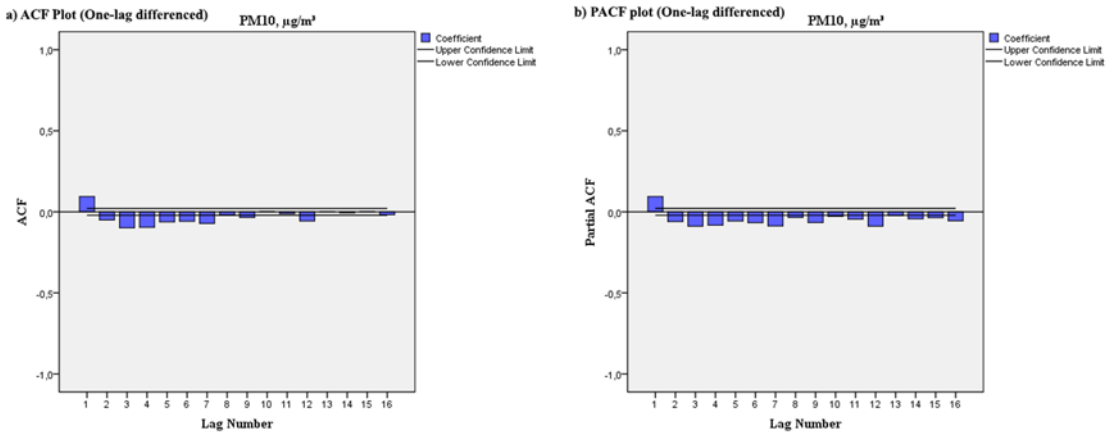

Figure 4. a) ACF and b) PACF plots for one-lag differenced hourly PM_{10} data.

One-lag differenced data shows a stationary character with time. Thus ARIMA model should include I(1) term. However, the degree of AR(p) and MA(q) processes are difficult to determine as periodicity is set to 24, which means many lags may be involved in the models. Here, although ACF plot promotes a clear MA(1) process and PACF plot promotes an AR(1) process at first sight, such ARIMA(1,1,1) model, other significant but negative lags were present in both levels at higher lags. ACF plot shows some significant lags up to 12 lag and then a sharp cut-off is observed. Therefore, we employed some models varying p and q between 1 to 3 to identify the best model without unit roots, comparing their NBIC values. Table 2 shows the models tried and related model performance statistics. Consequently, a trial-and-error work changing these model parameters was resulted in determining ARIMA(3, 1, 2) model including both AR(3) and MA(2) process with the lowest NBIC of 6.607 and R^2 of 0.663. AR lags from 1 to 3 was significant whereas MA lag at level 2 as significant. The parameter estimates of ARIMA(3,1,2) models was tabulated in Table 3 and arranged model equation was then given in Eq. (8).

Table 2: Identified ARIMA models in the prediction of hourly PM_{10} levels and model statistics

Model	NBIC	Stationary-R^2	Significant Lags (at p<0.05)
ARIMA(1,1,1)	0.791	0.549	AR(1), MA(1)
ARIMA(1,1,2)	0.698	0.561	AR(1), MA(1)
ARIMA(2,1,1)	0.692	0.602	AR(1,2), MA(1)
ARIMA(2,1,2)	0.702	0.597	AR(1,2), MA(1)
ARIMA(3,1,1)	0.675	0.653	AR(1,2,3), MA(1)
ARIMA(3,1,2)	*0.607*	*0.663*	AR(1,2,3), MA(2)
ARIMA(3,1,3)	0.670	0.658	AR(1,2,3), MA(2)

Table 3: Parameter estimates of ARIMA(3,1,2) model.

Model Partitions		Parameter Estimate	SE	t	Significance (at p<0.01)
AR	Lag 1	0.218	0.010	21.289	0.000
	Lag 2	0.845	0.005	158.374	0.000
	Lag 3	-0.364	0.010	-35.627	0.000
Differencing Order		1			
MA	Lag 2	0.996	0.002	635.015	0.000

$$PM10_t = 1.218 \cdot PM10_{t-1} - 1.063 \cdot PM10_{t-2} - 0.481 \cdot PM10_{t-3} + 0.364 \cdot PM10_{t-4} + (1 + 0.996.B)\varepsilon_t \quad (8)$$

Estimates of ARIMA(3,1,2) model with upper and lower confidence limits against to original data as time series plot were given in Fig. 5, which shows that estimated points fitted the historical PM_{10}pattern very well. Also, based on this univariate ARIMA(3,1,2) model, an ARIMAX model with the inputs from AT, WS, WD and RH were constructed. These meteorological factors affect PM_{10} level in air in real-life, so this situation can be simulated by an ARIMAX model. ARIMAX models are constructed by transfer functions by calculating weights of external variables. After parameter estimation a model equation can be arranged based on significant lags of variables.

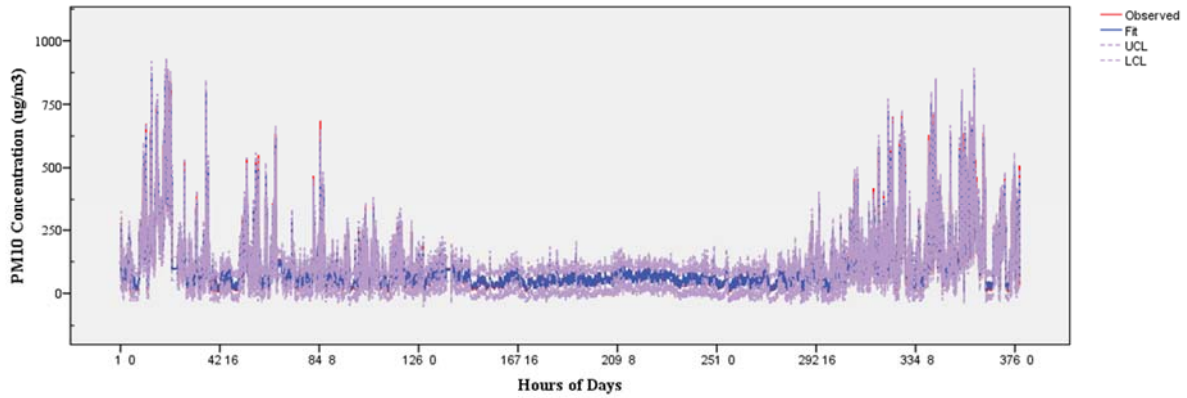

Figure 5. Line plot of the estimates of ARIMA(3,1,2) model with confidence limits against to observed data.

Based on the parameter estimates for ARIMAX(3,1,2) model including the terms from meteorological factors with R^2 of 0.667 and NBIC of 6.607, arranged ARIMAX model equation is given in Eq. (9) as follows:

$$PM10_t = 1.218 \cdot PM10_{t-1} - 1.063 \cdot PM10_{t-2} - 0.481 \cdot PM10_{t-3} + 0.364 \cdot PM10_{t-4} + (1 + 0.996.B) \cdot \varepsilon_t + (AT_t - 0.768 \cdot AT_{t-1}) + (WDI_t - 0.008 \cdot WDI_{t-1}) + ((1 + 9.021 \cdot WS_t) / (1 - 1.193 \cdot WS_{t-1} - 0.552 \cdot WS_{t-2})) + (RH_t - 0.463 \cdot RH_{t-1} - 0.484 \cdot RH_{t-4}) \quad (9)$$

Parameters estimates of ARIMAX model showed that $PM_{10(t)}$ was predicted by using AT at lags 0-1, WDI at lags 0-1, WS at lags 0-2 and RH at lags 0,1,4. Performance of ARIMA and ARIMAX models for one-hour ahead PM10 concentration prediction is very similar, comparing R^2 values. Thus, we selected PM_{10} ARIMAX model with external parameters from meteorological factors as benchmark for further tests.

ANN Models and Performance Evaluation

Designing of ANN models are related to selection of some parameters such as hidden layer neuron count and learning rate. Before construction of ANN model, the entire dataset is divided into training (75%), test (15%) and validation sets (10%). Later, ANN models were designated and model parameters were set. In the present study, an open source library, Fast Artificial Neural Network (*FANN*) implemented by Nissen (2003), was utilized as ANN modeling engine in the prediction of one-hour ahead PM_{10} concentration with lagged input vectors. The input vector includes the first lags of all model inputs as shown in Fig. 2, which can be written as $PM10_t = f_{net}\ (PM10_{t-1},\ AT_{t-1},\ WD_{t-1},\ WS_{t-1},\ RH_{t-1})$ model. The *FANN* library offers an automated training method, so-called cascading-training procedure, which provides a way to determine the final neural network structure consists of a number of hidden layers with one shortcut connected neuron in each. Therefore, the ANN model were set by utilizing cascading-training technique of this library.

Feed forward backpropagation type ANN with sigmoid function for transfer functions of input layer and tanh for hidden layer were then determined in training of networks. Maximum number of epochs was set to 1000, applying an early stopping criterion to avoid over fitting or underfitting, setting the validation process at every 10 training epochs. A starting learning rate of 0.45 was gradually decreased by 1.1% at every epoch during the cascading-training procedure, which was resulted in an ANN(5-13-1) model, including 13 hidden layer neuron. Several experiments with different structures were tried as mentioned here, however, ANN(5-13-1) model produced the best error measure and model accuracy with RMSE of 0.478, training R^2 of 0.857 and testing R^2 of 0.841. Also, Index-of-Agreement (IA) that measures prediction errors was calculated to test the quality of fit. IA value of 0.81 obtained with this model, which is close to 1.0, suggested a well agreement with the selected model. Thus, the validation of ANN model did not tend to underfitting or overfitting on average. A performance plot obtained from predicted values from ANN model was visualized in Fig. 6. The performance plot of the results of the best ANN model for the whole dataset is visualized on Fig. 3. The red line indicates an exact fit of R^2=1.0, hashed black line indicates a linear fitting line of R^2=0.857. 95% confidence band limits were also shown in blue-dotted lines, clearly indicating the most of the data points fall in the band limits.

Hourly time series dataset was plotted against to predictions of ANN(5-13-1) model in Fig. 7. All the data is well followed by ANN model, simulating historical pattern of hourly PM_{10} concentration. As it can be seen in Fig. 7 that at some extreme conditions with elevated PM_{10} levels, particularly the levels higher than 550 µg/m^3 observed

during strictly calm days. Due to air circulation issues occurred in Duzce province in calm nights during winter periods, extreme conditions can be observed. Therefore, elevated PM_{10} levels mostly occurred winter times with a rate of 2% for levels higher than 500 $\mu g/m^3$. However, most frequent PM_{10} values within a range of $\mu \pm 3\sigma$ were predicted reasonably successfully. Extreme value problem for ANN model is a well-known issue, because neural networks cannot successfully evaluate less trained input values or less frequent data observed at extreme conditions. However, all the ANN models experimented in the tests were very successful in the predictions comparing to TSMs.

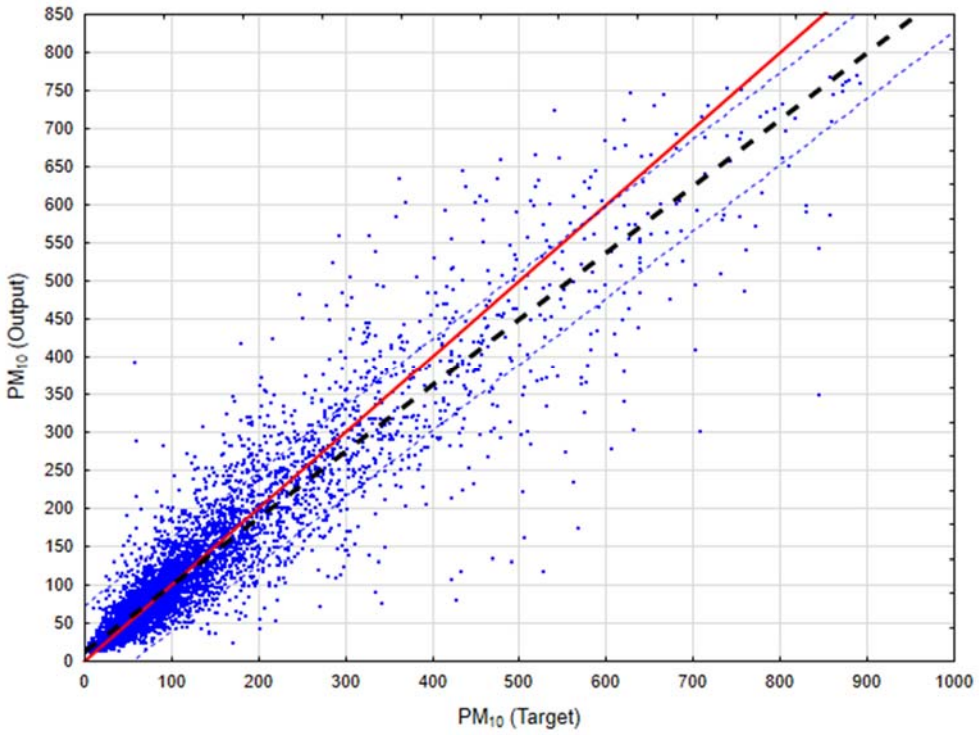

Figure 6. Performance plot for ANN(5-13-1) model and linear fitting line

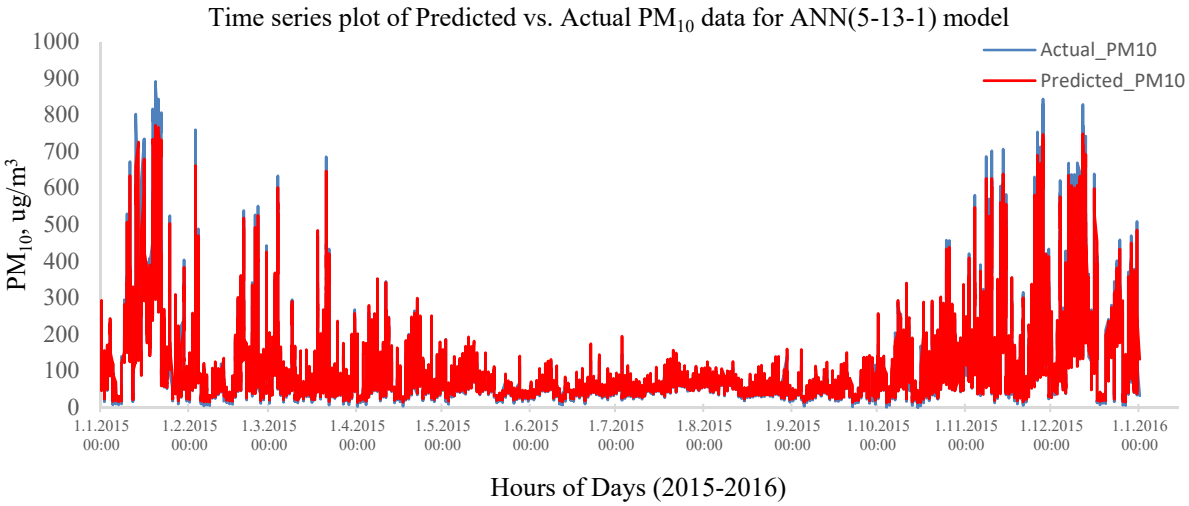

Figure 7. Hourly time series plots for the predictions of the ANN model against to actual data

Conclusion

The present study investigated short-term PM_{10} modelling based on hourly monitoring data of meteorological factors and particle concentrations. In order to obtained a reasonable model for time series data, we have used time series modeling techniques and ANN models. ARIMA and ARIMAX models were applied to data as TSMs. A univariate ARIMA(3,1,2) model were fitted to predicted hourly PM_{10} level one-hour ahead. This model included

AR(3) and MA(2) processes with one lag differentiation, with R2 of 0.663. Based on this model, a multivariate ARIMAX(3,1,2) model fitted by covering the terms from $PM_{10(t-1...t-4)}$, $AT_{(t..t-1)}$, $WDI_{(t..t-1)}$, $WS_{(t..t-2)}$ and $RH_{(t,t-1,t-4)}$ with R^2 of 0.667. Therefore, ARIMAX model is selected as benchmark to compare predictions by ANN model.

ANN models for prediction next-hour PM_{10} level were designed. The best ANN model is in the form of 5-13-1 with 13 hidden neuron in middle layer, with testing R^2 of 0.857. The input vector of ANN was $PM10_{t-1}$, AT_{t-1}, WD_{t-1}, WS_{t-1}, RH_{t-1} and the output was $PM10_t$. Cascading-learning method of FANN library was utilized to determine ANN model parameters such as neuron count and learning rate. ANN model is slightly tended to underpredict mostly at extreme conditions but yielded better prediction results than TSMs in general. On the other hand, ANN model did not tend to overpredict as time series plots indicated. Comparing to TSMs, ANN models were very flexible in handling of model and execution, because TSMs need to be updated with new model residuals before operating on new input data in any new hour. Hence, TSMs are not tolerate any interruption on time scale as they were constructed on sequenced residual data, so their handling in real-life applications are difficult. On the other hand, ANN models obtained after training step can be used on any data with proper input vector. Therefore, we concluded that a real-life application of emergency perception strategy can be designed based on ANN models for hourly PM_{10} prediction. However, to properly tackle with extreme values of air PM_{10} levels observed during pollution episodes in winter periods in particular, some other methods such as time based hybrid models or discrete ANN models for higher levels should be considered.

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DESIGNING AND IMPLEMENTATION OF OUTDOOR TRANSFORMER SECURITY SYSTEM

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Abstract: In agriculture, quality and high productivity depend on irrigation of crops in dry months. Pressurized irrigation methods are preferred due to both natural water resources more efficiently as well as better quality agricultural production. This situation brings with it the demand for electricity at irrigation. For this reason, the farmers are in need of transformers supplied with their own resources owned or state. During unirrigated winter months, states cut the energy of electrical transformers to eliminate or minimize energy losses occurred in transmission lines. However, this condition has created serious problems in the transformer security. In the previous studies, it is seen that many products have used GSM / GPRS communications technology taken their energy from network or solar panels connected to transformer. But, common feature of these products is a system that triggered by latching of lid in the protection provided region and then generating alarm. In this study, it is focused on the designing of security system triggered in the case of unauthorized persons to start approaching or leaving the transformer pole and this is the only possible by using system integrated outdoor PIR (Passive Infrared Sensor) sensors. In addition, developed Transformer Security System (TSS) uses both GPRS and MMS infrastructure. In sleep mode, TSS register the GPRS network in 4 seconds by receiving from the Passive Infrared Detector (PIR) and taking 5 seconds during video recording with audio and visual stimuli. After then, with alarm status information and image recording is transferred to the central monitoring software. As a result, security in the field of medium voltage electrical transformer is provided by using M2M technology and the continuity of the structure of interconnected power lines are protected.

Keywords: Agricultural Irrigation, Electric Transformer, M2M, GSM/TCIP

Introduction

Agriculture is among the most important source of income for many countries in the world are located in the first row. In agriculture, the quality and high yield depends on irrigated crop in arid last month (Schultz, 1964). In agricultural irrigation systems, pressure irrigation methods are preferred due to both more efficiently in natural water using and more quality in agricultural production (Nakayama, 1991). This situation brings with it the demand for electricity for irrigation. For this reason, the farmers are in need of transformers supplied with their own resources owned or state. During unirrigated winter months, states cut the energy of electrical transformers to eliminate or minimize energy losses occurred in transmission lines (Patterson, 1996). This situation is created serious security holes in the transformers. In addition, harm is not just to stay with stolen material, but also it leads to an explosion of the transformer when it is energized (Bisak, 1991). Considering the studies conducted on the subject, short message services provided by the GSM operators are used in the study for remote monitoring of transformer substations to security purposes (Bekiroglu, 2009).The general characteristics of security system using GSM/GPRS communication are products taking their energy from connected to the network or solar panels and it works with the snapping of a cover in the provided protection region (Korkmaz, 2007). Eventually, in the case of attempt to steal the system becomes active and provides notification center or person. But if the transformer is reached the system is disabled by cutting the cables connected to latch. The limited capabilities of existing solutions and not respond to the needs required different solution approaches. In this study, it is focused on the design and implementation of a system triggered in case of the approach to non-authorized persons transformer pole and start out directly. This is the only possible by using system integrated outdoor PIR (Passive Infrared Sensor) sensors. Developed transformer Security System (TSS) uses both GPRS and MMS infrastructure. The purpose of this study is to provide the ensuring security in the field of medium voltage electrical transformer using M2M technology (Wu, 2011) for agricultural purposes and protecting the sustainability of the interconnected structure in power lines.

Materials and Methods

Passive Infrared Sensor (PIR) Sensor

Passive Infrared Sensor (PIR) is a kind of sensor can detect infrared radiation depending on the body temperature and translated into an electrical signal with the helping of lens. Physically, all objects having a temperature greater than absolute zero point (-273 centigrade degree) radiate energy according to their temperature. These rays moves strongly up to a certain distance and when entered the sensor's detection distance these emissions are converted into an electrical signal detecting by pyrocell (Hong, 2013). These sensors (general operating principle is shown in Figure 1) are categorized as two main groups; open and indoor area motion sensors. The indoor motion sensor has less sensitivity, detection angle and distance according the outdoor motion sensors. Outdoor motion sensors are commonly used in military border security system, fire alarm / warning systems and open area security systems. Considering the usage areas, it is appears to be important because of their properties such as the sensitivity of detection distance, animal distinguish and energy consumption. The sensing distance and operational stability of PIR sensors depend on the geometric shape of used Fresnel lens, focus distance between the lens and IR filter, the quality of IR filter, pyroelectric material and the stability of the amplifier and comparator circuit. The stability and distance of sensor is provided by the distance and placement angle between the Fresnel lens and pyroelectric sensor is adjusted in accordance with lens law.

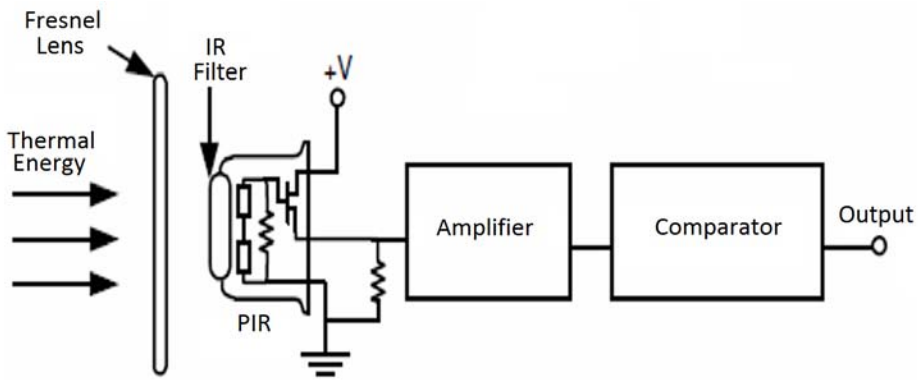

Figure 1. Operational principle of PIR Sensor

Transformer Security System

In the transformer security system (Figure 2), non-authorized persons input to the transformer pole when PIR sensor generates a warning sign. With taken this signal, video or photo of environment is taken and stored in external memory unit. Thanks to the communication unit on the system, the information is transmitted to main server locating in the monitoring center by establishing TCP/IP links over the GPRS/GSM line. The work integrity of the electrical transformer is checked using central monitoring unit or mobile devices by police and private security firms with individual users.

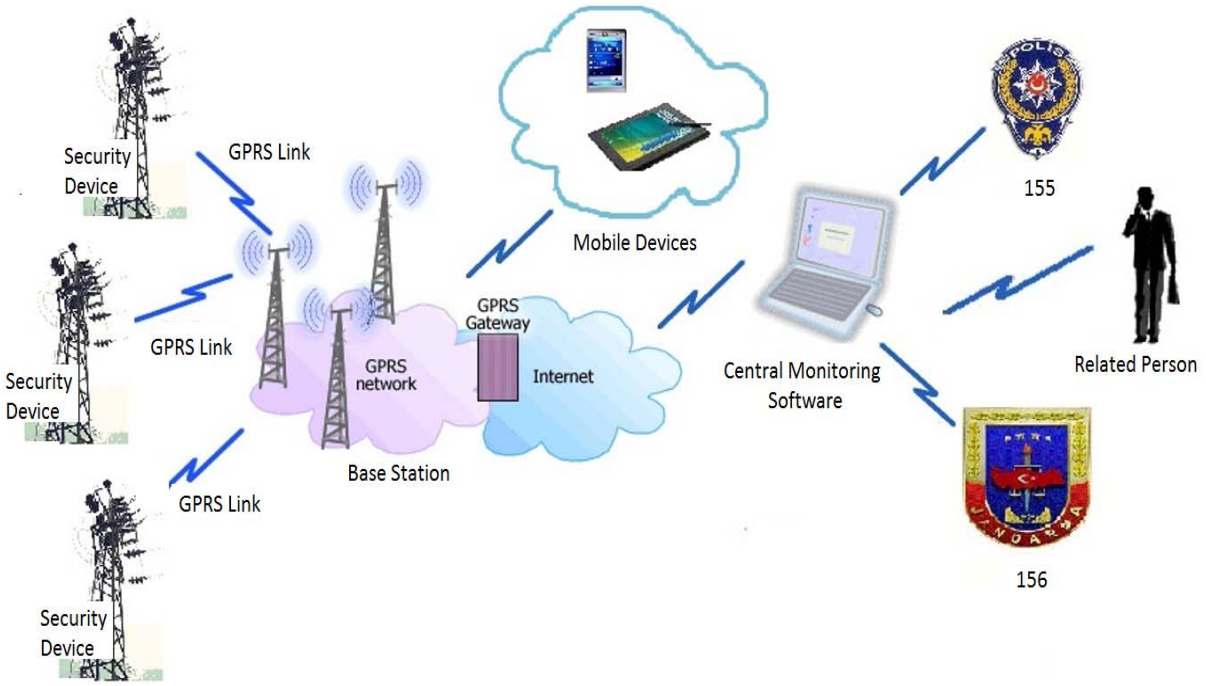

Figure 2. Transformer Security System

The working principle of Transformer Security System

The flow diagram of microcontroller software of TSS software is shown in Figure 3. After energizing the device, all elements included in the motion sensor and communication units are activated. Using GPS system device transmits information to monitoring center by taking information of coordinates and so ready for use. When alarm signal is came from the PIR sensor, videos / photos of environment are taken by activating IR illumination. The captured video or photo is stored in the external/internal memory unit. Then taken alarm information and video or photo is transmitted to server over the GSM/GPRS transmission line by connecting TCP/IP connection. When data transmission is performed successfully, the check information send by server is received and do not sent back. If data transmission is not performed successfully the error information is sent to the device by server. The device taken error information repeats transmission processing three times until it completes successfully. Alarm information received by successful software is displayed on the map in accordance with the coordinates of device. Alarm sending device can be controlled by an operator controlling system in the monitoring unit. In this control, it can be activated or passive by checking lighting on the device, audio devices or any mechanisms that can be added later. Alarm sending device without active or becomes inactive is also passed to state to produce a new alarm whether sleep mode taken out of event of alarm. As soon as the alarm generated by device is transmitted to center, if the connection has trouble for any reason, alarm information is stored in internal/external memory unit. When the device can also connect with the center, it transmits stored alarm information to center and a defined GSM number as MMS message.

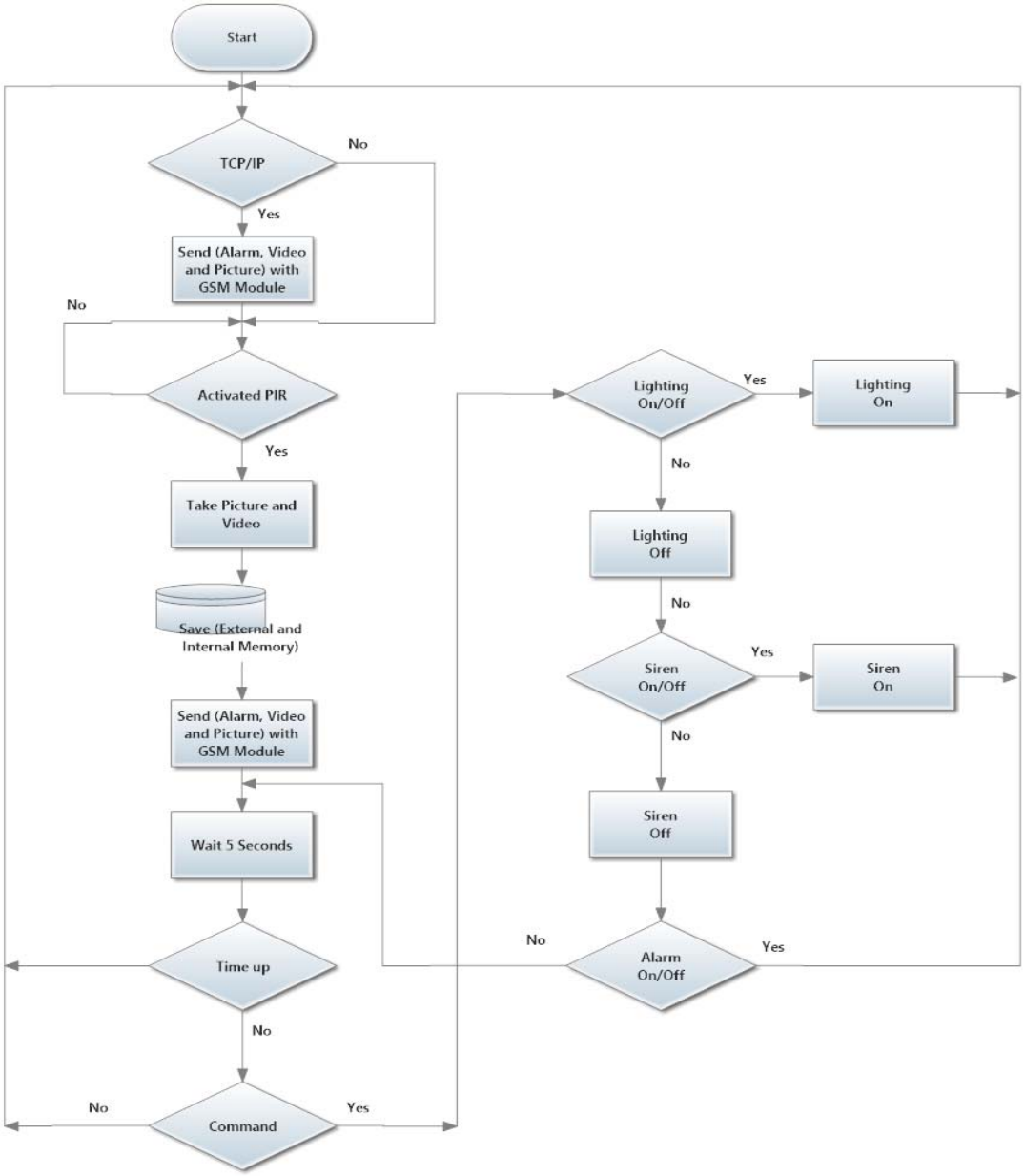

Figure 3. Flow diagram of system.

Results and Discussion

The features and hardware of designed outdoor security system are shown Figure 4. The device can be positioned in one or more points, produced alarm/warning and alerts with the helping of battery, taken photos or videos of environment and it is ready to communicate to introduced or will be introduced GSM number obtained all information via MMS. After energizing device, all elements on device are activated. After performing the task, device goes into sleep mode until the next warning sign. In this way, the device can be operated continuously for 3 years without being connected to any source of energy.

Technical Specifications

- IP65 Protection
- 25 Meters Sensing Distance
- Sensitivity to 40kg and Over Bodies
- GSM / GPRS / GPS Communication Unit
- 3.3V_{DC} - 4.1V_{DC} Operating Range
- Sleep Mode
- Audible Warning
- Projector
- Night Vision Lighting
- External MMC Memory

Figure 4. Outdoor Security System

The interface of central monitoring software monitored devices from hardware is shown in Figure 5. At the point where the device is located when its position is changed or theft, notification is given to individual users and central monitoring instantaneously and this notification has taken coordinates at the certain time intervals and moving device information 7/24 monitoring of electrical transformer is provided with the monitoring software within the visual and audio stimuli .

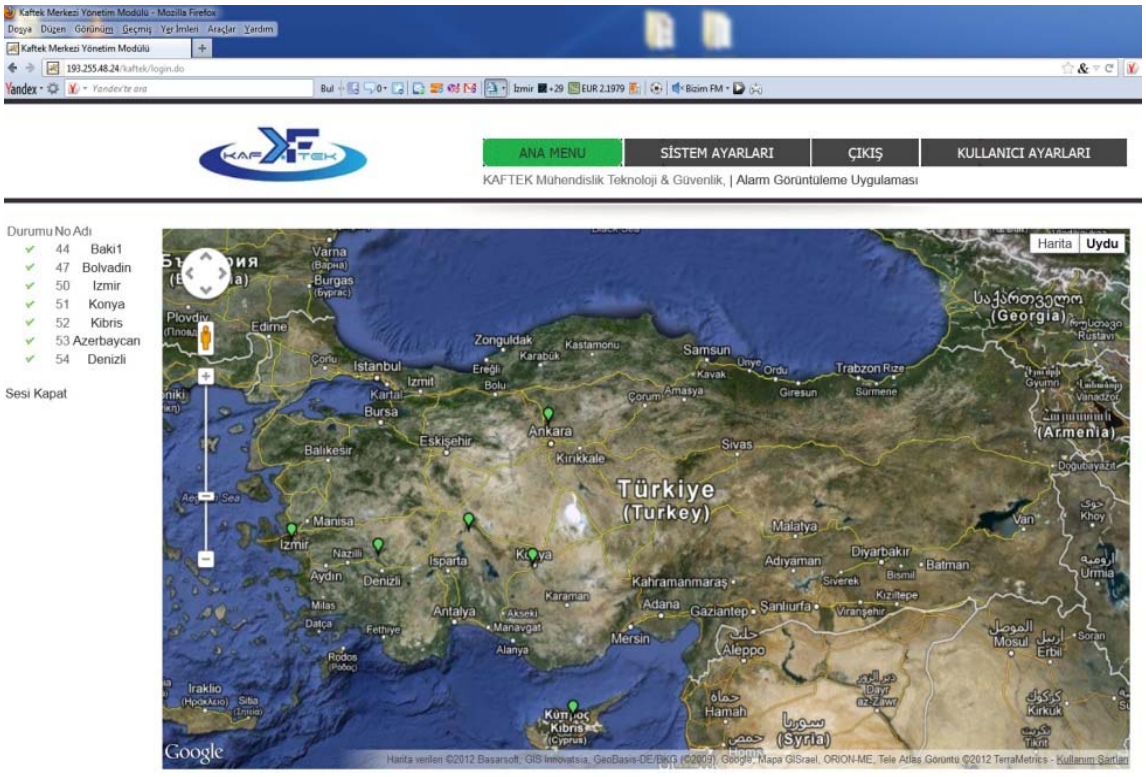

Figure 5. Central Monitoring Software

Alarm and images of performed system with taken data are shown in Figure 6. In sleep mode, TSS register on

GPRS networks in 4 seconds by receiving warn sign from Passive Infrared (PIR) detector and is taken video record of environment with visual and audio stimuli for 5 seconds. Status information with alarm and image recording are transferred to the software of central monitoring. In this process, if the fails to record the GPRS network it is provided uninterrupted transmission of the data to the monitoring center through SMS. When analyzed images, they have shown to be very successful to distinguish the environment and people. But at night times, it is not achieved the desired distinctiveness from the night images with IR illumination. Finally, it is determined that IR filter should be used in night to get quality image appropriate wavelength in camera.

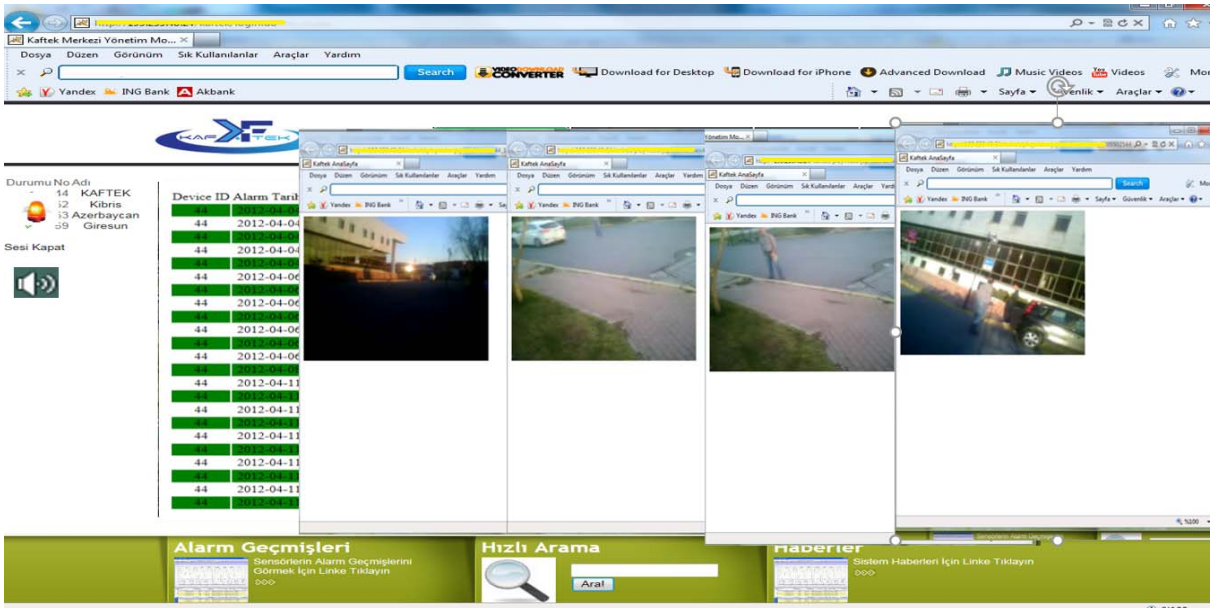

Figure 6. Integrated Test System

Conclusion

Agriculture plays a key role in many countries economy in the world. In agriculture effectively productivity depends on irrigation of crops in dry last month. For this reason, during unirrigated winter months, states cut the energy of electrical transformers to eliminate or minimize energy losses occurred in transmission lines. In this case, it has created serious vulnerability in transformers. The cooling oil and copper cables used in transformer attracts thieves due to higher selling prices. Performed transformer security systems use both GPS and MMS infrastructure. As a result, in this study a new monitoring system is realized for maintaining to continuity of the structure of interconnected power lines and security in the field of medium voltage electrical transformer used for agricultural purposes using M2M technology. The images are recorded in the server from the device that carries the distinction of being evidence in judicial review cases and with the lack of evidence, judicial process will provide the binding decisions faster. In the future studies, it will be continued in monitoring different species in their habitat and safety issues in the military field.

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ENVIRONMENTAL MANAGEMENT SYSTEMS FOR PORT AREAS

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Abstract: This paper is a report the two main environmental management system (EMS) standards EMAS and ISO 14001 environmental performance indicator for port industry. The European Union (EU) is considered by some to have the most extensive environmental laws of any international organization. Protection of the environment is a well-established policy in the European Union. The environment has become a critical issue in business today. Since the applications of logistics are generally positive for the efficiency of transport systems, it has been suggested that logistics are environmentally friendly. Therefore organizations systematic environmental programs are planned and documented way to manage the case.

Keywords: Environmental management systems, EMAS, ISO 14001

Introduction

Europe constitutes the densest port regions worldwide. It has more than 1200 commercial seaports along the 70,000 km of coastal zone, and over 200 ports in its inland waterways. According to the latest 2011 figures, more than 60,000 merchant ships called at European ports, which represented approximately 3.7 billion tonnes of cargo. Bulk carriers accounted for 70% of it, container ships 18% and Ro–Ro vessels 7%, the rest being other general cargo. A total number of 385 million passengers pass by ports every year and about 1.5 million of workers are employed directly in European ports (EC, 2013).

Environmental Management Systems (EMS) consists of a collection of internal policies, assessments, plans and implementation actions (Coglianese, & Nash, 2001). The ISO 14000 series of standards or the International Standard for Environment was released in September 1996 and comprises of two main parts: (i) specification with guidance for use and (ii) general guidelines or principles, systems and supporting techniques (Zutshi & Sohal, 2004). The reactive (or traditional) safety management approach is useful when dealing with technological failures, or unusual events (ICAO, 2013). An environmental management system helps organizations identify, manage, monitor and control their environmental issues in a "holistic" manner (ISO, 2015). The international standard ISO 14001 designed by the private body called International Organization for Standardization (ISO), and the Eco Management and Audit Scheme (EMAS) regulated by the European Regulation EC 1221/2009 (Testa et al., 2014). Port areas are hazardous areas of intense intermodal consideration as all the transport modes coalesce there. In most cases port areas are situated next to urban areas and/or other areas of special environmental attention due to the presence of protected species or even due to recreational purposes. Environmental Management System specifically for ports that can also be used by companies. Port development indicators are also included in operational indicators and they relate to operations carried out at sea, on land or both, be planned and executed with careful consideration of their environmental impacts (Puig, Wooldridge, & Darbra, 2014).

Environmental Management

Environmental management system has become one of the main tools used by companies to handle the environmental aspects and the impacts that their activities have on the environment. The first version of ISO 14001 (Environmental Management System: Requirements with guidance for use), the EMS standard from the International Organization for Standardization (ISO) was launched in 1996 (Lucila M. S. Campos, 2012). The ISO 14000 family of standards provides practical tools for companies and organizations of all kinds looking to manage their environmental responsibilities. Voluntary standards such as ISO 14001 were developed to overcome weaknesses in traditional regulatory instruments (McGuire, 2014). EMAS and ISO 14001. These schemes provide a third-party guarantee of environmental "excellence", which is able to give an advantaged position (with respect to their competitors) to those organizations that, by adopting EMAS or ISO 14001, commit themselves to improve the environmental performance (Iraldo, Testa, & Frey, 2009). In 1987, the World Commission on the Environment and Development of the United Nations published the report "Our Common Future" in which sustainable development is defined as the principle of "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (To & Lee, 2014). ISO 14001 or EMAS, provide benefits on

environmental and economic performances (Fresner & Engelhardt, 2004). Effective port environmental management needs to take into account the potential impacts on the environment, mitigating options, methods of prediction, information on environmental indicators and legislation (PPRISM, 2012). The ECOPORTS project also develops tools that will help port administrations to put the recommendations of the 2001 Environmental Review into action (for instance, the Port Environmental Review System (PERS) can be used as a standard for the implementation of these recommendations) (ESPO 2003). In 1974, the European Commission set up a Port Working Group, consisting of port authority representatives from Europe's major ports. Early 1993, the European Sea Ports Organisation was born out of this working group, as an independent lobby for seaport interests (ESPO, 2012). As part of the Environmental Performance Review, the environmental priorities of the sector have been redefined. Priority issues change their ranking with time but certain components retain their significance for the sector (ESPO, 2013).

In 1994, the Europen Sea Ports Organisation (ESPO) published its first Europen Enviromental Code Of Practise. This code was intended to be an expression of the collective commitment of the European port administrations to environmental improvement (Hooydonk, 2006). ISO 14001:2015 specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance (ISO, 2015).

ISO 14001-EMAS

The ISO 14001 is an international environmental standard that specifies requirements related to an EMS to allow the organization to devise its policy and objectives while considering the legal requirements and information concerning significant environmental impacts (L. M. S. Campos, Heizen, Verdinelli, & Miguel, 2015). One of the most widely used voluntary approaches involves the adoption of the certified environmental management system (EMS) called ISO 14001 (Arimura, Darnall, Ganguli, & Katayama, 2016). There are two main reference standards that set requirements for an EMS: the international standard ISO 14001 designed by the private body called International Organization for Standardization (ISO), and the Eco Management and Audit Scheme (EMAS) regulated by the European Regulation EC 1221/2009 (Testa et al., 2014). The first step aims at testing if EMAS and, more in general, an Environmental Management System, are really able to produce an improvement in environmental performance as perceived by the organization. The second step aims at investigating if and how this performance, especially when strengthened by a third-party registration such as EMAS, can really give an organization better position on the four most important competitive leverages: innovation, marketing, productivity and intangible assets (Fig. 1) (Iraldo et al., 2009).

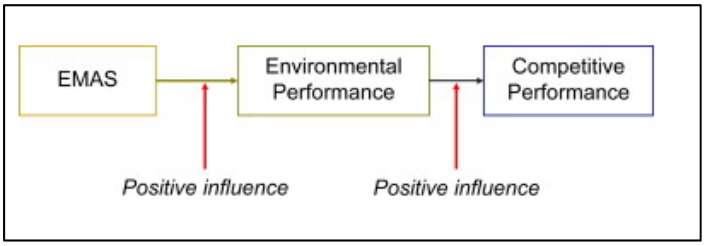

Figure1. The conceptual framework.

The Self Diagnosis Method

The Self Diagnosis Method (SDM) is designed to support port managers in their efforts to regularly review the environmental management performance in their port. The diagnosis generated through this analysis can determine both the enabling factors and the barriers to the implementation of effective environmental management systems (Romero, Asmus, Milanelli, Buruaem, & Abessa, 2014). The SDM should be a practical first step towards meeting ISO 14001 and/or EMAS. The presence of important ISO 14001 and EMAS requirements has been reviewed. The structure of the new version of the SDM is practically parallel to the order of the standard ISO 14001 (Table 1) (Darbra, Ronza, Casal, Stojanovic, & Wooldridge, 2004).

Table 1. Relationship between the structure of the SDM and ISO 14001.

SDM section	ISO 14001 section
1. A. Environmental policy document	4.2
1. B. Environmental policy scope	4.2
1. C. Environmental regulations and port activities	4.3.1, 4.3.2
1. D. Objectives and targets	4.3.3
1. E. Resources and budget	4.4.1
2. A. Responsibilities of the environmental management representative	4.4.1
2. B. Responsibilities of key personnel	4.4.1
2. C. Individual environmental responsibilities	4.4.1
3. Environmental training	4.4.2
4. A. Internal communication	4.4.3a
4. B. External communication	4.4.3b
5. A. Management programs and action plans	4.3.4
5. B. Standard operating procedures and working instructions	4.4.6
5. C. Environmental management manual	4.4.4
5. D. Environmental documentation management	4.4.4, 4.4.5
6. Emergency planning	4.4.7
7. A. Environmental monitoring	4.5.1–4.5.3
7. B. Monitoring of management program	4.5.1–4.5.3
8. A. Environmental audit	4.5.4
8. B. Review	4.6

Results and Discussion

The first remark to be made is that all the priorities of the 2013 top-10 remain in the top-10 of 2016. There are just some variations in the ordering of the priority items. The relationship with the local community, port development and water quality primarily appear to be gaining importance. On the other hand, the handling of port waste, and dredging appear to move down the top-10 scale. Air quality remains the number one priority of the European ports, as in 2013. This is fully in line with the maintenance of air quality as a top priority also of the EU policy agenda and the various ongoing policy initiatives that include the implementation of the Sulphur Directive and the ongoing political process on the air quality package. Energy consumption becomes the second priority issue of the European ports. Since 2009, the importance of energy consumption has raised year over year as. One of the reasons for this increase is, of course, the direct link between energy consumption, and the carbon footprint of the ports and Climate Change. Noise is the third concern by priority and its importance has also grown smoothly since 2004. The relationship with local community climbs at the number four of priorities as the ports grant their license to operate and to grow from their local communities. Another interesting fact is that there are three issues that have appeared consistently in the priority list of the port sector over the last 20 years, although they are not in the top positions of the table 2. These issues are port development (land), dredging operations and dust (ESPO, 2016).

Table 2. Top 10 environmental priorities of the European port sector over time.

	1996	2004	2009	2013	2016
1	Port Development (water)	Garbage / Port waste	Noise	Air quality	Air quality
2	Water quality	Dredging: operations	Air quality	Garbage/ Port waste	Energy Consumption
3	Dredging disposal	Dredging disposal	Garbage / Port waste	Energy Consumption	Noise
4	Dredging: operations	Dust	Dredging: operations	Noise	Relationship with local community
5	Dust	Noise	Dredging: disposal	Ship waste	Garbage/ Port waste
6	Port Development (land)	Air quality	Relationship with local community	Relationship with local community	Ship waste
7	Contaminated land	Hazardous cargo	Energy consumption	Dredging: operations	Port development (land related)
8	Habitat loss / degradation	Bunkering	Dust	Dust	Water quality
9	Traffic volume	Port Development (land)	Port Development (water)	Port development (land)	Dust
10	Industrial effluent	Ship discharge (bilge)	Port Development (land)	Water quality	Dredging: operations

A set of 10 key management indicators has been developed for this purpose in cooperation between ESPO, EcoPorts and PORTOPIA. These have also been monitored back in 2013 and the 2016 review comes to update the figures and to show their evolution. Table 3 below shows the percentage of positive responses to each of these 10 indicators in the review of 2013 and 2016, so that the variations over time are demonstrated Clear positive trends can be demonstrated over time for the majority (7/10) of the selected indicators while one stays stable and 2 decline. The rise in the percentage of ports that are certified by a recognised Environmental Management System (EMS), such as ISO 14001, PERS and/or EMAS, from 54 to 70 % between 2013 and 2016 is particularly impressive. On the other hand the results show an 11 % decrease in the percentage of ports that have an environmental training programme for their employees and this clearly requires further investigation by ESPO. The results demonstrate that the big majority of European ports have implemented an Environmental Policy (92 %), maintain actual inventories of applicable environmental legislation (90%) and of their significant environmental aspects (89%), define objectives and targets for environmental improvement (89%), have documented environmental responsibilities of key personnel (85%) and monitor their environmental impact (82%). The trends are also positive on communicating efforts with 2 out of 3 of the respondent ports producing a publically available environmental report on a regular basis. The table 4 below shows the Environmental Management Index of European ports in 2013 and in 2016 respectively. The evolution confirms the positive trends identified. (ESPO/EcoPorts, 2016).

As stated above, the overall improvement over time of European ports in environmental management is well demonstrated by the increase in the percentage of ports that achieve certification under one or more of the established environmental management systems (EMS). A total of 64 ports out of the 91 that contributed to the review are EMS certified, being 46 of 5 them under ISO 14001, 5 under EMAS and 26 under the EcoPorts Port Environmental Review System (PERS) as shown in the following figure 2. Some ports are certified under more than one system (ESPO/EcoPorts, 2016).

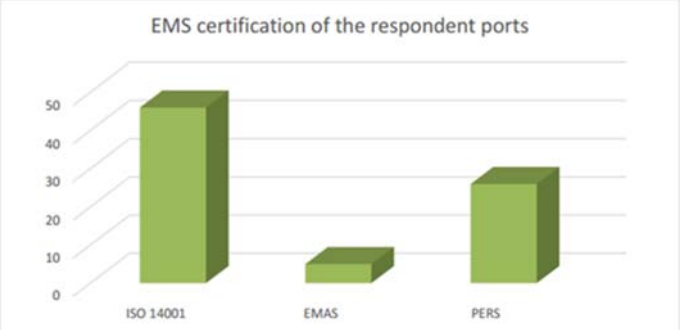

Figure 2. EMS certification of the respondent ports

Table 3. Percentages of positive answers and 2013-2016 variations on key environmental management indicators

	Key Environmental Management Indicators	2013 (%)	2016 (%)	Changes 2013-2016
A	Certified Environmental Management System (EMS)	54	70	+16
B	Existence of an Environmental Policy	90	92	+2
C	Environmental Policy making reference to ESPO's policy documents	38	34	-4
D	Existence of an inventory of relevant environmental legislation	90	90	-
E	Existence of an inventory of Significant Environmental Aspects	84	89	+5
F	Definition of objectives and targets for environmental improvement	84	89	+5
G	Existence of an environmental training program for port employees	66	55	-11
H	Existence of an environmental monitoring program	79	82	+3
I	Documented environmental responsibilities of key personnel	71	85	+14
J	Publicly available environmental report	62	66	+4

Tablo 4. Environmental Management Index 2013 - 2016

	2013	2016
Environmental Management Index	7.25	7.72

The products currently provided by ECOPORTS gradually lead to the level required to attain ISO 14001 or EMAS certification (Fig. 3), although all of them may also be considered as tools that stand on their own.(Darbra et al., 2004).

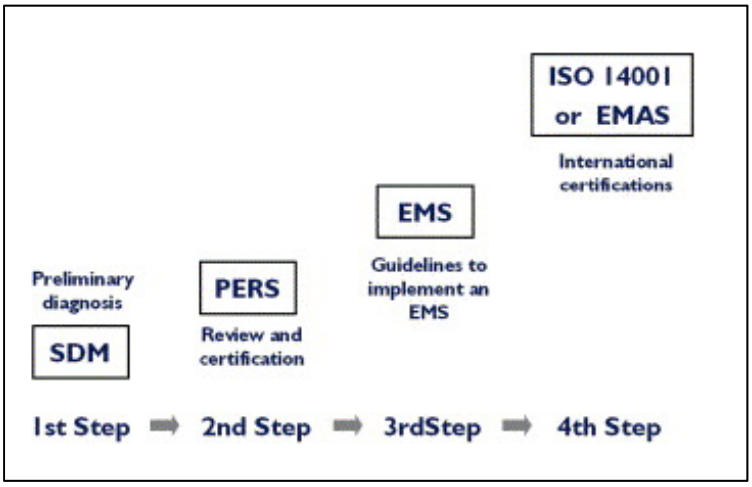

Figure 3. Diagram showing the relationship between the ECOPORTS tools and the international standards.

Conclusion

The vital importance of the ports industry for EU trade is demonstrated by the statistics: the maritime sector is responsible for over two thirds (70%) of all trade between the Community and the rest of the world, as well as 41% of goods traffic within the Community (Short Sea Shipping). Ports are the gateway for the movement of millions of passengers each year and a wide range of goods (including vehicles, fresh food, steel, timber, building materials, machinery and manufactured goods) and raw materials (oil, petroleum, chemicals, ores, grain and animal feedstuffs) which are needed to fuel the European Union's economy (ESPO, 2004). The EC PORTOPIA project has gained data and insight on Environmental Performance Indicators for inland ports (Seguí, Puig, Quintieri, Wooldridge, & Darbra, 2016).

A sustainable port is one in which the port authority together with port users, proactively and responsibly develops and operates, based on an economic green growth strategy, on the working with nature philosophy and on stakeholder anticipation, starting from a long term vision on the area in which it is located and from its privileged position within the logistic chain, thus assuring development that anticipates on the needs of future generations, for their own benefit and the prosperity of the region that it serves (Vellinga, 2013). Among various motivations for green activities, the rise of environmental awareness can be critical to the development of a firm's green strategies (Luan, Tien, & Chen, 2016).

Maritime ports, especially those connected with or situated far inland in estuaries connected with navigable inland waterways and railways, can also play a significant role in reducing CO_2 emissions, but will also have to face the effects of climate change (EC, 2011). International Maritime Organization (IMO) has recognized that provision of reception facilities is crucial for effective MARPOL implementation, and the Marine Environment Protection Committee (MEPC) has strongly encouraged Member States, particularly those Parties to MARPOL as port States, to fulfil their treaty obligations on providing adequate reception facilities. MARPOL Annex VI, first adopted in 1997, limits the main air pollutants contained in ships exhaust gas, including sulphur oxides (SO_X) and nitrous oxides (NO_X), and prohibits deliberate emissions of ozone depleting substances (IMO, 2011).

Implementing ISO 14001can be time-consuming and incur some initial costs but the benefits outweigh the expense (Davies, 2005). Future research should deeply measure how certified organizations implement the requirements included in the environmental management system standards such as EMAS and ISO 14001.

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INFLUENCES OF PROCESS PARAMETERS ON THE QUALITY OF HYDROXYAPATITE COATING ON AZ91 MAGNESIUM ALLOY

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Abstract: Biodegradable materials such as AZ91 magnesium alloy arouse most of the researchers' interest in recent years. AZ91 Magnesium alloy is a potential alloy in order to use in biomaterial applications as it is both light and similar to the mechanical features of bone. However, this alloy shows corrosive behavior (in biological environment) in human body. Extensive studies have been conducted to use of AZ91 Mg alloy as a biodegradable material. This study focuses on the use of AZ91 Mg alloy as a permanent implant. As it is necessary to prevent the corrosion of such alloy in the body, its surface was coated by sol-gel method with hydroxyapatite material which has sufficient strength and tissue compatibility. The effects of process parameters, i.e. different dipping numbers of sol-gel coating at the coating stage and different sintering temperatures of these coatings, on coating quality was analyzed with Scanning Electron Microscopy (SEM) and x-ray diffractometer (XRD).

Keywords: AZ91 magnesium alloy, hydroxyapatite, Sol-gel coating method

Introduction

AZ91 Magnesium alloy is a potential alloy in order to use in biomedical applications as it is both lightweight and similar to the mechanical features of human bone particularly it shows similar Young's modulus to bone. Lightness is extremely important in biomedical applications because stainless steel and many of the similar metallic alloys can lead to infection by causing harm to tissues around the implant when it is used in the body (Wang, M.J., Chao, S.C., & Yen, S.K., 2016; Surmeneva, M.A. & Surmenev, R.A. , Microstructure characterization and corrosion behaviour of a nanohydroxyapatite coating deposited on AZ31 magnesium alloy using radio frequency magnetron sputtering, 2015; Liu, G.Y. , Hu, J. , Ding, Z.K. , & Wang, C. , Formation mechanism of calcium phosphate coating on micro-arc oxidized magnesium, 2011; Liu, G.Y. , Hu, J. , Ding, Z.K., & Wang, C. , Bioactive calcium phosphate coating formed on micro-arc oxidized magnesium by chemical deposition, 2011; Niu, B., ve diğerleri, 2016). However, its biodegradable behavior in biological environment restricts its use (Surmeneva, M.A., ve diğerleri, 2015; Niu, B., ve diğerleri, 2016). Various studies have been conducted to reduce its degradation rate; process modification, alloying of the magnesium and surface coating techniques (Chen, X.-B. , Birbilis, N. , & Abbott, T.B. , 2012; Hiromoto, S. & Tomozawa, M., Hydroxyapatite coating of AZ31 magnesium alloy by a solution treatment and its corrosion behavior in NaCl solution, 2011; Xu, L., ve diğerleri, 2009) for instance electrophoretic deposition, electrochemical deposition, sol-gel and dip coating have been widely studied. Corrosion preventive coatings for AZ91 magnesium alloy is very important to develop its usage area (Hiromoto, S. & Yamamotoa, A., High corrosion resistance of magnesium coated with hydroxyapatite directly synthesized in an aqueous solution, 2009).

Hydroxyapatite is a bioceramic material widely used in medicine and dentistry and a calcium phosphate-based material forming the inorganic structure of bone tissue (Kannan, M. B., 2015). HAp has almost the same chemical composition and structure as human bone (Rojaee, R., Fathi, M., & Raeissi, K., 2014). Because of its biocompatibility, it is used in the construction of various prosthesis, repairing of cracks and broken bones and coating of metallic biomaterials as an artificial bone (Hiromoto, S. & Tomozawa, M., Hydroxyapatite coating of AZ31 magnesium alloy by a solution treatment and its corrosion behavior in NaCl solution, 2011).

In this study, AZ91 Mg alloy was produced with hot press sintering method and coated with hydroxyapatite using combination of sol-gel and dip coating method. The effects of sintering temperature and dipping number on the quality of surface coating was investigated. Surface morphology and phase structure evaluation of the coatings were analyzed with SEM and XRD, respectively.

Materials and Methods

Sample Preparation

AZ91 magnesium alloy powders were sintered at a pressure of 275 MPa at 325 ºC for a period of 1 h with unidirectional hot pressing. Produced AZ91 Mg alloy was cut in to 60×10×8 mm pieces. The specimens were mechanically ground with SiC papers and finished with 1200 grit, then polished with 6 and 3 µ diamond suspension. Cleaning process was followed by dipping the specimens in acetone and ethanol in ultrasonic bath for 10 and 20 minutes, respectively.

Calcium nitrate tetra hydrate ($Ca(NO_3)_2.4H_2O$) and phosphorous pentoxide (P_2O_5) were selected as Ca and P precursors and dissolved separately in ethanol. Ca precursor was added drop wise to P precursor and then stirred at ambient temperature for 5 hours.

The specimens were dipped the number of 1, 3, and 5 vertically into the prepared solution and pulled off at the speed of 6 mm/min by an electrical dip coater. The dip coated specimens were maintained at room temperature for 24 hours to complete the aging process. Then, they were dried at 60 ºC for 24 hours and sintered to 300 ºC, 400 ºC, and 500 ºC for 6 hours (heating rate: 5 º/min.). The codes of the specimens are given in **Table 1**.

Table 1: Code-designated specimens.

Number of dipping → / **Sintering temperature ↓**	**1 dip**	**3 dip**	**5 dip**
300 ºC	1-300	3-300	5-300
400 ºC	1-400	3-400	5-400
500 ºC	1-500	3-500	5-500

Characterization

The surface and the cross-section morphologies of the specimens were obtained by a scanning electron microscope (SEM). The phases of the coatings sintered at different temperatures and different number of dipping were determined by X-ray diffraction (XRD) technique with a CuKα wavelength of 1.5418 (Å). The settings of diffractometer were adjusted to 40 kV and 30 mA at a 2Θ range of 25-70 º employing a step size of 0.02 º/s.

Results and Discussion

The surface of morphologies of the specimens prepared under different sintering temperatures and dipping numbers are shown in **Fig. 1**. It is obviously seen that coatings fully cover the substrate but there are a lot of cracks on the surface. Crack formation could be resulted from the stresses when volatile constituents escape from the material surface at the sintering stage. And the amount of the cracks and crack area portion decrease with increasing dip number.

The cross-section micrographs of the specimens are shown in **Fig. 2**, which reveals coating thickness of about 3 µm. The coating thickness of the specimens increase with increasing dip number and decrease with increasing sintering temperature.

The distribution of elements in the coatings is given by the EDS analysis in **Table 2**, which indicates the presence of O, Mg, Al, P and Ca. According to the EDS results coating layer consists substrate major element and at the same time the substrate consists the coating elements, too. So, although there are a lot of cracks on the surfaces, the coating layer and substrate are integrated each other.

Fig. 3, Fig. 4, and Fig. 5 shows the XRD patterns of the coatings sintered at stable temperature with 1, 3 and 5 dip numbers and pure AZ91 Mg alloy; **Fig. 6, Fig. 7, and Fig. 8** shows the XRD patterns of the coatings sintered at 300, 400, and 500 ºC with stable dip number and pure AZ91 Mg alloy. α, β, and γ represent Mg, $Mg_{17}Al_{12}$, and hydroxyapatite phases, respectively. Phases were determined according to the literature (Hou, Liang, Chen, Dong, & Han, 2015; Razavi, ve diğerleri, 2014; Kabirian & Mahmudi, 2009; Lee, Pai, & Chang, 2013). AZ91 Mg alloy used in present study was composed of Mg phase together with some $Mg_{17}Al_{12}$ phase as stated in the literature. Coating and substrate peaks cannot be distinguished from each other. This may be due to the average up to 3 micrometers thin film coating layer. As the number of dip and sintering temperature increased, the new γ peaks are formed and the intensity of AZ91 peaks are decreased.

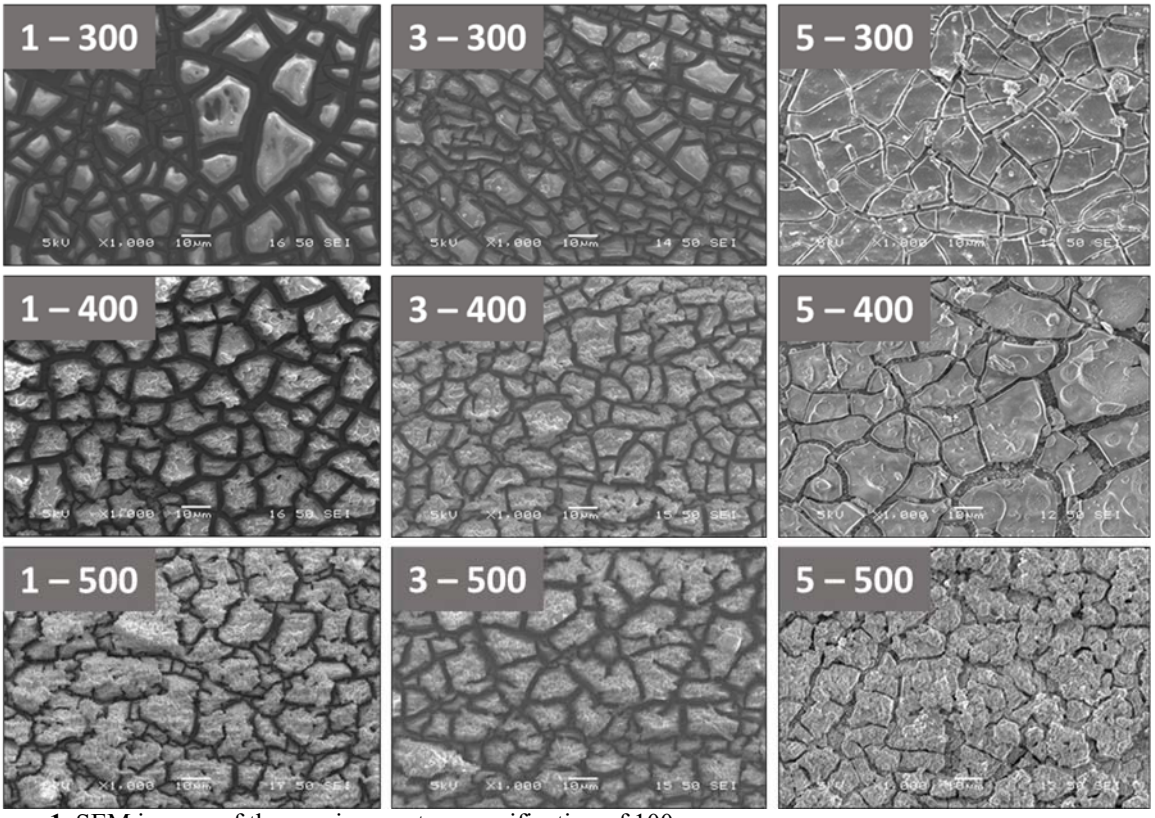

Figure 1. SEM images of the specimens at a magnification of 100x.

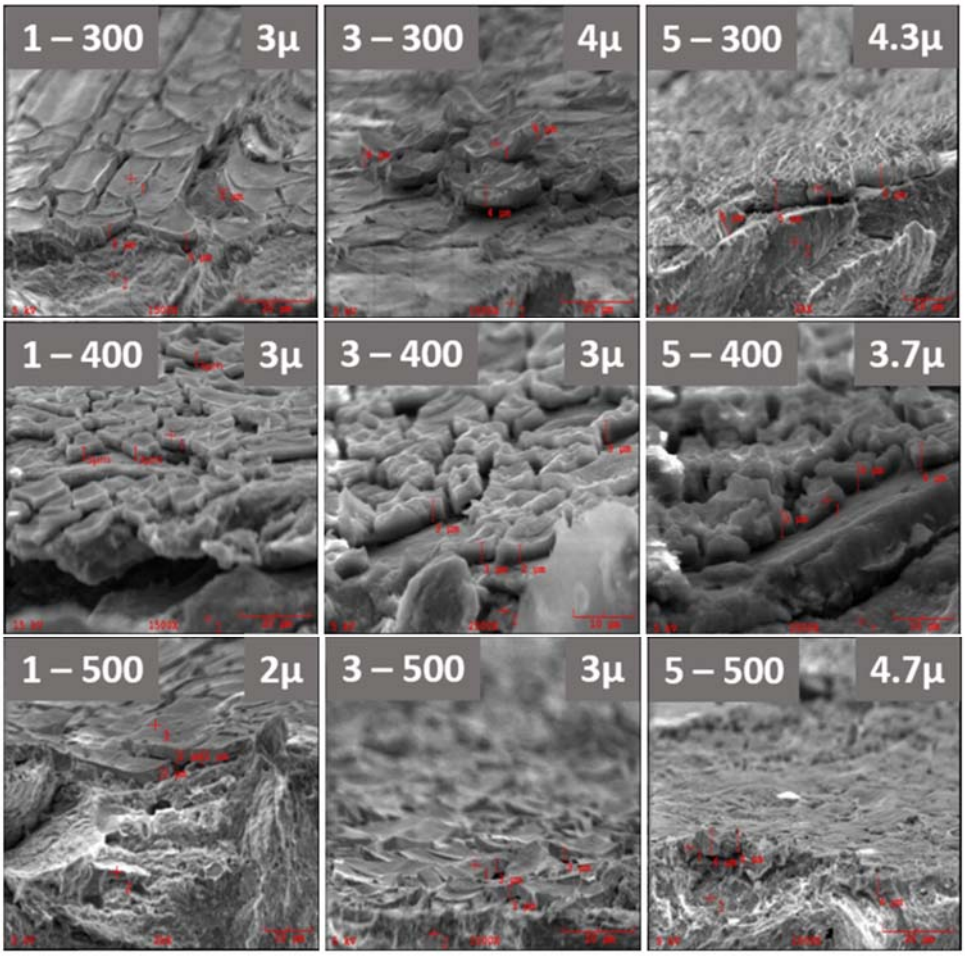

Figure 2. Cross section and EDS analysis of the specimens.

Table 2: The average value of point EDS analysis of specimens given in **Fig. 2.**

Element	O		Mg		Al		P		Ca	
Point	1	2	1	2	1	2	1	2	1	2
Average	8.434	3.227	12.071	76.473	1.747	2.528	11.375	2.160	66.373	15.612

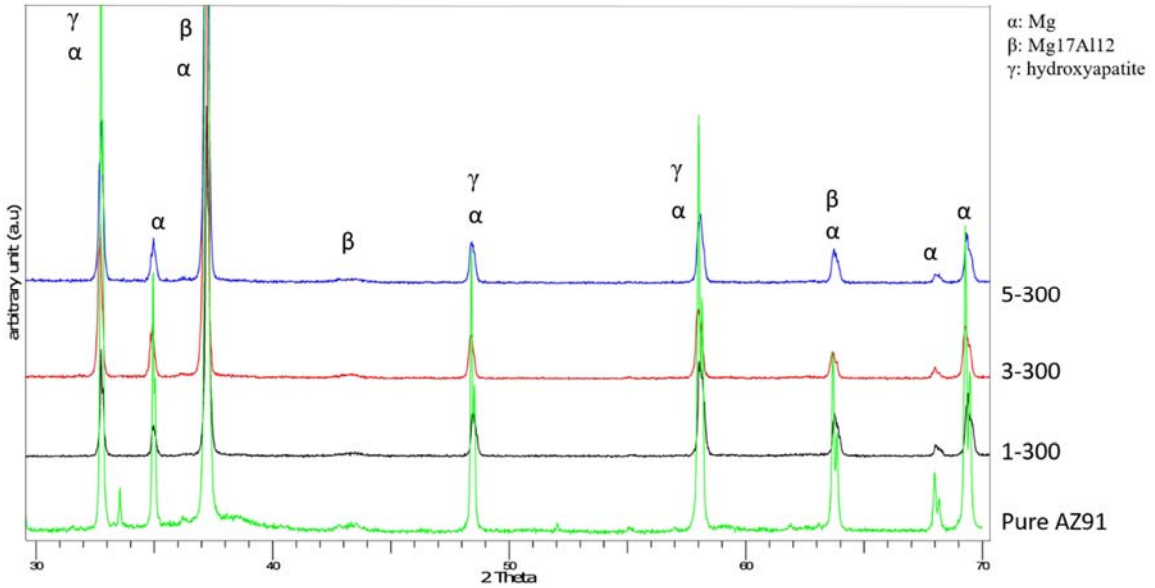

Figure 3. XRD patterns of the coatings sintered at 300 ºC with 1, 3 and 5 dip numbers and pure AZ91 Mg alloy.

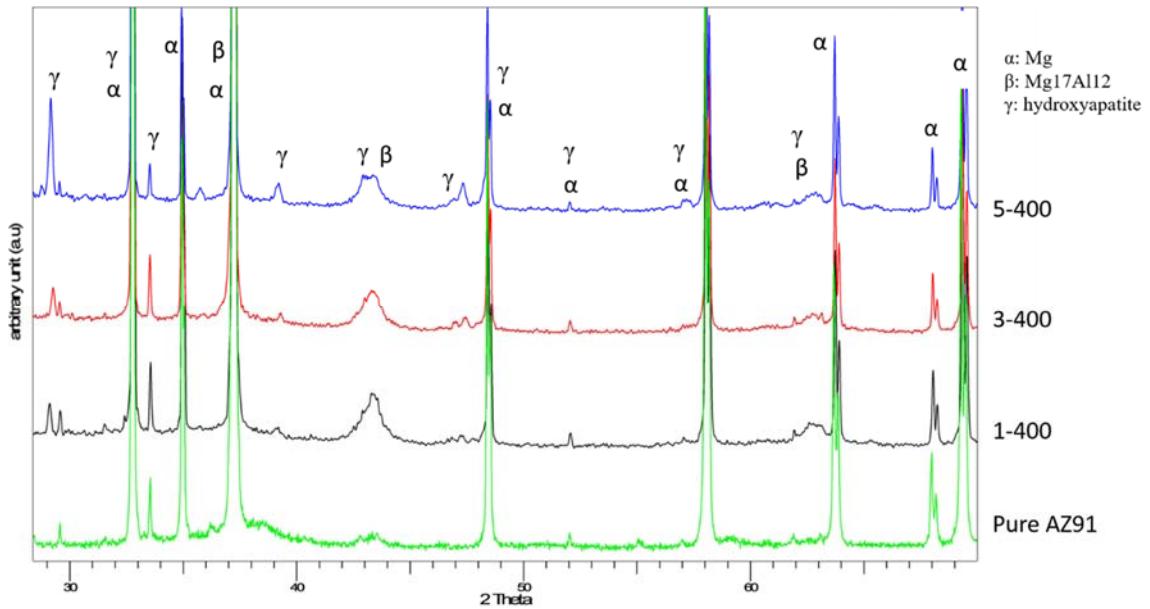

Figure 4. XRD patterns of the coatings sintered at 400 ºC with 1, 3 and 5 dip numbers and pure AZ91 Mg alloy.

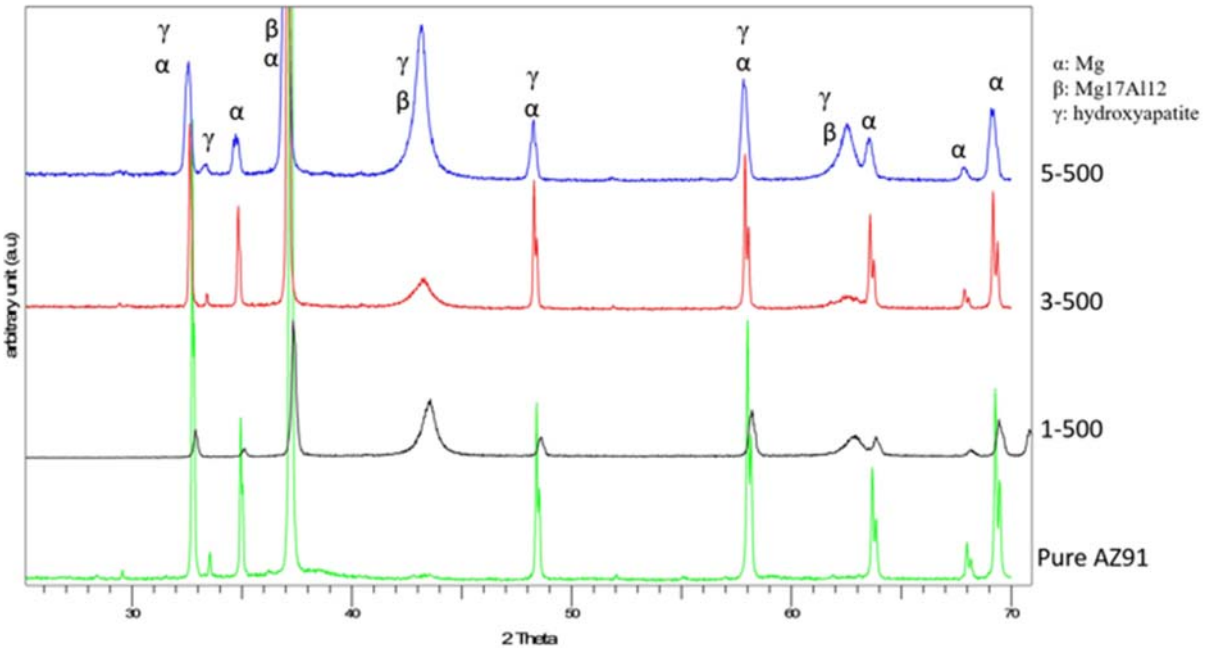

Figure 5. XRD patterns of the coatings sintered at 500 ºC with 1, 3 and 5 dip numbers and pure AZ91 Mg alloy.

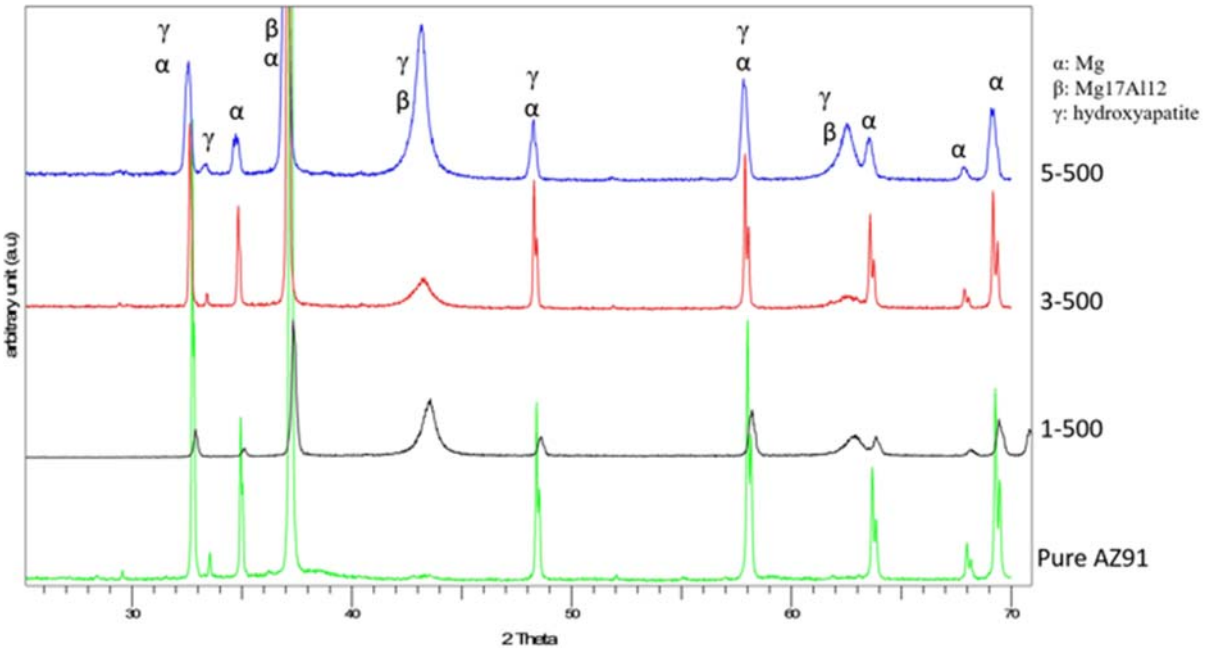

Figure 6. XRD patterns of the coatings sintered at 300, 400, and 500 ºC with 1 dip number and pure AZ91 Mg alloy.

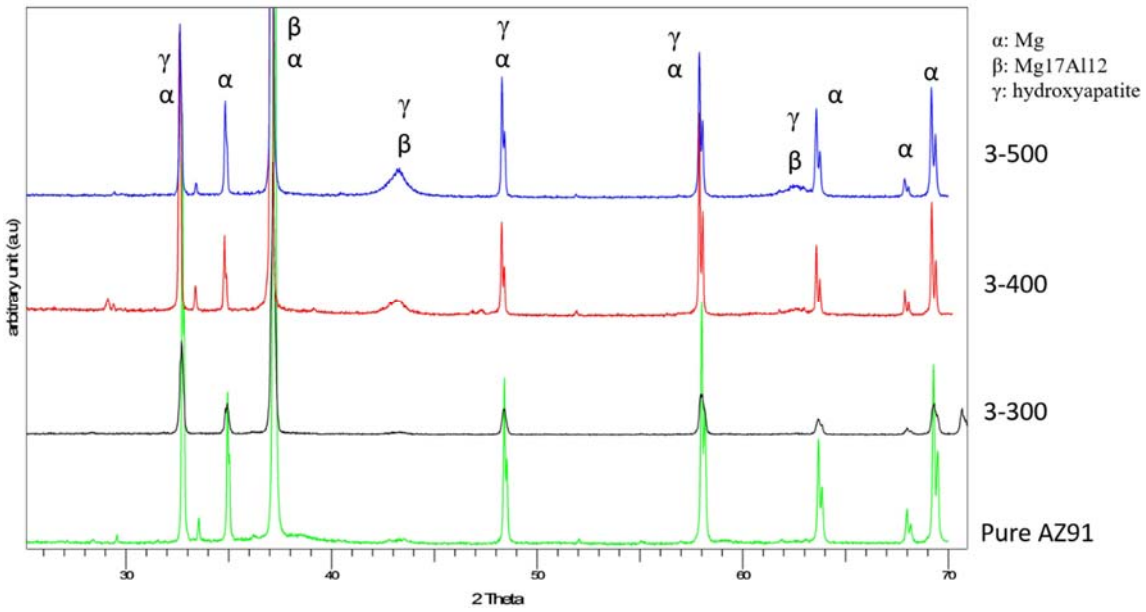

Figure 7. XRD patterns of the coatings sintered at 300, 400, and 500 ºC with 3 dip number and pure AZ91 Mg alloy.

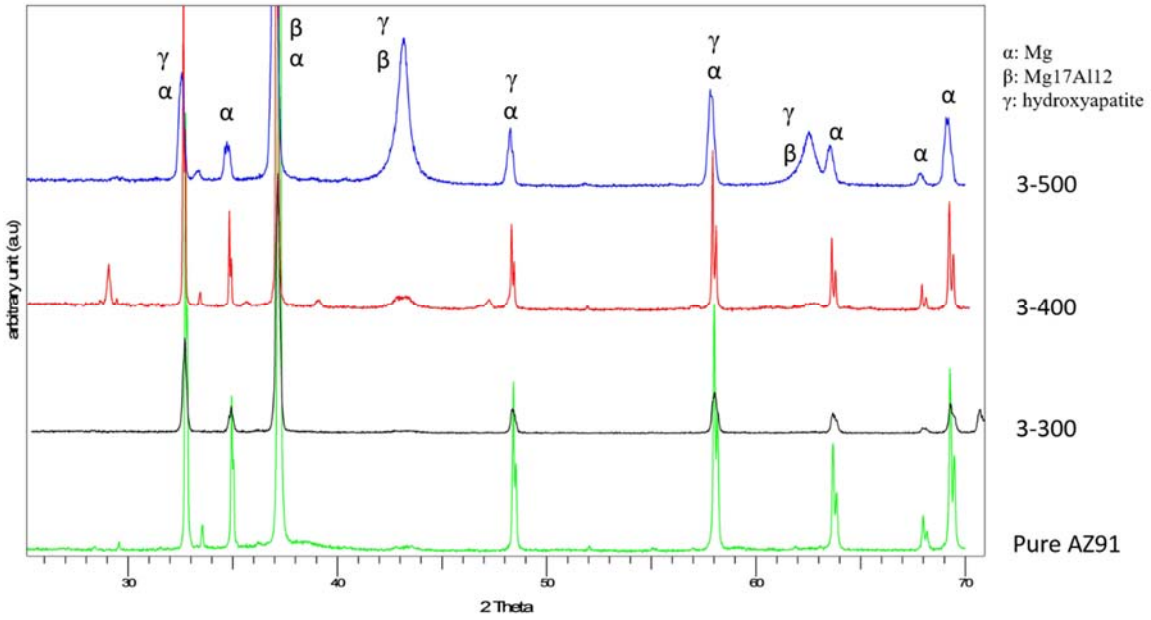

Figure 8. XRD patterns of the coatings sintered at 300, 400, and 500 ºC with 5 dip number and pure AZ91 Mg alloy.

Conclusion

AZ91 alloy was produced with hot press sintering method in this study. Produced specimens were coated with hydroxyapatite using combination of sol-gel and dip coating method. The effects of process parameters on coating quality was evaluated with SEM and x-ray diffractometer (XRD). Coating layer thickness is increased with the increasing number of dip. Furthermore, with increasing sintering temperatures, the cracks on the surface of coatings are increased.

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MDS CODES FROM POLYCYCLIC CODES OVER FINITE FIELDS

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Abstract: In this work, we construct polycyclic codes over finite fields by using linear algebraic methods. After the construction, we perform an exhaustive search by using polycyclic codes to obtain MDS codes over finite fields which have many applications in cryptography. The computer search results are presented at the end of the paper.

Keywords: Polycyclic Codes, MDS Codes, Finite Fields

Introduction

Polycyclic codes are the generalization of cyclic and constacyclic codes and were studied in (William, 1972) for the first time. In (Radkova, 2009) Radkova et al. studied the cyclic and constacyclic codes from a linear algebraic point of view. In this work, we construct polycyclic codes over finite fields by using same methods.Then we perform an exhaustive search by using polycyclic codes to obtain MDS codes over finite fields which have many applications in cryptography. The computer search results are presented at the end of the paper.

Polycyclic Codes

Polycyclic codes are the generalization of cyclic and constacyclic codes. We give the definition of polycyclic code.

Definition 2.1: A linear code C with length n over a finite field F is called polycyclic code induced by the polynomial $v(x) = v_0 + v_1 x + \cdots + v_{n-1}x^{n-1} \in F[x]$ such that if $c = (c_0, c_1, \cdots, c_{n-1}) \in C$ then its $v-vector$ shift $(0, c_0, c_1, \cdots, c_{n-2}) + c_{n-1}(v_0, v_1, \cdots, v_{n-1}) \in C.$

Let $F = GF(q)$ and let F^n be the n-dimensiomal vector space over F with standard basis $e_1 = (1,0,\ldots,0), e_2 = (0,1,\ldots,0), \ldots, e_n = (0,0,\ldots,n).$
Then polycyclic shift with respect to a vector v is the following transformation:

$$\begin{array}{rccc} \tau_v : & F^n & \to & F^n \\ & (c_0, c_1, \cdots, c_{n-1}) & \mapsto & (v_0 c_{n-1} + v_1 c_{n-1}, \cdots, c_{n-2} + v_{n-1} c_{n-1}). \end{array}$$

Then it has the following matrix

$$T_v = \begin{pmatrix} 0 & \cdots & \cdots & 0 & v_0 \\ 1 & 0 & \cdots & 0 & v_1 \\ 0 & 1 & & \vdots & \vdots \\ \vdots & & \ddots & 0 & \vdots \\ 0 & \cdots & 0 & 1 & v_{n-1} \end{pmatrix}$$

with respect to tstansard basis. Note that the characteristic polynomial of T_v is $f(x) = x^n - v(x)$.

Let $gcd(n,q) = 1$. Assume that $f(x) = x^n - v(x) = f_1(x) f_2(x) \ldots f_t(x)$ be the factorization of $f(x)$ into monic irreducible factors over F. Cayley-Hamilton Theorem states that the matrix T_v satisfies $f(T_v) = 0$.

Now we consider the set of homogeneous equations

$$f_i(T_v)x = 0, \quad x \in F^n \text{ for } i = 1,\ldots,t.$$

Let U_i be the solution space of $f_i(T_v)x = 0, \quad x \in F^n$. We denote $U_i = Kerf_i(\tau_v)$. Then each U_i is a subspace of F^n.

Then we have the following theorem:

Theorem 2.2: The following statements hold for the subspaces U_i of F^n:

(1) U_i is τ_v-invariant subspace of F^n;

(2) If W is a τ_v-invariant subspace of F^n and $W_i \cap W = U_i$ for $i = 1,2,\ldots,t$, then W_i is free τ_v-invariant and $W = W_1 \oplus \ldots \oplus W_t$;

(3) $F^n = U_1 \oplus \ldots \oplus U_t$;

(4) $dim_F(U_i) = deg(f_i) =: k_i$;

(5) $f_i(x)$ is the minimal polynomial of τ_v over U_i;

(6) U_i is the minimal τ_v-invariant subspace of F^n;

(7) For any subspace U of F^n, U is the direct sum of some of minimal τ_v-invariant subspaces U_i of F^n.

Then the following theorem is clear from the definition:

Theorem 2.3: A linear code C with length n over F is a polycyclic code with respect to some $v(x) \in F[x]$ if and only if C is a τ_v-invariant subspace of F^n.

Theorem 2.4: Let C be a linear polycyclic code with length n over F with respect to some $v(x) \in F[x]$. Then the following statements hold:

(1) $C = U_{i_1} \oplus U_{i_2} \oplus \ldots \oplus U_{i_s}$ for some minimal τ_v-invariant subspaces of R^n and $k := dim(C) = k_{i_1} + \ldots + k_{i_s}$, where $k_{i_j} = dim(U_{i_j}), \quad j = 1,\ldots,s$;

(2) $h(x) = f_{i_1}(x)\ldots f_{i_s}(x)$ is the minimal polynomial of τ_v over C;

(3) $dim(h(T)) = n - k$;\

(4) $c \in C$ if and only if $h(T)c = 0$.

Then we have the following result which explains how we construct pollcyclic codes over finite fields.

Corollary 2.5: $H = h(T_v)$ is a parity check matrix for the code C and $G = (g(T_v))^t$ is a generator matrix for the code C where $x^n - v(x) = f(x) = g(x)h(x)$. In this case, $g(x)$ is said to be the generating polynomial of the polycyclic code C.

MDS Codes

In this section we briefly explain the MDS codes and its applications in cryptography. The reader who wants more information about this topic may consult (Augot, 2014).

Definition 3.1: Let C be linear code over F_q with parameters [n,k,d]. C is said to be a MDS code if $d = n + k - 1$ is satisfied.

Definition 3.2: A matrix M is MDS if its concatenation with the identity matrix $G_M := [I_k \mid M]$ yields a generating matrix of an MDS code C.

MDS matrices are used in linear diffusion layers in cryptography. A linear diffusion layer of a block cipher is defined by an invertible matrix of size $k \times k$ over F_q. It takes $x \in F_q^n$ as a input and yields $y \in F_q^k$ as an output with $y = x \times M$.

The security of a diffusion layer is measured by its differential branch number and the linear branch number. The larger the two branch numbers are, the stronger a diffusion layer is. The diffusion layers with the optimal branch numbers are called being maximum distance separable. Optimal linear diffusion can thus obtained by using codes with largest possible minimal distance, namely MDS codes.

Several different techniques have been studied to obtain MDS matrices, a well known example being circulant matrices as used in the AES (Daemen, 1012) or FOX (Junod, 2004). Recently a new construction has been proposed: the so-called recursive MDS matrices, that were for example used in LED (Guo, 2011). These matrices have the property that they can be expressed as a power of a companion matrix C.

Definition 3.3: The companion matrix of monic polynomial $c(x) = c_0 + c_1 x + \ldots + c_{n-1}x^{n-1} + x^n$ is defined as the square matrix

$$T_v = \begin{pmatrix} 0 & \cdots & \cdots & 0 & c_0 \\ 1 & 0 & \cdots & 0 & c_1 \\ 0 & 1 & & \vdots & \vdots \\ \vdots & & \ddots & 0 & \vdots \\ 0 & \cdots & 0 & 1 & c_{n-1} \end{pmatrix}$$

Recently Augot et al. in [4] propose a fast algorithm which yields $k \times k$ square matrices whose k^{th} power of its companion matrices are MDS matrices. They obtain recursive MDS matrices by using shortened BCH codes.

The Link Between Polycyclic Codes and Recursive MDS Matrices

The matrix of a linear transformation of a polycyclic shift with respect to a polynomial $v(x) = v_0 + v_1 x + \ldots + v_{n-1}x^{n-1}$ and the companion matrix of a monic polynomial $x^n + v(x)$ same and as the following:

$$T_v = \begin{pmatrix} 0 & \cdots & \cdots & 0 & v_0 \\ 1 & 0 & \cdots & 0 & v_1 \\ 0 & 1 & & \vdots & \vdots \\ \vdots & & \ddots & 0 & \vdots \\ 0 & \cdots & 0 & 1 & v_{n-1} \end{pmatrix}$$

There is an obvious link between polycyclic codes and recursive MDS matrices. Augot et al.'s algorithm already finds the polynomials whose companion matrices are recursive MDS matrices. So we perform an algorithm as explained below:

1. Choose a field F_{2^s} and a code length n.
2. Take a polynomial $v(x)$ of degree $n-1$ form $F_{2^s}[x]$ from the previous algorithm results (Augot's Algorithm).
3. Compute the polycyclic codes with respect to $v(x)$ using the theory we just derive.
4. Decide if the polycyclic codes we obtain MDS code or not.

We run this algorithm by using computer algebra system MAGMA (Bosma, 1997) and we have seen that most of the codes we obtain is indeed MDS. We think it is worth to study on this topic deeper and more theoretical point of view. We present the result in a table.

Table 1: The Number of MDS and non-MDS Codes

s	n	Number of MDS Codes	Number of non-MDS Codes
4	4	256	0
4	6	384	0
5	10	4700	0
5	12	5610	30
6	6	7650	0
6	10	12720	0
6	14	15996	48

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NEIGHBOR INTEGRITY OF HARARY GRAPHS

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Abstract: A network is a series of interconnected centers and transmission paths. A system like transportation, communication, computer, logistics, etc., constitutes a network. Failure of the links between stations, break down the centers, software faults on the network, hardware malfunctions, transmission errors that may occur in various centers affect the quality of service to be received over a network, more importantly, it causes a long interruption. In such a situation, to know the vulnerability, the resistance of the network to disruption of operation after the failure of certain stations or links until the system break down completely, is becoming important. A network can be modelled by a graph representing the centers by vertices and the links between the centers by edges. Various vulnerability parameters were defined in graph theory to study the vulnerability of the networks. Connectivity, integrity, toughness, tenacity, scattering number and rupture degree are some of the vulnerability parameters defined in graph theory. But in spy networks, if a spy or a station is revealed, then the adjacent stations cannot be trusted. Neighbor integrity is a vulnerability parameter that considers the neighborhoods and hence can be applied to the spy networks. The neighbor integrity of a graph G is defined to be $NI(G) = \min_{S \subseteq V(G)} \{|S| + c(G/S)\}$ where S is any vertex subversion strategy of G, and c(G/S) is the order of the largest connected component of G/S.
In this study, we deal with the problem of computing the neighbor integrity of Harary graphs which are the graphs having maximum possible connectivity with the minimum number of edges and hence many researchers are interested in studying its stability properties.

Keywords: Graph Theory, vulnerability, neighbor integrity, Harary graphs.

Introducton

A network consists of centers and lines which connect the centers. A network can be divided into different networks or it can be formed by many sub networks. Failure of / break down the links between centers, failure of the centers, software faults on the network, hardware malfunctions, transmission errors that may ocur in various centers affect performance of a network more importantly. They can cause an interruption on the received service over a network for a long time. The resistance of the network to disruption of operation after the failure of certain stations or links until performance of the network completely stops is called vulnerability. To learn about the vulnerability of the network is very important for the network designers and network analysts. It provides the construction of the network to be designed both in the most appropriate way possible against the threat and in a manner which provides the reconstruction of the network exposed to a damage in a short time. There are different network topologies such as path, tree, star topology and each network topology has advantages and disadvantages. When a network topology need to be modelled mathematically, usage of graph theory emerges as one of the ways of modelling. In a network topology, a network can be modelled by a graph representing the centers by vertices and the links between the centers by edges. Various vulnerability parameters were defined in graph theory to study the vulnerability of the networks. These parameters can be evaluated by using the number of the elements that are not working, the number of the sub networks, and the number of elements in the remaining largest network that can still mutually communicate. Connectivity (Harary, 1969), integrity (Barefoot, 1987), toughness (Goddard, 1990), tenacity (Cozzens et al., 1995), scattering number (Jung, 1978) and rupture degree (Li, 2005) are some of the vulnerability parameters defined in graph theory. Some informations about the vulnerability of the network modelled by graphs can be obtained by using these graph parameters.

The basis of these parameters is the connectivity which is the minimum number of centers that must be removed to disconnect the network. Network designers and network analysts want to design a network which is more reliable or less vulnerable. So they want maximum possible connectivity whereas they want minimum number of edges for the lowest cost network.

For any fixed integers m and n such that $n \geq m + 1$, Harary constructed the class of graphs $H_{m,n}$ which are m-connected with the minimum number of edges on n vertices. So Harary graphs have the maximum possible

connectivity with the minimum number of edges and hence many researchers are interested in studying its stability properties (Harary, 1962). Three cases are followed to create Harary graphs:

Case 1: If m is even, let $m = 2k$, then $H_{m,n}$ has vertices 0,1,2, … , $n-1$, and two vertices i and j are adjacent if and only if $|i-j| \leq k$, where the addition is taken modulo n.

Case 2: If m is odd $(m > 1)$ and n is even, *let* $m = 2k+1$ $(k > 0)$, then $H_{m,n}$ is constructed by first drawing $H_{2k,n}$ and then adding edges joining vertex i to vertex $i + \frac{n}{2}$ for $1 \leq i \leq \frac{n}{2}$.

Case 3: If m is odd $(m > 1)$ and n is odd, let $m = 2k+1$ $(k > 0)$, then $H_{2k+1,n}$ is constructed by first drawing $H_{2k,n}$ and then adding edges joining the vertex i to $i + \frac{n+1}{2}$ for $0 \leq i \leq \frac{(n-1)}{2}$.

Note that under this definition, the vertex 0 is adjacent to both the vertices $\frac{(n+1)}{2}$ and $\frac{(n-1)}{2}$. Again note that all vertices of $H_{m,n}$ have degree m except for the vertex 0, which has degree $m+1$.

In particular, if a vertex loses its function in the security system or in spy networks then adjacent vertices become disfunctional in the same way. With this in mind, many neighbor vulnerability parameters were determined. One such parameter is the neighbor integrity. The concept of neighbor integrity was introduced by Cozzens and Wu in (Cozzens et al., 1996).

Let G be a simple graph without loops and multiple edges and let u be any vertex in G. The set $N(u) = \{v \in V(G); v \neq u, v$ and u are adjacent$\}$ is the open neighborhood of u and $N[u] = \{u\} \cup N(u)$ denotes the closed neighborhood of u. A vertex u in G is said to be subverted if the closed neighborhood of u, $N[u]$, is removed from G. A set of vertices $S = \{u_1, u_2, u_3, \dots, u_m\}$ is called a vertex subversion strategy of G if each of the vertices in S has been subverted from G. If S has been subverted from the graph G, then the survival subgraph is disconnected, a clique or an empty graph. The survival subgraph is denoted by G/S. The neighbor integrity of a graph G is defined to be

$$NI(G) = \min_{S \subseteq V(G)} \{|S| + c(G/S)\}$$

where S is any vertex subversion strategy of G and $c(G/S)$ is the maximum order of the components of G/S (Cozzens et al., 1996).

Neighbor Integrity of Harary Graphs

In this section, we investigate lower and upper bounds of the neighbor integrity for the three cases of the Harary graphs.

Theorem 1. Let $H_{m,n}$ be a Harary graph with $m = 2k$ and $n \geq 3$. Then the neighbor integrity of $H_{m,n}$ is

a) If $1 \leq k \leq \left\lfloor \frac{n}{2} \right\rfloor$, then

$$NI(H_{m,n}) = \begin{cases} \lceil 2\sqrt{n} \rceil - (2k+1), & \text{if } 1 \leq k \leq \dfrac{\sqrt{n}-1}{2} \\ \left\lceil \dfrac{n}{2k+1} \right\rceil, & \text{otherwise.} \end{cases}$$

b) If $k > \left\lfloor \frac{n}{2} \right\rfloor$, then $NI(H_{m,n}) = 1$.

Proof. It is obvious that $H_{m,n} \cong C_n^k$. Thus we have $NI(H_{m,n}) = NI(C_n^k)$.

a) For $1 \leq k \leq \left\lfloor \frac{n}{2} \right\rfloor$ we get $NI(H_{m,n}) = NI(C_n^k) = \begin{cases} \lceil 2\sqrt{n} \rceil - (2k+1), & \text{if } 1 \leq k \leq \frac{\sqrt{n}-1}{2} \\ \left\lceil \frac{n}{2k+1} \right\rceil, & \text{otherwise.} \end{cases}$

since it was proved by Cozzens and Wu in (Cozzens, 1998).

b) For $k > \left\lfloor \frac{n}{2} \right\rfloor$, $diam(C_n) = \left\lfloor \frac{n}{2} \right\rfloor \leq k$. Thus we get $C_n^k \cong K_n$. Therefore we obtain

$$NI(H_{m,n}) = NI(C_n^k) = NI(K_n) = 1.$$

Theorem 2. Let $H_{m,n}$ be a Harary graph with $m = 2k + 1$ and n even, and let $n \geq (4k + 2)(2k + 2)$ and $k \geq 2$. Then the neighbor integrity of $H_{m,n}$ is

$$2\lceil\sqrt{n - (2k + 2)}\rceil - (2k + 1) \leq NI(H_{m,n}) \leq \gamma(H_{m,n}).$$

Proof. Let S be a subversion strategy of $H_{m,n}$ and let $|S| = r$.

If r vertices are removed from $H_{m,n}$, then we have at least $r - 1$ components and $c(H_{m,n}/S) \geq \frac{n-(2k+2)r}{r-1}$. Hence

$$|S| + c(H_{m,n}/S) \geq r + \frac{n-(2k+2)r}{r-1} \text{ and}$$

$$NI(H_{m,n}) \geq \min_r \left\{r - (2k + 2) + \frac{n-(2k+2)}{r-1}\right\}.$$

The function $f(r) = r - (2k + 2) + \frac{n-(2k+2)}{r-1}$ takes its minimum value at $r = \sqrt{n - (2k + 2)} + 1$. Consequently, we obtain

$$NI(H_{m,n}) \geq 2\sqrt{n - (2k + 2)} - (2k + 1).$$

As the neighbor integrity is integer valued, we round this up to get a lower bound and get

$$NI(H_{m,n}) \geq \lceil 2\sqrt{(n - (2k + 2)}\,)\rceil - (2k + 1).$$

Fort he upper bound, let S be the minimum dominating set of $H_{m,n}$ and the domination number be $\gamma(H_{m,n})$. Then $N[S] = V(G)$ and therefore we have $c(H_{m,n}/S) = 0$. Since according to the definition we have $NI(G) \leq |S| + c(G/S)$, we obtain an upper bound as $NI(G) \leq \gamma(H_{m,n})$.

Theorem 3. Let $H_{m,n}$ be a Harary graph with $m = 2k + 1$ and n odd, and let $n \geq (4k + 5)(2k + 2)$ and $k \geq 2$. Then the neighbor integrity of $H_{m,n}$ is

$$2\lceil\sqrt{n - (2k + 3)}\rceil - (2k + 1) \leq NI(H_{m,n}) \leq \gamma(H_{m,n}).$$

Proof.. Let S be a subversion strategy of $H_{m,n}$ and let $|S| = r$.

If r vertices are removed from $H_{m,n}$, then we get at least $r - 1$ components and $c(H_{m,n}/S) \geq r + \frac{n-1-(2k+2)r}{r-1}$. Hence we obtain

$$|S| + c(H_{m,n}/S) \geq r + \frac{n-1-(2k+2)r}{r-1} \text{ and}$$

$$NI(H_{m,n}) \geq \min_r \left\{r - (2k + 2) + \frac{n-(2k+3)}{r-1}\right\}.$$

The function $f(r) = r - (2k + 2) + \frac{n-(2k+3)}{r-1}$ takes its minimum value at $r = \sqrt{n - (2k + 3)} + 1$. Consequently we get

$$NI(H_{m,n}) \geq 2\sqrt{n - (2k + 3)} - (2k + 1).$$

Since the neighbor integrity is integer valued, we round this up to get a lower bound and obtain

$$NI(H_{m,n}) \geq 2\lceil\sqrt{n - (2k + 3)}\rceil - (2k + 1).$$

For the upper bound, the proof is very similar to that of the previous theorem.

Conclusion

Connectivity is a basic measure used to determine the vulnerability of a graph. And it is equal to the minimum number of vertices removed from the graph to make the graph disconnected. We always prefer a stable and durable network which has maximum connectivity. Increase in the connectivity also requires an increase in the number of edges but we prefer to use minimum number of edges for a lowest cost network. Ultimately, we have to balance the cost and stability. Harary graphs which have the maximum possible connectivity with the minimum number of edges provide this balance. In this paper we obtained lower and upper bounds for the neighbor integrity of the three cases of the Harary graphs.

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OPEN GREEN SPACES FUNCTION IN DESTINATION BRANDING: THE CASE OF BARTIN

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Abstract: Open green spaces are greatly important for the creation of sustainable cities in social, cultural, economical and ecological sense. In our days, they have assumed other duties in diverse areas in addition to these properties including the creation of urban identity and destination branding. Destination branding is the indicator of the properties that differentiate that destination from other destinations and describe its natural, cultural and man-made properties. The aim of the study is to determine the principles of design for open green spaces focusing on branding and identity in the process of branding of cities on the special example of Bartın. The study has been carried out in the scope of a method consisting of five stages including literature review and obtaining data, analysis of existing open green spaces in Bartın City with land surveys, carrying out a questionnaire using the Analytical Hierarchy Process (AHP); evaluating all the data obtained and submitting the results and recommendations. In conclusion, open and green spaces are effective in the creation of destination branding and the identity of the city.

Keywords: Destination Branding, Open Green Spaces, Tourism

Introduction

Urban spaces comprise the building blocks, open green areas and roads connecting these spaces. Within the city, all the spaces without any buildings on them and water surfaces are considered as open areas, while urban areas largely covered with plantation areas arranged as parks, playgrounds, play areas, sporting areas or squares to provide the citizens with the possibility of active and passive recreation are defined as green areas (Yücel, Aslanboğa, Korkut, 2008). Open green areas have multiple functions in the city that can be outlined as follows: they provide balance for the city in physical sense (mass-space), act as buffers between different utilization areas including dwellings, trade and industry, clear the air, absorb noise and dust, contribute to the protection of biodiversity, provide the city with microclimatic properties, reduces the risk of flood and erosion, facilitate circulation, provides pedestrians with safe transport possibility, provide the possibility of active and passive recreation, , contribute to the esthetic appearance of the city, and are effective in the creation of city identity (Öztan, 1968; Selitsaniotis, Nikolaou, 2009; Ely, Pitman, 2014). Together with this, trees, shrubs, herbaceous, and aquatic plants used in green areas host animals, reduce the speed of rainwater, filter the rainwater and decreases carbon emission (Vegetation in the Built Environment, 2007).

In our days, the open green areas in cities serve not only for the habitants of cities, but also for domestic and foreign tourists. Tour operators organize city tours with touristic purposes to cover especially such spaces. For example, Central Park in New York, Güell Park in Barcelona, Hyde Park in London, Schönbrunn Palace Gardens in Vienna, Alhambra Palace Gardens in Spain, Spaniard Stairs in Rome, tulip gardens in Holland, Emirgan Woods in Istanbul, San Marco Square in Venice, and the Red Square in Moscow have all become attraction points for tourists. However, lately destinations with similar natural and physical characteristics are focusing on bringing their properties that will represent them and differentiate them from other destinations and becoming a brand. The purpose here is to increase their competition power and to attract more tourists.

In the Turkish Tourism Strategy 2023 also, importance of making cities with strong cultural and natural assets to become brands and making them attraction points for tourists is mentioned among the Tourism Strategies for strengthening the tourism sector (Anonymous, 2007). Not only products, but cities, regions or countries can have brands. Characteristics that must be possessed by a product brand are outlined below. The brand name must remind the benefits of the brand. Of the properties of the product, it must remind the action or color. It must be easy to say and remember. It must be distinguishing. It must not have a bad meaning in different countries or languages. Powerful brands have a word, a slogan, a color, a symbol and a story. All these elements are effective in giving an identity to a brand (Kotler, 2011).

While branding a destination is similar to branding a product, there are also aspects that they differ. Destinations mostly attempt to become a brand by bringing their properties to the forefront to become attractive centers for tourists. Comprehensive market and consumer surveys are required to be successful when creating a brand.

Determining the target markets and positioning the brands are important (Günlü, İçöz, 2004). Characteristics such as the landscape, zoning structure, infrastructure, identity and culture are effective for branding places (Vuignier, 2015).

The brand of a destination is formed by bringing together the brand elements including name, symbol, slogan, color, architecture, cultural inheritance, language, and myths and legends that defines a destination and differentiates it from others (Taşçı, 2007). Brand both ensure distinguishing a destination from other destinations and are the quality symbol of that destination. At the same time, it provides the destination with an identity, and ensures physical and psychological attraction of tourists to that destination (Yılmaz and Çizel 2000).

Identity comprises the elements that differentiate a place from others (Lynch, 1960). Identities of cities are formed based on the natural, socio-cultural and physical identity elements (Köylü, Kiper, 2007). According to Ocakçı (1994), elements constituting the city identity are listed as elements arising from natural, humane manmade sources. Identity elements arising from the natural environment are data including the topographic structure, climate, plant cover, geologic structure and presence of water. Humane data comprise the demographic structure, corporate structure and cultural structure, which can be listed as the population structure, attitudes of individuals, cultural accumulation and experiences, thoughts and expectations related to future, equipments and requests, political, managerial and legal structure and customs and traditions. Manmade environments include buildings, bridges, squares, parks and similar made to meet the requirements of individuals (Önem, Kılınçaslan, 2005).

Another purpose of destination branding is to develop a positive image for the destination (Taşçı, 2007). Tourists form a brand image in their minds depending on the brand identity. Destination's identity and image mutually affect each other. Destination identity is developed and re-structured based on this image. Destination image is critically important in the formation of the definitive and positive brand identity (Qu, Kim, Im, 2011). Image includes the identity formed by the elements used to distinguish that place from others. Identity represents individuality and not being the same with others. Image is formed by the looker. Destination must have some practical or emotional meaning for the looker (Lynch, 1960).

According to Evans (2012), two similar stages are seen in the branding of national, regional or local historical cities. In the first of these, architectural and cultural activity areas, public buildings, dwellings and commercial buildings, shopping centers, transport facilities are re-constructed, or the existing ones are renewed. In the second stage, city design including the public areas such as parks and open areas, squares, cultural, historical and creative areas and transport roads are improved (Evans, 2015).

Ensuring the satisfaction of tourists in issues including accommodation, security and cleaning is also important to be a powerful destination brand. Tourist who leaves the destination satisfied will strengthen the brand even more. With this reason, cooperation must be ensured between public and private sectors to provide for tourist satisfaction in different areas in the destination (Bordas, 2007).

Destination brand also bears an identity and is used as a marketing tool. Since TV and radio are mostly used as communication tools, importance of music and movies for the promotion of a destination is great. Creating brands for destinations and developing strategies to protect the images can be possible by making long-term plans and implementing them. At this stage, public entities and institutions at relevant locations, representatives of the private sector, nongovernmental organizations and local people must work together and in coordination (Günlü, İçöz, 2004). Providing economical support, developing branding strategies targeting the services for the local people and tourists and determining public policies can be possible depending on such potentials (Vuignier, 2015).

Urban quality and feeling of space are effective elements on branding. Urban quality means much more as compared to the physical characteristics of buildings, open green areas and roads. The urban quality is formed by bringing the architectural form, scale, squares, open green areas, landmark, vistas and similar together with the spatial psychology. In short, urban quality is closely related to the social, psychological and cultural properties of the destination (Montgomery, 1998).

In this context, the aim of this study is to determine the principles of design focusing on branding and identity for cities in branding process on the special example of Bartın. In this context, answers have been searched for questions such as "Why is the importance of the branding process for Bartın Province?", "What is the importance of open green areas in the branding process of Bartın Province? and "What can be done?" In conclusion, elements representing the city identity of Bartın have been determined and principles of design for open green areas have been suggested.

Materials and Methods

The main materials of the study comprise the open green areas in the Bartın city center and Bartın Province (Figure 1). Bartın Province is located in the Western Black Sea Region between 41°37' northern latitude and 32°22' eastern longitude. Its surface area is 2143 km^2, and the mean altitude is 25 m (Anonymous, 2008). Bartın Province is established on the plain formed by Kocaçay and Kocanaz Creeks that make the Bartın River. Bartın Province has 104 parks in varying sizes in the scope of open green areas. These parks have been built by the Bartın Municipality. These parks have areas such as sporting areas, playgrounds, resting places and jogging tracks (Bartın Municipality, 2014). Furthermore, old photographs of Bartın, land expeditions and data obtained through questionnaires have also been used as materials.

Since the Bartın Province has the potential of being a branded city with its civil architectural structures reflecting the Ottoman Period, shipyards for building of wooden yachts and boats, traditional handcrafts including "tel kırma" (traditional ornamentation technique special for Bartın) and local dishes in addition to its natural beauties, it has been selected as the subject matter of the study.

a b

Figure 1. a) Bartın's location (URL1, 2013).
b) Bartın's neighbors (URL2, 2013).

Methodology of the study has been determined after a review of the studies (Montgomery, 1998; Qu, H., Kim L. H., Im, H. H., 2011; Akpınar Külekçi, Bulut, 2012; Çelik, Gökçe, Koca, 2013) in the literature. In this frame, this study was carried out using a method consisting of five stages. The first stage was the literature review and obtaining the data. In this stage a literature review was carried out on domestic and foreign literature on subjects including open green areas and their functions, branding, destination branding, and the study area. Plans, reports and visual data related to existing open green areas were obtained from the Bartın Municipality, Directorate for Parks and Gardens. The second stage was analyzing the open green areas within the development zones of the Bartın Province with land surveys. In this stage, the then-current situations of open green areas included in the zoning sheets were analyzed on-site and observations were made. Six parks out of 104 in different sizes were included in the study. These parks were selected because they had many functions including playgrounds, sporting areas and resting areas and addressed the entire city. The third stage was the poll carried out using the AHP by the experts of the relevant stakeholders. According to Russell and Taylor (2003), AHP method is the listing of alternatives based on multiple criteria and using this list in selection. It will thus be possible to determine the brand identity and principles of design based on the questionnaire applied. Data obtained in the survey carried out by the author and colleagues (Çelik, Gökçe, Koca, 2013) were used when preparing the questions in the questionnaire. The reason for this was to determine the priority sequence of the data obtained for the identity of Bartın. It will be possible to develop the design criteria for the open green areas for branding based on this sequence. Stakeholders considered as relevant for the subject matter of the study and that the questionnaire is planned to the applied to included Bartın Provincial Governorship, Bartın Provincial Directorate of Environmental and Water Affairs, Bartın Provincial Directorate of Culture and Tourism, Bartın Municipality, Bartın University, Bartın Provincial Directorate of Environment and Urbanization and relevant professional chambers. The fourth stage was the evaluation of all the data obtained from a perspective of landscape architecture so as to overlap with the objective of the study. The fifth stage was preparation of conclusions and recommendations based on the literature review, land analyses and results of the questionnaire.

Results and Discussion

In the frame of the functions of the open green areas in destination branding, findings obtained from relevant public entities and organizations and questionnaire are outlined below in two sections. These sections include the findings related to the Bartın City and open green areas and findings of the questionnaire.

Findings related to the Bartın City and open green areas: Bartın Province is located amongst Zonguldak, Karabük and Kastamonu Provinces and the Black Sea. City center is located in the hinterland, at a distance of 12 km to the sea. Economy of the city depends on animal husbandry and forestry. Bartın Province has four districts including the central district, Amasra, Ulus and Kurucaşile. Bartın has a marine climate with cool summers and warm and rainy winters. In the city, a natural protected area along the river banks and an urban protected area in the city center are present. Furthermore, there are 258 registered wooden houses in the central district (Anonymous, 2007).

Bartın Province has the properties of a destination with historical, cultural and natural potentials. These potentials allow diverse touristic activities. There are plateaus that serve mountain and highlands tourism including the mountains and plateaus of Uluyayla, Zoni and Ardıç. Furthermore, Mugada Lava Columns and Kastamonu-Bartın Küre Mountains National Park also serve various touristic activities including photo-safari, biking tours or bird observation with mountain tourism in the first place. Bartın has a past of 3000 years, and was first established by Gaskas in the 14th century B.C. Later, it was domineered by various kingdoms with Hittites, Lidia, Byzantine, Seljuk and Ottomans in the first place. While it was a district of Zonguldak in 1924, it was made province in 1991 (Bartın Municipality, 2014).

There are one hundred and four parks in different sizes in Bartın city that can be included in the scope of open green areas. Of these parks, Alibaysal Park, Gazhane Park, Karaçay Picnic Area, Sevgi Park, Municipality Park and Republic Square have been included in the study (Figure 2). These parks have sporting areas, playgrounds, resting areas, jogging tracks and similar areas, and they address the entire city (Figure 3). These parks have been built by the Bartın Municipality. Maintenance, repair and renewal works for parks are implemented by Bartın Municipality Directorate for Parks and Gardens.

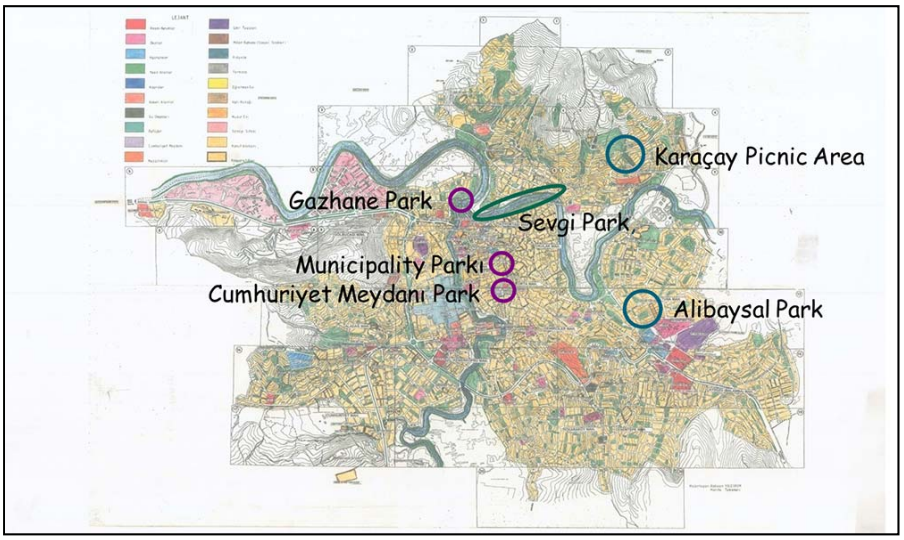

Figure 2. Open Green Areas of Bartın City.

A questionnaire was carried out in the aim of the study with the participation of experts in relevant stakeholders to determine the priority levels of elements representing the Bartın city using AHP. The design principles focusing on branding and identity special for the Bartın Province were determined based on data obtained from the questionnaire. Bartın Provincial Governorship, Bartın Provincial Directorate of Environmental and Water Affairs, Bartın Provincial Directorate of Culture and Tourism, Bartın Municipality, Bartın University, Bartın Provincial Directorate of Environment and Urbanization and relevant professional chambers are the relevant stakeholders that questionnaire will be applied to. A questionnaire was held on 10 experts from these public entities and organizations. Results of the questionnaire carried out using AHP are summarized below.


Bartın River


Gazhane Park


Sevgi Park


Sevgi Park


Karaçay Picnic Area


Alibaysal Park


Cumhuriyet Square Rark


Municipality Park

Figure 3. Bartın River and parks included in the study.

The Expert Choice (EC) program was made use of for the use of AHP method and calculations. Priority order or weights were found for main criteria with the use of this program. The questionnaires carried out were considered

as significant since the Consistency rates of questionnaires were found under 0,1. The purpose of the questionnaires was to determine the order of the main criteria. The identity components and brand components for Bartın Province, which are among the main criteria, are given in Table 1.

Table 1: Main criteria used in the questionnaire

IDENTITY COMPONENTS	BRAND COMPONENTS THAT CAN BE USED IN THE DESIGN		
	Color	**Symbol**	**Slogan**
Historical Buildings	Blue	Historical houses	City of rivers
River	Green	Strawberry	Amasra
Natural beauties (flora, fauna, endemic plant species, geologic formations, etc.)	White	Bartın River	City nested in nature
Strawberry festival	Yellow	Water balance	
Hıdrellez festival	Red	Falls	
Traditional handcrafts including "Telkırma"	Brown		
Presence of local dishes			
River running through the city			
A city nested in nature			

Experts were asked to make evaluations between the criteria with comparisons in couples based on the basic scales given in Table 2.

Table 2: Priority levels and definitions to be used in comparisons in couples between the criteria

Priority Levels	Value Definitions
1	Equally important
3	Important in medium level
5	Strongly important
7	Very strongly important
9	Definitely important
2, 4, 6, 8	Intermediary values

Experts from different professions including landscape architects, architects, urban and regional planners, tourism professionals, and communication and marketing experts working in relevant public entities and organizations participated in the questionnaire. All the participants have the opinion that open green areas are important in the creation of identity. Participants listed the parks they considered important among the open green areas in Bartın with the following order:, Gazhane Park, Sevgi Park, Karaçay Picnic Area, Municipality Park, Alibaysal Park and Republic Square.

The binary comparison matrix that the experts compared each basic criterion related to the identity components is given in Table 3. These values are attributed by the experts participating in the study.

Data obtained from Table 3 are summarized below. In this table, criteria given in lines are compared with the criteria in columns. These comparisons have been asked in the questionnaire in the form questions. Historical buildings have been attributed 5 points (strongly important) when compared to local dishes. However, when the criterion of historical building was compared with the criteria of natural beauties of the Bartın City, river running through the city and city nesting in nature, all these three criteria were attributed 5 points (strongly important). This value has been expressed as 1/5 because of the overlapping of lines and columns in the table. That is, importance of historical buildings is less when compared to these three criteria. Comparison of the criterion of river with the criterion of hıdrellez festival had given 5 points (strongly important) and the same with the presence of local dishes had given 3 points (important in medium level). The criterion of natural beauties of the city was attributed 7 points (very strongly important) when compared to the criteria of strawberry festival and hidrellez festival. Strawberry festival was attributed 5 points (strongly important) when compared to the criteria of river and hıdrellez festival. The traditional handcraft, "tel kırma" was attributed 7 points (very strongly important) when compared to the hıdrellez festival. The criterion of presence of local dishes was attributed 3 (important in medium

level) when compared to hıdrellez festival. However, when presence of local dishes was compared with the criteria of river running through the city and city nested in natures, these two criteria were attributed 7 points (very strongly important) and these values were expressed as 1/7 in the table. In summary, experts considered the criteria of river running through the city and city nesting in nature more important as compared to criteria of presence of local dishes, hıdrellez festival, strawberry festival and "tel kırma".

Table 3: Binary comparison matrix for basic criteria

CRITERIA	Historical buildings	River	Natural beauties	Strawberry festival	Hıdrellez Festival	Tel kırma	Local dishes	River running in the city	City nesting in nature
Historical buildings	1	3	1/5	3	3	1	5	1/5	1/5
River	1/3	1	1/5	1/5	5	1/3	3	1/3	1/3
Natural beauties	5	5	1	7	7	5	5	1	1
Strawberry festival	1/3	5	1/7	1	5	1/3	3	1/3	1/5
Hıdrellez festival	1/3	1/5	1/7	1/5	1	1/7	1/3	1/7	1/7
Tel kırma	1	3	1/5	3	7	1	3	1/3	1/3
Local dishes	1/5	1/3	1/5	1/3	3	1/3	1	1/7	1/7
River running in the city	5	3	1	3	7	3	7	1	1
City nested in nature	5	3	1	5	7	3	7	1	1

When the identity components for Bartın that can be used in the design are sequenced by experts based on weight ratios, the criterion with the highest weight (0.195) was the criterion of "river running through the city". Other criteria were, respectively:

- Natural beauties (weight ratio 0,174),
- River (weight ratio 0,142),
- Historical buildings (weight ratio 0,133),
- City nesting in nature (weight ratio 0,119),
- Presence of traditional handcrafts including "Telkırma" (weight ratio 0,104),
- Presence of local dishes (weight ratio 0,055),
- Strawberry festival (weight ratio 0,041),
- Hıdrellez festival (weight ratio 0,014).

Data related to brands components that can be used in the design according to experts are given in figures below.

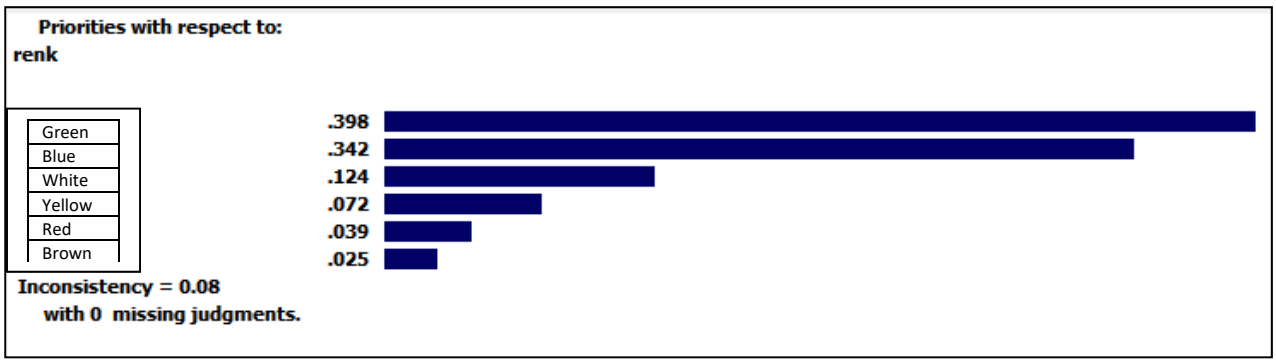

Figure 4. Weights attributed to color main criteria.

Based on Figure 4, levels of priorities of color main criteria are sequences as green (weight ratio 0,398), blue (weight ratio 0,342), white (weight ratio 0,124), yellow (weight ratio 0,072), red (weight ratio 0,039) and brown (weight ratio 0,025). The sum of the weight ratios of criteria is "1". Since the TO shown in the lowest part of the screen is 0,08 < 0,1, the comparison is consistent. The first three colors considered by experts to represent Bartın are green, blue and white, in this order.

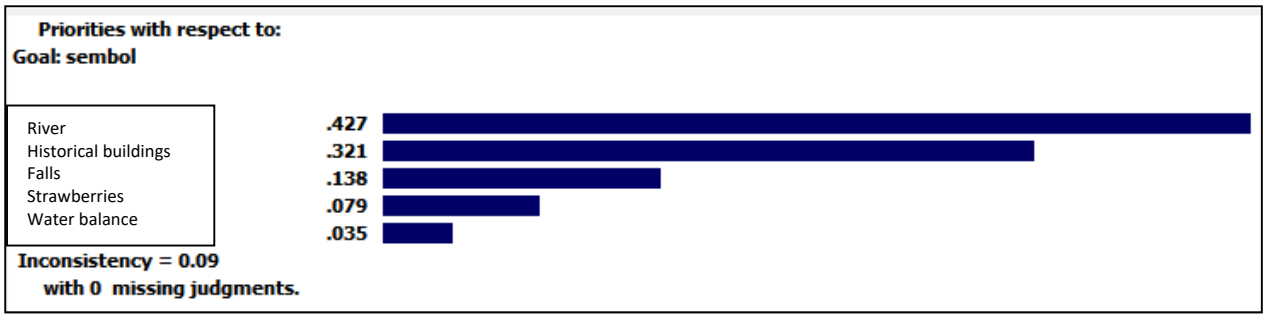

Figure 5. Weight values attributed to symbol main criteria.

According to Figure 5, priority levels for symbol main criteria are sequenced as the Bartın River (weight ratio 0,427), historical buildings (weight ratio 0,321), Falls (weight ratio 0,138), strawberry (weight ratio 0,079) and water balance (weight ratio 0,035). The sum of the weight ratios of criteria is "1". Since the TO shown in the lowest part of the screen is 0,09 < 0,1, comparison is consistent. Experts have selected the river, historical houses and the Falls as the symbols representing Bartın, in this order.

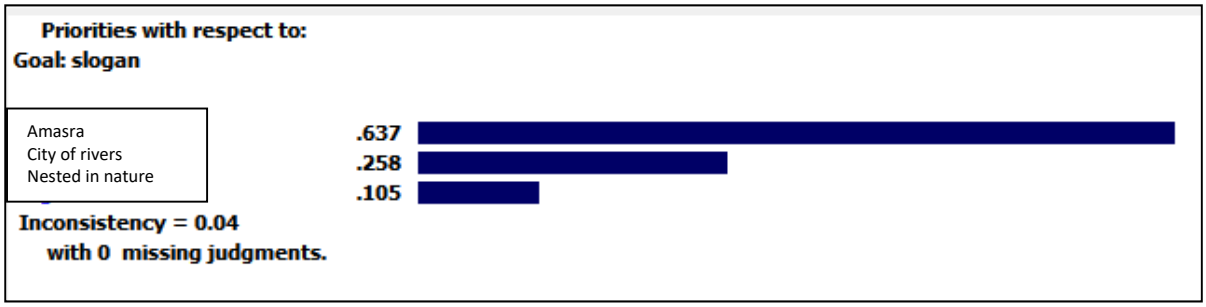

Figure 6. Weight ratios attributed to slogan main criteria.

According to Figure 6, priority levels for slogan main criteria are sequenced as Amasra (weight ratio 0,637), city of rivers (weight ratio 0,258) and city nested in nature (weight ratio 0,105). The sum of the weight ratios of criteria is "1". Since the TO shown in the lowest part of the screen is 0,04 < 0,1, comparison is consistent. Experts have selected Amasra, city of rivers and city nested in nature as the slogans that can be used in the logo representing Bartın, in this order.

In conclusion, each criterion has been compared with others in couples, and the matrix of this comparison has been considered satisfactorily consistent based on the AHP method. In the outline of all the results, the criterion "river running through the city" has the highest priority level with 0.195. Based on the color criterion, green has been found to be in the first place with 0,398 priority level. The most important criterion among the symbol criteria is the criterion of Bartın River and has a priority level of 0,427. Among the slogan criteria, the most important criterion is the criterion of Amasra with a priority level of 0,637.

Identity components and brand components for the Bartın province have been sequences based on the data obtained from the questionnaire. Based on these data, principles of design focusing on branding and identity for open green areas for Bartın are recommended as follows.

- Identity, color, symbol and slogan criteria obtained from the results of the questionnaire can be given as the definitive criteria for the design to be made for open green areas.
- Open green areas can be designed with nature as the theme.
- Photograph take areas can be created in the open green areas with the symbols of "Bartın River", "historical houses" and "Falls" as plastic objects.

- Symbols can be used and slogans “Amasra”, “City of Rivers” and “City Nesting in Nature” can be written on flooring.
- Adventures parks with the theme of river can be constructed in playgrounds.
- Plant arrangements in green, blue and white colors can be designed.
- Designs can be developed for urban equipment elements in harmony with the identity, color and symbol components.
- Water element can be used together with plant arrangements.
- Bartın River can be made use of as a whole with its potential of transport and structure convenient for recreational organizations.
- Footing and jogging tracks, resting areas, photograph take points and playgrounds can be constructed along the Bartın River banks, and existing ones can be improved.
- Stands reflecting the civil architecture characteristics can be created in open green areas to sell traditional handcraft products and local dishes.
- Squares can be designed for open green areas to hold the celebrations such as strawberry festival or hıdrellez festival.
- The Bartın logo suggested based on the data obtained is presented in Figure 7.

Figure 7. The Bartın logo suggested (illustration by Murat Sarı, graphic drawing by Mustafa Semih Saraoğlu).

Revising the existing open green areas according to the recommended design criteria and developing the new designs also according to these criteria are important in the branding process of Bartın. Public and private sectors, nongovernmental organizations, Bartın University and local people must work together in a multidisciplinary fashion in order to achieve success.

Although Amasra had taken the first place among the slogans that could be used for branding of Bartın in the data obtained from the questionnaire, Amasra was not used in the suggested logo. The reason for this is that the element remembered first upon mention of Bartın was Amasra till today. However, the slogan “Bartın, City of Rivers” was used with the purpose of diminishing or wiping off this judgment and ensuring that Bartın will be called with its own name and branding with its own identity components and creating its new image. The branding strategies in tourism focusing on urban landscape have been determined for the Bartın City in the study of Çelik and other (2013). In the study carried out, the colors to be used in Bartın logo depending on focusing on natural beauties of Bartın have been determined by the majority of participants as blue for the river and sky and green for nature. No sequencing of criteria was asked in the questionnaire. This sequencing was made based only on the numerical superiority of the participants of the questionnaire. In the present study however, participants were asked to sequence colors. The same colors were preferred in this study also; however, order of colors has been changed. Green has taken the first place and blue has taken the second places in this study. A regards the slogan, including the word “Amasra” in the slogan as an important destination, which is considered as a strong aspect of Bartın, and “City of Rivers” since a river runs through the city has been preferred by the participants. Sequencing of the slogan was the same in the previous study and the present study. While river and natural beauties had been preferred as symbols in the first study, river and historical houses have been preferred by the participants of the questionnaire in this study. River has taken the first place in both studies as the symbol to represent Bartın. In this scope, uses

focusing on the river and its surroundings must be developed in planning and design studies to be carried out for Bartın city landscape and open green areas, and the existing ones must be improved. Natural landscape elements included in the identity components of the Bartın City have taken their places in the front in both studies. Cultural landscape elements including historical houses, handcrafts, local dishes, strawberry festival and "Hıdrellez" festival are in the second place.

Conclusion

Open green spaces of the city, as well as many other factors are effective in the destination branding. Open green spaces are such spaces that serve the city both in functional and esthetic aspects. Use of natural and socio-cultural landscape elements reflecting the city identity for the design criteria of such spaces will positively affect branding. Increase in the recreational esthetic and physical values result in the increase in the attractiveness of cities or touristic destinations. Since branding gives rise to being preferred, national policies are being used lately for the branding of cities, regions and countries.

Furthermore, while branding imposes values on destinations such as quality and confidence, it also establishes positive relations with tourists to create brand dependence. Creating unforgettable travel experiences related to a certain destination is possible through the establishment of emotional connections between the tourist and the destination (Taşçı, 2007). Moreover, brand positioning activities must be supported by carrying out both qualitative and quantitative studies focusing on both tourism and its demand (market structure and tendencies and profiles of tourists, etc.). The entire sector including the public and private sectors and all the entities must act in cooperation action plans must be prepared and common strategies must be developed.

Lastly, the brand identity is formed together with the city identity during the destination branding. Open green areas are effective on both destination branding and creation of the city identity. Brand image is created together with identity.

As regards the brand image, the consumer/tourist attributes a meaning to the product/destination in his/her mind as a results of his/her experiences related to the product/destination and identifies with an object. Brand components, advertisements and similar issues are effective on perceptions of tourists. The short-term objective when creating the image is to influence the tourists, while the long-term objective is to be an assuring brand (Ak, Sağdıç, 2009).

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PERCEPTIONS OF BUSINESS PROFESSIONALS TOWARDS MOBILE DEVICE USAGE

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Abstract: In today's world, mobile devices became an inevitable part of our lives. The main purpose of this study is to find out perceptions of business professionals towards use of their mobile device in the workplace as well as at the business meeting settings. To understand business professionals' mobile phone usage at the workplace, an online survey was conducted with Turkish business professionals, who are members of Linked-in social network. Findings of the study indicate the fact that, mobile phone usage at work is positively welcomed in general. Respondents especially appreciate "the flexibility" and "the ability of doing a better job" through accessing corporate emails and other business apps outside official working hours and they strongly believe that "mobile phone usage at work is necessary". However, they slightly believe that their colleagues inappropriately use mobile phone at workplace. "Bringing phone to the meeting", "Excusing oneself to take a call", and "Checking time" are among the most appropriate mobile phone actions during the formal business meetings. On the other hand, "Checking a social media account", "Taking a call without excuse", and "Browsing Internet due to boredom" are seen inappropriate by most of the respondents.

Keywords: Bring-Your-Own-Device (BYOD), mobile phone usage, smartphone.

Introduction

Mobile technologies are promisingly evolving and becoming essential in our lives. Mobile device usage and smartphone ownership continues to increase in the world. Based on the Guardian research, China, India, U.S, Indonesia, Brazil, Japan, Russia, Mexico, Vietnam, Germany, and Turkey are the top countries where smartphone penetrations grow fastest and create the largest number of new owners (Arthur, 2014). Smartphone adoption continues to be more popular among 25-34 year olds and followed by 35-44 year olds segment in both US and Europe (ComScore, 2012). In today's world, mobile devices became an inevitable part of our lives. People now expect to access information anytime, anywhere, and in real-time. Fear of missing out, or FOMO in short, is the main driver behind our mobile addiction. Not to miss out from anything, 31% of mobile phone owners state that they never turn their phone off and 45% of owners rarely turn it off (Rainie & Zickuhr, 2015). Smartphones have been becoming so important that 42% of Turkish people indicate they would prefer to give up TV rather than their smartphones (Google Ipsos MediaCT, 2013).

Mobile technologies can be considered as one of the major forces that contribute to change in the way of doing business. Employees are increasingly becoming mobile, and they use mobile devices such as smartphones and tablets to do their work at the office, at home, and while traveling. Employees currently use their smartphones and tablets for the following work related activities: accessing employee intranet / portal, accessing to e-mail and/or calendar, reading or viewing documents, spreadsheets, or presentations, accessing social networking, watching video, taking work-related photos and/or videos, team portals, editing documents, spreadsheets, or presentations, web meeting, instant messaging, processor-intensive activities like analytics or modeling, videoconferencing, and company- or industry-specific application that is created by the company (Cisco Systems, 2012). Findings of the Ovum Multi-Market BYOD research shows employees appreciate flexibility of access to key tasks out of office hours and majority of them believe that accessing to corporate emails and content outside of office hours improves their ability to do their job well (Absalom, 2013).

The use of employee-owned devices in the workplace is clearly rising and companies are increasingly supporting the Bring-Your-Own-Device (BYOD) trend in order to save costs associated with providing devices themselves. BYOD is defined as "using a personal smartphone or tablet for any activity other than making calls or sending texts, therefore accessing corporate data" (Drury, 2012). Regardless of the company's location, size or industry, BYOD will be a common reality in the workplace (Symantec, 2013). A significant number of employees want to use a single device in all areas of their life. Ovum Multi-Market BYOD research indicates that approximately 57% of all employees worldwide are accessing corporate data in some form on a personal smartphone or tablet (Absalom, 2013). The findings of Rapid7 revealed that 64% of respondents allow personally-owned mobile devices to be used at work; however nearly half of all respondents indicated they were unaware of how many mobile devices on average each employee is using to access company data (Rapid7, 2013). Although "Always-on" access to corporate data is seen as more of a benefit; some companies do not allow personally-owned mobile devices to be used for work because of security risks.

Employees use their mobile phone during the business meetings that they attend. There are several studies on the use of mobile devices in the business settings such as business meetings (Broughton et al., 2010; Washington, Okoro, & Cardon, 2013; Bradberry, 2014; Wahla & Awan, 2014). While some people show tolerance for mobile phone use in business settings; some people think it's inappropriate and annoying to use mobile phone during business meetings. Three out of four people indicated that checking texts or emails is unacceptable behavior in business meetings; while 87% of people declared that answering a call is rarely or never acceptable in business meetings. Even at more informal business settings, the majority of people said that writing or sending a text message is inappropriate (Washington, Okoro, & Cardon, 2013). According to some research results, elder people with higher positions tend to approve mobile phone use in meetings less than their colleagues at lower positions do (Washington, Okoro, & Cardon, 2013; Bradberry, 2014).

In this study, perceptions of Turkish business professionals towards use of their mobile device in the workplace as well as at the business meeting settings will be analyzed. The Consumer Barometer Report (2015) results reveal that Turkey is the 6th country among the world regarding the personal internet usage and as first half of the 2015, mobile phone penetration rate reached to 92.9% in Turkey (Bilgi Teknolojileri ve İletişim Kurumu, 2015). It is obvious that smartphone penetration is on the rise in Turkey. Therefore it is worthwhile to analyze perceptions about the use of mobile device in business settings.

Research Methodology

The main purpose of this study is to find out perceptions of business professionals towards use of their mobile phone in the workplace as well as at the business meeting settings. To understand business professionals' mobile phone usage at the workplace, an online survey was conducted with Turkish business professionals, who are members of Linked-in social network, in June-July 2016. The main advantage of conducting the survey with the members of Linked-in social network is to reach people who are really business professionals. In this online questionnaire attitude toward mobile device usage in the business settings was measured with 14-item, five-point Likert-type scale (1= "strongly disagree" to 5= "strongly agree"), which is adapted from the study of Wahla and Awan (2014). The Cronbach's Alpha for this 14-item scale is 0.814; so it can be argued that scale reliability is quite high. Perceived appropriateness of mobile phone actions during formal business meetings was measured with 11 item, five-point Likert-type scale which is adapted from the study of Washington, Okoro, and Cardon (2013). This 11-item scale is highly reliable with a Cronbach's Alpha score of 0.862.

383 respondents answered the online questionnaire and 42 respondents who do not work currently are eliminated from the analysis. A total of 341 usable responses was gathered and demographic characteristics of the respondents are presented as frequencies and percentages in Table 1.

The distribution of gender groups are quite fairly distributed. Among the 341 respondents, 55.7% of the respondents consists of females while 44.3% consists of males. Majority of the respondents (55.1%) are between the ages of 30-39, 29% of respondents between the ages of 20-29, and finally 11.4 % of them are between the ages of 40-49. Regarding their occupations, 80.9% of respondents are working at private sector, while 15.8% of them are working at public sector. The majority of the respondents (51.9%) have graduate, and 38.1% of the respondents have bachelor degree.

Table 1 Demographic profile of the respondents

		N	**%**			**N**	**%**
Education	Primary School	2	0.6	**Gender**	Male	151	44.3
	High School	12	3.5		Female	190	55.7
	2-years University	20	5.9	**Age**		**N**	**%**
	Undergraduate	130	38.1		Below 20	2	0.6
	Graduate	177	51.9		20 - 29	99	29.0
		N	**%**		30 - 39	188	55.1
Occupation	Private	276	80.9		40 - 49	39	11.4
	Public	54	15.8		50 - 59	12	3.5
	NGO	3	0.9		60 and over	1	0.3
	Other	8	2.4				

As it is illustrated in the Table 2, employers (9.4%), senior executives (10.9%), middle managers (27.6%), lower level of managers (13.8%), employees (20.8%), and teaching staff (15.5%) are among the participants of the online survey.

Table 2 Position of the respondents

Position	N	%
Employer	32	9.4
Senior Executive	37	10.9
Middle Manager	94	27.6
Lower Level Manager	47	13.8
Employee	71	20.8
Teaching Staff	53	15.5
Other	7	2.1
Total	341	100

Results and Discussion

Majority of the respondents (98.5%) who attended the survey own a smartphone. 70.6% of the respondents stated that they use their personally-owned mobile devices for both business and personal usage. Some of the respondents (21.9%) use two mobile phones, one is for personal purposes the other is for business use. While, 7.5% use corporate phone both for personal and work-related purposes. 37.5% of the respondents indicated that their work-related phone calls are paid by their corporation. When the respondents were asked whether their corporation allows them to use their personal mobile phone for work, 14.7% of the respondents told that it is not permissible.

Respondents were asked 14 questions (see Table 3) about their attitude towards mobile device usage in the business

settings. 9 of the scale items remarked with "R" in Table 3 were asked with negative statement towards mobile device usage, and then had been coded as reverse questions for the ease of analysis. The statements that respondents mostly agree with are "I like the flexibility of being able to access corporate emails and other business apps outside official working hours" (μ: 4.29), "Mobile phone usage at work is necessary" (μ: 4.23), "Being able to access corporate emails and other business apps outside official working hours enables me to do my job better" (μ: 4.17) and "Employer does not have a legal right to restrict use of mobile phone in office" (μ: 3.96). On the other hand, the statement that respondents least agree with is "I don't think my colleagues inappropriately use mobile phone at workplace" (μ: 2.63). And for the statements "Mobile phone usage does not cause distraction in workplace" (μ: 2.99) and "Personal mobile phone usage in staff and team meetings should be allowed" (μ: 2.92), people tend to neither agree nor disagree with a mean score near 3.

Table 3 Attitude toward mobile device usage in the business settings

	Mean	**Std. Dev**
I like the flexibility of being able to access corporate emails and other business apps outside official working hours	4.29	1.009
Mobile phone usage at work is necessary	4.23	1.019
Being able to access corporate emails and other business apps outside official working hours enables me to do my job better	4.17	1.127
Employer does not have a legal right to restrict use of mobile phone in office (R)	3.96	1.316
If my employer strictly bans use of mobile phone it will have negative impact on my morale	3.79	1.259
Supervisor does not have a responsibility to monitor the appropriateness of mobile phone usage (R)	3.77	1.385
Employer should not apply restriction on use of mobile phone in office timing (R)	3.75	1.254
Using mobile phone at work improve your efficiency	3.57	1.182
Mobile phones can be used for personal purposes at work (R)	3.37	1.301
Unproductive use of mobile phone like calls to friends and family will not be harmful for organization and employees' performance (R)	3.37	1.239
It is not necessary to make personal phone calls only during breaks and lunch time (R)	3.23	1.412
Mobile phone usage does not cause distraction in workplace (R)	2.99	1.342
Personal mobile phone usage in staff and team meetings should be allowed (R)	2.92	1.507
I don't think my colleagues inappropriately use mobile phone at workplace (R)	2.63	1.238

Table 4 illustrates the professionals' attitude towards mobile device usage in formal business meetings. The most acceptable actions are "Bringing phone to the meeting" (μ: 3.78), "Excusing oneself to take a call" (μ: 3.53) and "Checking time" (μ: 3.35). On the other hand, "Checking a social media account" (μ: 1.90), "Taking a call without excuse" (μ: 1.90) and "Browsing Internet due to boredom" (μ: 2.12) are not seen appropriate by most of the respondents.

Table 4 Perceived appropriateness of mobile phone actions during formal business meetings

	Mean	**Std. Dev**
Bringing phone to the meeting	3.78	1.227
Excusing oneself to take a call	3.53	1.162
Checking time	3.35	1.341

Checking incoming calls	3.07	1.295
Writing text messages or emails	3.05	1.312
Reading text messages or emails	2.99	1.392
Using a mobile app	2.58	1.316
Making calls	2.44	1.439
Browsing Internet due to boredom	2.12	1.233
Taking a call without excuse	1.90	1.192
Checking a social media account	1.90	1.217

Conclusion

In this study, perceptions of business professionals towards use of mobile phone in the workplace as well as at the business meeting settings were analyzed. Findings of the study indicate the fact that, mobile phone usage at work is positively welcomed in general by most of the professionals. Professionals especially appreciate "the flexibility" and "the ability of doing a better job" through accessing corporate emails and other business apps outside official working hours and they strongly believe that "mobile phone usage at work is necessary". However, they slightly believe that their colleagues inappropriately use mobile phone at workplace. The use of mobile phone in formal meetings is questioned as well. To some extent, it is acceptable for professionals to bring phone to the meeting, excusing oneself to take a call and checking time. However, checking a social media account, taking a call without excuse and browsing Internet due to boredom are regarded as inappropriate in formal business meetings.

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TEACHERS' VIEWS ON THE USE OF INTERACTIVE EDUCATION WEBSITES IN SOCIAL STUDIES CLASSES

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Abstract : This study aims to determine the views of teachers on the use of interactive education websites in social studies classes This study aims to determine interactive education websites used by teachers in social studies classes according to their views. Participants were asked about their opinions on the education websites they used in social studies classes, the benefits to students and teachers, and the problems encountered. The participants of the study were 18 classroom teachers working in the city center and districts of Afyonkarahisar Province in the spring term of the 2015–2016 academic year. Criterion sampling, a purposeful sampling method, was used to determine the participants. A phenomenological design, a qualitative research method, was used and data collection was conducted by using a Semi-Structured Interview Form prepared by the researcher. A content analysis technique was used to analyze the data. The data analysis showed that the interactive education websites used by the teachers in their classes were mostly Morpa Kampüs and Okulistik, Vitamin and partially, EBA. The study found that the teachers reported that the use of interactive education websites in social studies classes offers many benefits to teachers and students.

Keywords: Social studies, class teacher, interactive education websites

Introduction

Today, information and communication technologies are used intensively, and it is unquestionable that knowledge accumulation is increasing each passing day and it is necessary to make greater use of this resource. Along with globalization, the circulation of knowledge and the need to make better use of it have led to the development of information acquisition technologies, such as the Internet (Şahan, 2005). The Internet, the largest communication network used by individuals to acquire, produce and share information, has begun to be used in numerous fields such as education, healthcare, government, industry, and defense. The use of Internet in education has caused many changes. The use of the Internet is continually increasing and Internet-based education has gradually come into prominence. In Internet or Web-based education, teachers and students can connect to their class material via a computer connection, whenever they want and wherever they are. In Turkey, the aim is to form an association between education and technology, as necessities of the information age. In the 2010–2014 strategic plan (MNE, 2009), the Ministry of National Education aimed to enable all schools to have Internet access, to make information technology classes common, to prevent inequality in access to the Internet and, therefore to provide a student-oriented and project-based education for the use and dissemination of new technologies. It is inevitable that teachers will benefit from technology in their classes. Social studies education supported by technology plays an important role in obtaining information that is impossible in conventional classes, and in the acquisition of various skills. It is necessary for today's teachers to benefit from technology in order to increase primary school students' opportunities to learn in social studies classes, and to enable them to establish a connection between past, present and future (Mason, 2000). Today, children's use of technology and the Internet for education and entertainment is increasing. Students benefit from technology in many areas, such as Internet research, and access to videos, images, search engines, maps, social media and games. Because social studies contain the subjects of many disciplines, technology should be used in these lessons as much as possible.

Teachers can develop their students' global awareness, using various effective, appropriate and authentic educational technologies (Crawford and Kibry, 2008). In a study in which Brad et al. (2015) planned to teach social studies subjects via video games, an increase was observed in the children's skills of problem solving, motivation, interest and goal setting and planning. Also, it was found that students better understood concrete concepts and theories used in real life. Marcus et al. (2010), stated that movies play an important role in teaching historical subjects in social studies lessons and should be used by teachers as they enable students to acquire the skills of historical empathy, interpretation and analytical thinking.

In a study conducted by Yeşiltaş and Kaymakçı (2014) to determine the technological dimension of a social studies teaching program, it was found that these programs are structured in a way to provide the opportunity to use technological products in terms of their general purposes, content, learning–teaching processes and assessment–

evaluation tools and methods. Having technological knowledge, as well as field knowledge and teaching skills, affects teachers' views on the inclusion of educational technologies in classes (Crawford and Kibry, 2008). The lack of knowledge and skill in the use of technology in social studies classes leads teachers to teach their lessons in conventional way. The teachers' use of technological applications in their lessons is associated with their skills and self-efficacy in using technology (Friedman and Heafnee, 2010). In Turkey, interactive education software has been produced that can incorporate video, images, documentaries, animations, cartoon movies, and caricatures on subjects in social studies and other education, in compliance with each grade level. The number of teachers who use this kind of software is increasing daily. This study aims to determine the views of teachers on the use of interactive education websites in social studies classes This study aims to determine interactive education websites used by teachers in social studies classes according to their views. Participants were asked about their opinions on the education websites they used in social studies classes, the adequacy of these educational websites, the benefits of using these websites to students and teachers, and the problems encountered. Answers were sought for the following questions:

1. What are the views of classroom teachers about the adequacy of different educational websites that they use in social studies classes?
2. What are the views of classroom teachers about the stage of the social studies class at which they use interactive education websites?
3. What are the views of classroom teachers about why they use different education websites in social studies classes?
4. What are the views of classroom teachers about the benefits to teachers of using different education websites in social studies classes?
5. What are the views of classroom teachers about the benefits to students of using different education websites in social studies classes?
6. What are the views of classroom teachers about difficulties they encounter while using different education websites in social studies classes?

Method

Research Design

A phenomenological design, a qualitative research method, was used in the study. Phenomenology examines the real nature of a phenomenon (Patton, 2014). The aim of phenomenological research design is to reveal the experiences and perceptions of individuals about a phenomenon and the meanings they attribute to it (Yıldırım and Şimşek, 2013). Phenomenological research defines the common or shared experiences about a phenomenon or concept (Creswell, 2015). It focuses on how individuals describe phenomena, what they think about them, how they perceive them and attribute a meaning to them. In this research design, in-depth interviews should be conducted with individuals who have directly experienced the relevant phenomenon, in other words, have experiences about it, in order to collect data (Patton, 2014). In the present study, the phenomenological design was considered as a method which provided an opportunity to assess the interactive education websites used by the teachers in social studies classes, to determine why and how they use them, and the problems they encounter and recommended solutions.

Participants (Study Group)

The participants of the study consisted of 18 teachers working in the city center and districts of Afyonkarahisar Province in the spring term of the 2015–2016 academic year. The criterion sampling method, a purposeful sampling strategy that enables all cases fulfilling some criteria to be selected, was used to determine the participants. Purposeful sampling methods are used to increase transferability in qualitative researches with the aim of revealing incidents and facts, and their features of variability (Yıldırım and Şimşek, 2013). In purposeful sampling, cases are selected for a study because they provide more information and they are enlightening. They can provide important explanatory information about the relevant phenomena studied. Cases that are rich in information provide more data for researchers (Patton, 2014). The criteria determined for participant teachers were as follows; working with fourth graders and participating voluntarily in the study. The effective factor in setting "working with fourth graders" as a criterion for classroom teachers was that there were several questions in the interview form about education websites used at this grade. Social studies classes are included in the fourth-grade curriculum in primary school, requiring the classroom teachers to work with fourth graders. The information about the 18 participants who constituted the study group is showed in Table 1.

Table 1. Information about participants

Variable		f
Sex	Female	9
	Male	11
	Total	**18**
Seniority	0–10 years	4
	11–20 years	9
	21–30 years	3
	30 and above	2
	Total	**18**

Data Collection and Data Collection Tools

The data were collected using a Semi-Structured Interview Form which was developed by the researcher and consisted of 9 open-ended questions. In qualitative research, a semi-structured interview is a commonly used data collection method when the researchers want to analyze a subject in detail and to better comprehend the responses given (Harrell and Bradley, 2009). A Semi-Structured Interview Form with 11 open-ended questions was prepared on the basis of a literature review and given to three experts in different departments of a faculty of education in a state university who examined it to ensure its internal and external validity. These classroom teaching experts were asked to ensure the scope and face validity, and to check whether the questions in the interview form were clear and understandable, and that they involved the topic discussed. As a result of the expert review, two questions were judged to be inappropriate to the research topic and were excluded from the interview form. After the necessary adjustments were made in accordance with the experts' opinions and comments, an interview form consisting of 9 open-ended questions was developed. Later, a pilot interview was conducted with a classroom teacher. An assessment was conducted after this interview was written down, which showed that the questions were understood clearly by the participant.

Data Analysis

The content analysis technique was used to analyze the data. In content analysis, the data obtained in a study is subjected to an in-depth analysis, in order to develop concepts and themes. The process of content analysis consists of stages, including data coding, finding themes which divide codes into certain categories, the organization and description of data according to codes and themes, and the interpretation of findings (Yıldırım and Şimşek, 2013). The interviews were recorded by video camera and transcribed by the researchers. All of the written interview data were coded by two researchers. The interrelated codes were classified by their similarities and differences, and the researchers decided under which sub-themes the data would be grouped and presented. These sub-themes, which were associated with each other, were combined and inserted into the main themes presented in broader dimensions. The consistency between codes established by the two researchers was calculated using the formula, [Agreement / (Agreement + Disagreement) x 100] (Miles and Huberman, 1994). As a result of the comparison between codes, the consistency between encoders was calculated as 0.88. The fact that reliability calculations were found to be above 70% was regarded as reliable for the study (Miles and Huberman, 1994). Code names (T1, T2, T3 ...) instead of the teachers' names were used in direct quotation to support the results obtained.

Results

Information about the interactive education websites mostly used by the teachers in social studies classes is shown in Table 2. Later, the participants' comments and direct quotations about the adequacy of these websites were also presented.

Table 2. The most used interactive education websites in social studies lesson

The most used education websites	Frequency
Morpa Kampus	13
Okulistik	8
Vitamin	5
Eğitim Bilişim Ağı (Education Information Network)	2

As can be seen from Table 2, it was found that the interactive education websites mostly used in social studies classes were Morpa Kampus, Okulistik and Vitamin. The participants reported that these websites are compatible with the acquisitions in social studies teaching programs and they are quite adequate. Also, the participants emphasized that these interactive education websites are highly professional and they are appreciated by their students. Moreover, it was also reported that Eğitim Bilişim Ağı (Education Information Network) is not used

often in social studies because its content is inadequate and complicated, and is incompatible with the acquisitions in social studies teaching programs and is not intended for primary school programs in particular.

The participant teachers reported that the websites such as Okulistik and Morpa Kampus are professional and commonly used in social studies classes. One of the participants, T4, said, "*The websites like Okulistik and Morpa, which were created more professionally, are important sources for me in social studies lessons, therefore I find them quite practical."* Another participant, T12, also said, *"The interactive websites that I use most in social studies and find useful are Morpa Kampus and Okulistik, respectively. These websites go in parallel with the subjects that we teach in lessons. I think they are adequate and it is easy to use them."*

The participants also emphasized that the other interactive education website used in social studies classes is Vitamin. One of the participants, T2, said that, *"My students are pleased when they see me opening Vitamin. Videos, images, and particularly exercises in this website work a lot for me. I find these websites adequate."*

Another participant, T1, reported that EBA does not have any content related to primary school programs and it is not used often in social studies and other classes because its usage is complicated compared to other websites. He/she said, *"The passwords of EBA were also given to us, but I cannot use this website because it is not yet adequate. The data in this website are inadequate because accurate and proper data for primary schools have not been uploaded to the website. I find Morpa Kampus adequate for those who want to use it in terms of visual aspects and information because it offers an opportunity to project books on the interactive whiteboards."*

From the teachers' views, it can be stated that they use mostly the Morpa Kampus and Okulistik education websites in social studies classes, and that the newly-developing EBA program is not preferred because it does not follow the lesson content and acquisitions exactly.

Information about the most commonly used and liked categories of the interactive websites in social studies classes is showed in Table 3.

Table 3. The most commonly used and liked categories of the interactive websites

The most commonly used and liked categories	Frequency
Audible and animated video lectures	16
Assessment exams	12
Homeworks	10
Interactive activities	8
Worksheets	8
Games	2
Music	2
Documentaries	2
Images	2

As shown in Table 3, the category most used by the teachers in social studies classes was audible and animated videos that are based on lectures. The classroom teachers were also found to use images, animations, assessment questions and activities.

One participant teacher, T15, reported using video lessons, saying that, *"There are video lectures created in accordance with each subject of the lessons and their acquisitions. First, I have students listen to these lectures. I deliver the subject by myself sometimes, by pausing the video lecture or after it ends, and reinforce the subject with questions."*

The participants also reported that they use assessment exams in particular. They emphasized that they use tests prepared for each unit or theme, subject screening tests prepared for each subject, and mid-term and end-of-year assessment tests. It was also reported that the assessment questions are so useful and professional that they facilitate the work of teachers. One of the participants, T2, said, *"I like assessment categories most on these websites. In the past, we were working hard and it was so difficult and time-consuming for us to prepare questions accurately according to subjects and units. The exam questions in these websites have been prepared and arranged so professionally that they attract the students' attention. I can easily reach the subjects that I deliver in the lesson. I use animations and exam questions categories a lot, particularly for social studies classes, because it is a verbal class."*

Information about the most commonly used category of the interactive education websites in social studies classes is showed in Table 4.

Table 4. The most commonly used category of the interactive education websites in social studies classes

Stages of the lesson	Frequency
At all stages of the social studies lesson	**12**
Measurement and Assessment	**12**
Worksheets	6
Exercises	2
Tests	2
Subject revision	2
Drawing attention	**8**
Video	6
Music	2
Learning and teaching process	**7**
Lecturing	3
Animation	3
Games	1
Documentary	1

The participants reported that they use interactive education websites at almost all stages of the social studies lesson. In parallel with the results above, the teachers use interactive education websites mostly at the measurement and assessment stage of the social studies lesson. The participants reported that they use assessment exams (worksheets, exercises and tests) and audible and animated video lectures with the aim of subject revision at the end of the lesson. On this matter, one teacher, T6, said, *"I use these materials at the end of the lesson to reinforce what is learned and to make a general revision."* Another teacher, T18, said, *"I use these materials to conduct a revision at the conclusion stage of the lesson and to summarize the subject,"* while T9 said, *"I use these materials at the assessment stage of the lesson for the subject."*

The participants also reported that they use video and music in the second place to draw attention at the introduction stage of the class. One teacher, T15, said, *"I use these materials to attract my students' attention to the subject at the introduction stage of the lesson. I start the lesson sometimes with a song, narration or lecture-based videos. Afterwards, I proceed to the next stage with the textbook."*

The participants stated that they use video lectures, animations, games and documentaries in the learning and teaching process. On this matter, one teacher, T5, said, "*I use the education websites that enable students to become active and participate actively in the learning–teaching process, instead of following and listening to their teachers passively, at the development stage of the social studies lesson. I enable my students to watch the videos on these websites and do exercises. I use documentaries prepared for the social studies lesson, particularly regarding the subjects in the unit, 'I am learning my past'."*

Information about the subjects of the social studies lesson most commonly used in the interactive education websites is showed in Table 5.

Table 5. The subjects of the social studies lesson most commonly used in the interactive education websites

Subjects Used	Frequency
Turkish War of Independence	18
Elements of National Culture	16
Natural Disasters	16
Non-Governmental Organizations	14
Environmental Pollution	10
Developments in Science and Technology	10
National Holidays	9
Introducing other countries and cultures	3
Our individual differences	2

As can be seen in Table 5, the teachers stated that they use the education websites for almost all subjects. They also reported that they benefited mostly from the videos and documentaries related to the Turkish War of Independence within the context of history subjects in social studies classes. The participants also emphasized that they use animations and documentaries in particular for the subjects including elements of national culture, natural

disasters, non-governmental organizations, environmental pollution, developments in science and technology, national holidays, introducing other countries and cultures and our individual differences. On this matter, one of the participants, T6, said, *"Social studies is a verbal lesson, thus I benefit from documentaries generally for historical subjects, especially regarding the Turkish War of Independence, but I also try to use these materials for almost all subjects such as natural disasters, cultural elements from past to present and environmental issues."*

Information about the benefits to the teachers offered by the use of interactive education websites in social studies classes is showed in Table 6.

Table 6. Benefits for teachers of interactive education websites

Benefits for teachers	Frequency
Enabling teachers to be prepared	16
Enabling teachers to prevent the lesson from being monotonous	14
Providing convenience	10
Enabling teachers to draw their students' attention more easily Enabling teachers to reach a large number of examples and images, and further information about the subject	9
Providing teachers with a large number of materials (video, animation, activity)	8
Increasing the teacher's control over the lesson	7
Enabling teachers to concretize the subjects	5
Enabling teachers to reach measurement and assessment sources easily	5

As can be seen in Table 6, the teachers reported that using these websites in social studies and other classes enables teachers to be well-equipped and better prepared for the classes. They also stated that these websites enable social studies classes to be more entertaining, and less monotonous, and that they make it easy for teachers to access the intended information. The participants also emphasized that these websites enable teachers to access relevant information, images, examples, videos, activities, tests and exam questions for measurement and assessment appropriate to each subject. It was also stated that the high number of these sources increases the control of teachers over the classes, enables the subjects to be reified, and improves the motivation of students.

One of the participants, T18, offered the view that these websites enable teachers to be better prepared, saying, "*We could not always access various sources while preparing for the lessons in the past, but now there are materials available, prepared in accordance with the class subjects. The availability of these materials, from video lectures to exam questions, facilitates our works and enables us to be prepared for the classes."* One of the participants, T3, reported that the interactive education websites offer convenience to teachers and assist them, and that they also provide teachers with a large number of material. He/she said*, "They make giving lessons easy for teachers. They provide teachers with a large number of materials and enable them to come to school prepared."* Another teacher, T16, said, *"They provide teachers with different and rich content. They provide us with educational materials which are prepared in accordance with technology."*

One of the participants, T14, reported that using interactive websites enables students to enjoy the class, helps teachers hold their students' attention, and it prevents the lesson from being monotonous. He/she said, "*If I use various games and animations in the lesson, it stops being monotonous. In this respect, I think these websites enable social studies lessons to be enjoyed and listened to with interest by the students; thus, our work gets easier."* On this matter, another teacher, T8, said, *"Using the lecture method, the students become distracted after a while; therefore, these websites become helpful for teachers by enabling them to provide lessons easily."*

One of the teachers, T2, stated that the interactive education websites concretize what teachers teach and enable them to increase their control over the lesson. He/she said, *"Their benefits are considerable if a teacher finds subject-oriented materials for what he or she wants to teach in these websites. They can deliver the abstract concepts in the lesson concretely by using these websites. Therefore, it facilitates the teachers' work, allows them to establish control over the lesson, offers diversity in lecturing and enables teachers to make lessons entertaining, rather than boring*. On this, another teacher, T11, said, *"Thanks to the activities on them, these websites are useful in making the lesson entertaining, giving concrete examples and holding the students' attention."*

One of the participants, T5, reported that the interactive education websites provide teachers with a convenient way to hold their students' attention by saying, "*I think that different education websites are very useful for teachers to teach social studies. They enable us to mentally prepare the children for the lesson and most importantly, draw their attention to the subject. I also think that these websites help teachers enable students to comprehend what is taught...*"

Information about the benefits to the students offered by the use of interactive education websites in social studies classes is shown in Table 7.

Table 7. Benefits for students of interactive education websites

Benefits for students	**Frequency**
Enabling permanent learning	15
Drawing attention	12
Leading to individual learning	10
Enabling students to be motivated	10
Enabling students to enjoy social studies classes	8
Enabling students to recognize that they can obtain information in different ways	
Enabling active participation	5
Learning to learn	4
Supporting the students with different learning styles	3
	2

According to Table 7, the participants reported that the use of interactive education websites in social studies classes has various benefits for students, such as enabling permanent learning, drawing their attention, leading them to individual learning, and enabling them to be motivated. They also stated that teaching the lesson by using these websites causes children to like it, enables them to learn the different ways of getting information whenever and wherever they want, and helps them to learn by experience. Moreover, they emphasized that these websites contribute to "learning to learn" by enabling students to access information whenever they want, at their own pace, and to assess themselves by activities and questions, and that they help teachers reach children with different learning skills. On this, one of the participants, ST5, said, *"Students have difficulty understanding abstract concepts. These websites deliver concepts by concretizing them and enabling permanent learning because they appeal to students in both visual and audial ways. Students can get information for their research assignments or preparation for the next class by themselves, without the help of their teacher thanks to different websites. I think these websites are also useful for students because they try to enable students to acquire information in different ways."*

Information about the difficulties encountered while using interactive education websites in social studies lesson is showed in Table 8.

Table 8. Difficulties encountered while using interactive education websites in social studies classes

Difficulties faced	Frequency
Internet outage and low-speed internet connection	15
Inadequate number of activities	10
Inconsistency between the acquisition requirements in the program and the content on the websites	5
Not updating the websites according to the changes in the program	4
Some of the websites require students to pay membership fees	2
The content and usage of some websites is complicated	2

As can be seen in Table 8, Internet outage and low-speed internet connection are the difficulties most faced by classroom teachers. Apart from these, they also reported that they encounter difficulties, such as inadequate number of activities for the subject, inconsistency between the acquisitions in the programs and the content on the websites, websites not reflecting promptly changes in the programs, some websites requiring students to pay membership fees, and the fact that it is complicated to use some websites.

One of the participants, T1, reported having difficulty connecting to the Internet. He/she said, *"I have always difficulty while opening websites, and sometimes I encounter difficulty with the Internet connection. Because of these problems, I fall behind in teaching subjects and I have to teach lessons in simpler way."* Another participant, T3, said, *"I have difficulty with slow Internet speed and outages."* One of the participants, ST5, reported on the inadequacy of content and activities: "*The difficulty that I most frequently encounter is that some of the websites are inadequate in terms of content. Although our textbooks have tens of acquisitions, it is impossible to find a video or animation for each acquisition. I also encounter websites which are inadequate not only in terms of delivering lectures, but also educational games or assessment..."*

Conclusion and Recommendations

This study aimed to determine teachers' views on the use of different interactive education websites in social studies classes This study aimed to determine the use of different interactive education websites in social studies classes according to the views of teachers. It found that teachers generally use these websites in their lessons and they find them adequate. This study also showed that these interactive education websites are highly professional and that they are appreciated by the students. Moreover, it was found that Eğitim Bilişim Ağı (Education Information Network), which is quite new for the primary school level, is not used often in social studies because its content is inadequate and complicated, and it is incompatible with the program acquisitions and it is not intended for primary school programs in particular. Açıkalın (2010) observed that teachers use websites in social studies classes.

The category on the interactive education websites most frequently used by the teachers for social studies classes was found to be audible and animated video lectures. Tests prepared for each unit or theme, subject screening tests prepared for each subject, and mid-term and end of year assessment tests are also other materials that teachers use most frequently. Moreover, assignments, interactive activities, worksheets, games, music, documentaries and images prepared in accordance with each subject on the interactive education websites are also used and preferred. In a study conducted by Çetin (2010), students reported that the high number of elements, such as activity, experiment, game and animation, within the content of classes delivered using web-supporting teaching methods, makes them happy; the high number of questions in the content provide reinforcement; and web-based teaching can be conducted without constraints in time and place. Based on the study results, the use of interactive education websites by teachers in their classes should be made more common and teachers should be encouraged to use them.

It was found that the teachers use the interactive education websites mostly for the subjects including the Turkish War of Independence, elements of national culture, natural disasters, non-governmental organizations, environmental pollution, developments in science and technology, national holidays, introducing other countries and cultures, and our individual differences. The participants reported that the use of documentaries about historical subjects and videos about natural disasters is effective. Furthermore, images and videos, which contain elements of national culture, and introduce non-governmental organizations and explain their activities within the context of current events, are also used in the lessons. Images for environmental pollution and videos for raising environmental awareness are also used. It is highly important for teachers to include interactive education websites within the content regarding different disciplines in social studies classes so that the social studies education becomes effective and efficient.

The participants reported that using interactive education websites in social studies classes and other lessons enables teachers to be well-equipped and better prepared, makes social studies classes more entertaining and prevents them from being monotonous, and offers convenience to teachers by enabling them to access the intended information more easily. Moreover, the participants emphasized that these websites enable teachers to access relevant information, images, examples, videos, activities, tests and exam questions for assessment appropriate to each subject, increase the control of teachers over the classes, enable the subjects to be reified, and increase the motivation of students.

In a study conducted by Çiftçi, Taşkaya and Alemdar (2013) to determine the opinions of classroom teachers on the Fatih Project, it was found that using Internet software and tablets in education facilitates teachers' access to information, offers a large number of materials and simplifies teachers' work in several aspects, and consequently helps them save time. All teachers should be oriented and encouraged to use these websites. Most of the teachers using EBA reported that the biggest contribution of the platform in terms of its positive effects on teachers is that it positively affects the motivation of students for the lesson because it increases visuality (Türker and Güven, 2016).

The teachers reported that the use of interactive education websites in social studies classes has various benefits for students, such as enabling permanent learning, drawing their attention, leading them to individual learning and encouraging their motivation. The participants also stated that teaching social studies classes by using these websites causes children to enjoy the classes, enables them to learn the different ways of getting information whenever and wherever they want, and helps them to learn by experience. In a study "Exemplary Social Studies Teachers Use of Computer-Supported Instruction in the Classroom," conducted by Açıkalın (2010), the participants emphasized that the use of computers in social studies classes facilitates students' work and enables them to learn faster. In the same study, most of the participants emphasized that the Internet is very useful because it enables students to gain global and multiple perspectives. In a study conducted by Heafner (2013), the teachers emphasized that it is absolutely necessary to use technology in social studies classes because it makes learning

meaningful for children, motivates them to learn, enables them to learn in accordance with their own pace and interests, develops their research skills, and helps them learn by associating the social studies concepts with their lives. In an experimental study based on web-supported teaching, Çetin (2010) found that web applications improved the academic achievement of students significantly and increased their motivation towards the lesson.

Internet outage, inadequate number of activities and inconsistency between content and acquisition are the main difficulties faced by the teachers while using these websites. In a study titled "Secondary Social Studies Teachers' Perceptions of Effective Technology Practice," conducted by Heafner (2013), the participants stated that they experienced difficulties such as Internet outage in social studies classes, which causes loss of time while trying to follow curriculum. The sub-structural deficiencies in schools should be corrected to use these websites in an effective way. Also, the contents of these websites should be developed, organized and updated.

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TECHNOLOGICAL SUSTAINABILITY OF MOBILE LEARNING

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Abstract: This study aims to investigate and improve factors affecting technological sustainability of m-learning. In addition to literature review, an investigation based on interviews was conducted with 11 heads and systems experts of distance education centers to obtain the technological sustainability factors of m-learning. In order to understand the significance of these factors on m-learning sustainability, another investigation based on survey research was conducted with 75 system staffs from the universities which have m-learning facilities. The data analyzed and evaluated for a technological sustainability model of m-learning. The study may provide guidelines to m-learning initiatives for a sustainable mobile learning.

Keywords: mobile learning, m-learning, sustainability, technology

Introduction

In the last ten years, many educational institutions have started to give mobile learning which is defined as "intersection of online learning and mobile computing" by William (2003). The mobile devices which are used in m-learning can be listed as mobile device, like cellular phones, Personal Digital Assistants (PDA), smartphones, tablet PC etc. (Andronico et al., 2003). These devices are used for many instructional activities such as downloading and sharing document, collaborating on projects, reviewing coursework, preparing for exams, showcasing their work, sharing project results, reading (listening to) audio books, recording information, presenting projects; conducting research, saving their work, submitting work to the instructor etc. (Corbeil & Valdes-Corbeil, 2007). Although there are more advantages of online learning environments for both students and institutions, high dropout rate is a problem in online education (Bowers & Kumar, 2015).

This study aims to investigate the technologic dimension of m-learning sustainability and seeks to answer such research questions: What are the factors that can affect the technological sustainability of mobile learning? What is the current situation of the technological sustainability of m-learning at universities in Turkey?

Literature Review

Technological perspective of mobile learning sustainability has been handled in few studies. According to Stansfield et al. (2009), appropriate infrastructure & standards (cost effectiveness, systems security, adoption of open-source technologies), support for staff & users/students (adoption of open-source technologies, effective training, maintenance agreements in place), embracing innovation (identifying new trends, integration with mainstream programs, pro-active management) and testing and evaluation (rapid application development, clear technology requirements) are key issues of sustainable e-learning.

Ktoridou and Eteokleous (2005) address the technological aspects on their study. According to them, when mobile devices are compared with PC or desktops, mobile devices have advantages in terms of portability, transfer, usability, battery life, time, familiarity and youth lifestyle but have disadvantages in terms of functionality, expansion and upgrade, connectivity and interoperability, connectivity costs and security. Pea and Maldonado (2006) handled seven device features contributing to the rise in handheld use within schools and beyond: (1) size and portability; (2) small screen size; (3) computing power and modular platform; (4) communication ability through wireless and infrared beaming networks; (5) wide range of available multipurpose applications; (6) ready ability to synchronize and back-up with other computers; and (7) stylus driven interface.

Standards and architecture, tools and technologies, and functionality and uses are important factors from the technological view of e-learning (Conole, 2004). Kukulska-Hulme (2007) pointed out that "m-learning activity continues to take place on devices which are not designed for educational use, and that therefore usability issues are frequently reported". He gave some usability issues related to physical attributes as small screen size, heavy weight, inadequate memory and short battery life, network speed and reliability, and physical environment.

Five broad categories of technology must be considered from technological viewpoint of m-learning; these are transport, platform, delivery, media technologies, and development languages (Attewell, 2005). Cobcroft (2006) handled mobile devices, wireless infrastructure, learning management systems (LMS) in his literature review into mobile learning in the university context. Sánchez and his colleagues (2013) investigated the factors that determine the acceptance of the WebCT learning system among students. The factors they investigated are technical support; computer self-efficacy; perceived ease of use; perceived usefulness; attitude; and system usage. The study revealed the importance of the technical support variable. Oinas-Kukkonen and Kurkela, V. (2003), stated that network accessibility is a main advantage of m-learning. So, it can be taken for inspection of its effect on sustainability.

From a technology viewpoint, restrictions that may impede m-learning sustainability as discussed by Maniar and Bennett (2007), include following eight aspects: small screen size and poor screen resolution, lack of data input capability, low storage, low bandwidth; limited processor speed, short battery life, software issues and interoperability, and lack of standardization. There are some technological challenges and limitation for mobile learning, lack of standards is one of them (Grohmann et al., 2005). Georgiev et al. (2006), also examine the technological challenges of transition from e-learning to m-learning in their study in terms of student, educators and developers. According to them, challenges are for developers:

- *less memory, less computing power, smaller screen size, absence (in most cases) of keyboard, etc.*
- *need to know very well all the abilities and downfalls of the particular mobile devices and communication technologies to successfully design and develop a mobile learning system.*

for educators:

- *need to know very well how to operate mobile devices,*
- *need to know what to require from the developers,*
- *need to know what the limits and abilities of such systems are,*
- *need to be also fluent with the modern communications devices used by their students.*

for students:

the different features of mobile devices compared to the personal computers

Mekuria (2009), studied on sustainability factors in mobile broadband technology and services. Some following questions are handled with the study: (1) Which technology is suitable for designing, activating and affordable delivery of relevant mobile broadband services? (2) Which technology provides easy to tools and protocols to create local mobile content and integrate it to the global web knowledge through mobile IP technologies? (3) Which technology has support to alternative energy usage and provides low power network topologies? (4) What is the contribution of such a technology deployment for the long term mobile-ICT development initiative and digital inclusion? (5) Which technology can give the needed spinoff and employment creation through mobile local content and service provision for social and economic development? (6) Which technology and/or combination of technologies, has the inherent capacity for long term industry support and sustainable service provision. (7) Which technology can provide the maximum spectral efficiency for a given licensed frequency area, by a network operator.

Theoretical Framework and Hypotheses

The sustainability items based on the factors in literature are combined with the items which are obtained from interviews and the factor analyses were applied to the sustainability items in order to group the items under some factors which will be the independent variables (Table 1).

Table 1 Literature-based and Interview-based M-Learning Sustainability Factors

Technological sustainability items of m-learning	**Technological sustainability factors of m-learning**
system security	Adequacy of Infrastructure & Standards
connectivity	
accessibility	
interoperability	
modularity	
memory adequacy*	
quality standards	Evaluation and Improvements of Infrastructure & Standards
requirement specification	
expansion and upgrade	
maintenance	
testing	

availability of support for system use*	Technical Support for Staff, Instructor and Users
availability of support for connection problems*	
accessibility of support	
effectiveness of support	

*Interview-based sustainability items

After the factor analysis, a theoretical framework was developed to guide the study (Figure 1).

Figure 1 Theoretical Framework

The following hypotheses were established for this study:

H_1: Adequacy of infrastructure and standards will be associated with perceived general technological m-learning sustainability.

H_2: Evaluation and improvements of infrastructure and standards will be associated with perceived general technological m-learning sustainability.

H_3: Technical support for staff, instructors and users will be associated with perceived general technological m-learning sustainability.

H_4: Perceived general technological m-learning sustainability will be associated with perceived general m-learning sustainability.

Methodology

In this study, the literature was reviewed about current sustainability factors and an investigation was made in order to obtain additional sustainability factors from experts. A formal interview which consists of six predetermined and standardized questions, and comment area conducted with 11 heads or system staffs in distance education centers of universities.

Then, factor analysis was applied to group the items handled from both literature and interview. The items are collected under the titles: “Adequacy of Infrastructure & Standards”, “Evaluation and Improvements of I&S” and “Technical Support for Staff, Instructors and Users”.

In order to obtain data to understand the effects of these factors on technological m-learning sustainability, survey research conducted with system and support staff at distance education centers of universities. First part of the survey includes descriptive items like age and working year in m-learning environment. Another item is for understanding the accessibility to learning system from mobile devices. The second part of the form includes 15 Likert scale items for technological factors, 1 Likert scale item for general technological sustainability and 5 Likert scale items based on the definition of m-learning sustainability in recent study (Coskun-Setirek & Tanrikulu, 2015) for general m-learning sustainability. Totally 75 completed survey forms has been collected and analyzed for understanding the research questions.

Results and Discussion

As a result of data collection process for technological sustainability issues, 75 valid responses have been collected. For the analyses of the data, descriptive analyses, reliability analyses, factor analyses, multiple regression analyses and linear regression analysis techniques were respectively used.

Descriptive Analysis

In descriptive analysis, age and working year of staffs in mobile learning are analyzed. As shown in Table 2, 52% of the respondents of the survey part about technological issues are 20-30 years old and percentages of respondents whose m-learning experience more than 3 years is 44.

Table 2 Demographic Profile of Respondents

Age		<20	20-30	30-40	40-50	50>	Total
	Frequency	2	39	19	9	6	75
	Percent	2.7	52	25.3	12	8	100
Experience		<1	1-3 year(s)	3-5 years	5>		Total
	Frequency	15	27	18	15		75
	Percent	20.0	36.0	24.0	20.0		100.0

When the mean values of the issues are examined, it can be seen that all of them higher than the average value 3 (shown in Table 3). Each issue has value more than 3.5 except the quality standards with 3.41 mean values. The issues quality standards, requirement specification, expansion and upgrade, and maintenance have low mean values so these issues should be solved to increase the technological sustainability of that aspect. The higher mean values belong to accessibility, interoperability, connectivity, and availability of system use support issues. On the other hand, the value of perceived technological m-learning sustainability, 3.69, is higher than the value of perceived general m-learning sustainability, 3.44. It can be said that technological sustainability is in better condition than other dimension of m-learning.

Table 3 Descriptive Statistics of Variables

Technological Issues	N	Mean
system security	75	3.68
connectivity	75	3.84
accessibility	75	4.19
interoperability	75	3.89
modularity	75	3.63
memory adequacy	75	3.80
quality standards	75	3.41
requirement specification	75	3.53
expansion and upgrade	75	3.55
maintenance	75	3.57
testing	75	3.64
availability of system use support	75	3.88
availability of support for connection problems	75	3.60
accessibility of supports	75	3.68
effectiveness of support	75	3.80
Perceived General Technological M-learning Sustainability	75	3.69
Perceived General M-learning Sustainability	75	3.44

Reliability Analysis

Cronbach's Alpha analysis was used for finding the reliability values of each variable. According to Cronbach's Alpha analysis, as shown by Table 4, the overall value of Cronbach's Alpha was found as .925. According to Kline (2013), the reliability of the scale is quite high since it is more than .9.

Table 4 Reliability Statistics

Cronbach's Alpha	N of Items
.925	21

Factor Analysis

In this section, Exploratory Factor Analysis is used to classify the 15 sustainability aspects into certain groups. The reliability of the scale is high with the .925 Cronbach's alpha value. On the other hand, the subjects-to-variables ratio should be at least 5 and preferably 10 (Everitt, 1975). Corresponding ratio for this study is 6 and sample size is adequate for the analysis. When we took a rule of thumb into consideration, sample is found to be highly adequate for factor analysis with the .818 Kaiser-Meyer-Olkin Measure value (Table 5) because it is greater than .50 (a rule of thumb). In addition, the significance level of Barlett's Test (.000 as seen in Table 5) is below .001 therefore it is indicating sufficiently large correlations for principal component extraction and this test showed that the data is suitable for analysis.

Table 5 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.818
Bartlett's Test of Sphericity	Approx. Chi-Square	558.546
	df	105
	Sig.	.000

The Total Variance Explained table (Table 6) shows that 62.157% of the total variance is explained by classifying these 15 aspects into 3 components. Below 50% is interpreted as unsatisfactory by many researchers and 60% or more is preferred as a rule of thumb.

Table 6 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.306	42.041	42.041	6.306	42.041	42.041	3.473	23.153	23.153
2	1.633	10.884	52.924	1.633	10.884	52.924	2.995	19.966	43.119
3	1.385	9.233	62.157	1.385	9.233	62.157	2.856	19.039	62.157
4	1.072	7.144	69.302						
5	.837	5.578	74.880						
6	.677	4.512	79.392						
7	.582	3.882	83.274						
8	.526	3.505	86.778						
9	.384	2.559	89.338						
10	.358	2.384	91.721						
11	.350	2.334	94.055						
12	.289	1.925	95.980						
13	.262	1.748	97.728						
14	.189	1.260	98.989						
15	.152	1.011	100.000						

With the Rotated Component Matrix, it can be determined which variables load together under which factor. According to the Rotated Component Matrix (Table 7), 15 aspects were classified into 3 components as specified in theoretical framework of the study. The first group under component 2 was named as “Adequacy of Infrastructure & Standards”. The second group under first component was named as “Evaluation and Improvements of Infrastructure & Standards”. The last group under component 3 was named as “Technical Support for Staff, Instructors & Users”.

Table 7 Rotated Component Matrix

Technological Items	Component		
	1	2	3
system security	.401	.447	.285
connectivity	.429	.578	.206
accessibility	.397	.602	.180
interoperability	.331	.620	.219
modularity	.061	.827	.016
memory adequacy	.025	.817	.214
quality standards	.673	.398	.000
requirement specification	.770	.068	.230
expansion and upgrade	.732	.107	.268
maintenance	.796	.196	.164
testing	.631	.207	.265
availability of system use support	.291	.087	.771
availability of support for connection problems	.341	.142	.781
accessibility of supports	.037	.203	.800
effectiveness of support	.199	.193	.735

As a result of the factor analysis, the items and the variables of the study are figured out in Figure 2.

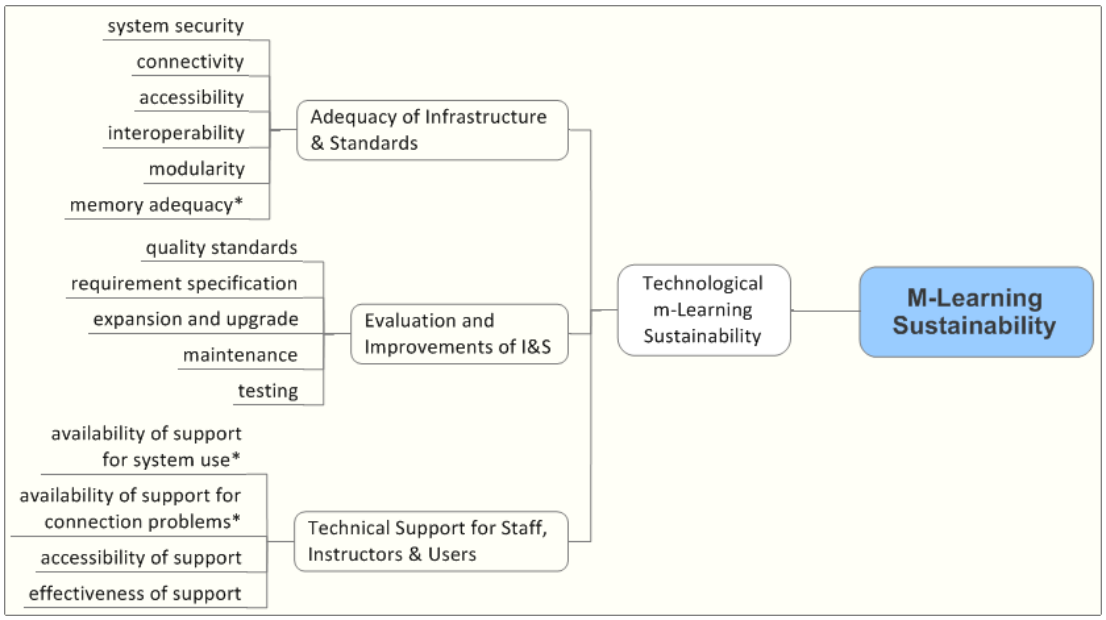

Figure 2 Technological Sustainability Items and Variables

Regression Analyses

For testing hypotheses 1, 2 and 3, a multiple regression analysis was constructed. The three influential variables "adequacy of infrastructure & standards", "evaluation and improvements of infrastructure and standards", and "technical support for staff, instructors and users" were used as independent variables, while perceived general technological m-learning sustainability was used as a dependent variable. The ANOVA table (Table 8) shows that F value of 30.116 having a significance level of 0.000 and the significance value is less than .05.

Table 8 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.368	3	7.456	30.116	.000[a]
	Residual	17.578	71	.248		
	Total	39.947	74			

As seen in Table 9, the adjusted R^2 is .541 and .541 of the variance in the dependent variable is explained by the independent variables. Durbin-Watson value shows that there is 2.001 auto-correlation between the independent variables and it is between desired range of 1.5-2.5. So we can examine the hypotheses and coefficients.

Table 9 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.748[a]	.560	.541	.498	2.011

a. Predictors: (Constant), adequacy of infrastructure & standards, evaluation and improvements of infrastructure and standards, and technical support for staff, instructors and users

b. Dependent Variable: perceived general technological m-learning sustainability

The results of regression analysis are presented in Coefficient table (Table 10). It shows that P-values of three independent variables are less than .05 and they are considered to have meaningful relationships with perceived general technological m-learning sustainability. Those factors are memory adequacy, investment, expansion and upgrade, and cost effectiveness. Therefore, all variables contribute significantly to the regression equation and hypotheses 1, 2 and 3 are supported by this test. The regression equation is specified as follows: PGTS = .651 + .364 X_1 + .256 X_2 + .272 X_3

Table 10 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.651	.326		1.998	.050
	adequacy of infrastructure & standards (X_1)	.364	.090	.367	4.064	.000
	evaluation and improvements of infrastructure & standards (X_2)	.256	.088	.271	2.907	.005
	technical support for staff, instructors and users (X_3)	.272	.083	.305	3.261	.002

a. Dependent Variable: Perceived General Technological M-learning Sustainability (PGTS)

For testing hypotheses 4, a linear regression analysis was used. The perceived general technological m-learning sustainability was used as independent variable, while perceived general m-learning sustainability was used as a dependent variable. As shown in ANOVA table (Table 11), F value is 76.475 and it has a significance level of 0.000 which is less than .05.

Table 11 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	25.827	1	25.827	76.475	.000[a]
	Residual	24.653	73	.338		
	Total	50.480	74			

a. Predictors: (Constant), Perceived General Technological M-learning Sustainability

b. Dependent Variable: Perceived General M-learning Sustainability

As seen in Table 12, R Square is .512 and the adjusted R^2 is .505 and independent variable explains .505 of the variance in the dependent variable. Durbin-Watson value shows that there is 1.769 auto-correlation between the independent variable and the dependent variable, and it is between desired range of 1.5-2.5. Therefore, the hypotheses and coefficients are can be examined.

Table 12 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.715[a]	.512	.505	.5811326	1.769

a. Predictors: (Constant), Perceived General Technological M-learning Sustainability

b. Dependent Variable: Perceived General M-learning Sustainability

Coefficients table (Table 13) presents the results of regression analysis of the Hypothesis 4. It shows that the P-value is less than .05 and there is a meaningful relationship between the perceived general technological m-learning sustainability perceived and the general technological m-learning sustainability. Therefore hypothesis 4 was also supported by the linear regression test.

Table 13 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.470	.346		1.359	.178
	Perceived General Technological M-learning Sustainability	.804	.092	.715	8.745	.000

a. Dependent Variable: Perceived General M-learning Sustainability

The result of regression analyses were given in Table 16. All three issues which are adequacy of infrastructure & standards, evaluation and improvements of infrastructure & standards, and technical support for staff, instructors and users are considered to have meaningful relationships with the technological m-learning sustainability. In

addition, there is a meaningful relationship between perceived general technological m-learning sustainability and perceived general technological m-learning sustainability.

Table 14 Result of Regression Analyses

Hypothesis	Factors	Coefficients Beta	t	Sig.	Significant
	TECHNOLOGICAL M-LEARNING SUSTAINABILITY				
1	Adequacy of Infrastructure & Standards	.367	4.064	.000	Yes
2	Evaluation and Improvements of I&S	.271	2.907	.005	Yes
3	Technical Support for Staff, Instructors & Users	.305	3.261	.002	Yes
4	Perceived General Technological M-Learning Sustainability	.715	8.745	.000	Yes

*Significance at .1 levels.

The model for technological sustainability was developed after the analyses (as presented in Figure 3).

Figure 3 The Final Model for M-learning Sustainability

CONCLUSION

In this study, the aims are specifying the current situation of m-learning and identifying factors affect technological sustainability of m-learning.

The descriptive analysis inform about the current situation of the sustainability of m-learning at universities in Turkey. It is observed that quality standards, requirement specification, expansion and upgrade, and maintenance issues have minimum mean values so these issues should improve to increase the technological and general sustainability of that aspect. The maximum mean value belongs to accessibility, interoperability, connectivity, and availability of system use support issues. On the other hand, the value of perceived technological m-learning sustainability, 3.69, is higher than the value of perceived general m-learning sustainability, 3.44. Therefore, it can be said that technological sustainability is in better condition than other dimension of m-learning.

The result of regression analyses show that all three issues which are adequacy of infrastructure & standards, evaluation and improvements of infrastructure & standards, and technical support for staff, instructors and users are related with perceived general technological m-learning sustainability. Moreover, there is a meaningful relationship between perceived general technological m-learning sustainability and perceived general technological m-learning sustainability. Therefore all hypotheses 1, 2, 3, 4 were supported.

The limitation of this study is that the investigation is geographically limited to Turkey. As a recommendation for future research, other dimension of the m-learning sustainability such as pedagogical, managerial, economical, psychological sustainability, etc. can be studied.

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THE COLOR PREFERENCES OF CONSUMERS ON FURNITURE SURFACES

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Abstract: In this study, the color preferences of consumers were studied on the most applied three finishing types on the furniture surfaces. These are transparent finishing, staining, and opaque painting. In this direction, it was targeted to set forth the color preferences, which would be the basis for the user-oriented design applications. A personal interview survey was prepared for gathering data for this study. Some questions took place in the survey to determine color and finishing type preferences of consumers according to their different demographic and economic characteristics. It was contacted with a total of 479 consumers with the random sampling method. The consumers were potential furniture buyers and living in the central counties of Ankara, Turkey. The data collected by the survey were analyzed statistically and the results were interpreted. In conclusion, the color and finishing type preferences of the consumers on furniture surfaces show a variation according to demographic characteristics, such as age, gender, marital status, educational level and income level.

Keywords: Color preference, furniture design, consumer preferences, marketing, surface finishing

Introduction

Economic factors (income level, general economic situation, and financial structure), social factors (culture and sub-culture, social class, reference groups, roles and family), psychological factors (motivation, perception, attitudes, learning and personality) and personal factors (demographic and situational) are influential in the purchasing decisions of the consumers. Individuals expect a number of differences in product according to their characteristics, which stem from these variables. In connection with this, every product should be designed in a manner that would answer these expectations of the consumers. Product characteristics requiring differentiation related to furniture are functionality, reliability, durability and safety, led by being aesthetic. It is necessary to dwell upon the aesthetic characteristics, such as functionality, form, balance-proportion and texture, led by color, in order to be able to harmonize the characteristics of the product to the expectations of the consumers in the differentiation of products.

Selection, arrangement and application of color affect to the appearance of the furniture and add a meaning to the furniture, in general to the space where the furniture is used. There are meanings, such as vigor, warmth, coolness, mobility, tranquility, contentment, giving trust, peace, cleanliness, purity, etc. in the colors applied to space or furnishings, such as furniture. Furniture users are affected by this meaning, whether or not they are aware of it. Furthermore, there are differences in the color preferences according to the structural characteristics of the furniture users.

It is impossible to avoid the mutual influence of color and people, since every product and every space where these products would be placed would definitely be colored. For this reason, the colors of the spaces and furnishings should be suitable to the function of the space, the psychology of people and to the preferences of the people using these spaces. When the coloring of the furniture is viewed from this aspect, then whether or not the standard furniture should be "single-colored or multi-colored" and "which one of this color or colors would be used" confronts us as a very important problem that should be solved. Because according to the color preference of the consumers, different colors of the same model are sold in different quantities and an excessive production of a furniture with a color that is preferred less and offered on the market causes an increase in the levels of stock and consequently in costs.

Different finishing applications on the furniture surfaces, such as transparent finishing, staining, and opaque painting are also influential on the preferences of the consumers. The same consumer who likes a color in one type of finishing may not like it on a different finishing type. For this reason, the determination of color preferences

according to the technique of finishing is also very important, especially for the enterprises producing standard furniture. The differences in color preferences are encountered in every kind of product produced for people, not only for furniture or furnishings. For this reason, the expectations of the consumers from the aspect of color in different products and spaces are determined and studies are being made on color preferences.

A color preference test aimed at the importance of color in clothing related to the uniforms of nurses was applied with a specially designed color placard to 50 children in the 4-6 years of age group, who were being treated in a hospital and the color preferences of the children in this age group were studied (Lin, et. al., 1997). The characteristics of every product in international circulation should be adapted to the cultural structure of the country to which it is sent. In a study aimed at the place and influence of color in the movie sector, the necessity of the colors of the movies produced in the United States being in conformance with the color preferences of the country to which they were circulated was stressed. Otherwise, the movie may not reach the envisaged sales volume with a drop in ticket sales (Lee, 2001). According to a study made on 123 university students in Ankara on the color preferences of university students, colors having the maximum intensity and brightness were preferred more. The ground-color is unimportant and blue is the most preferred color (Camgoz, et. al., 2002). According to a study made on British and Chinese test subjects related to their color perceptions, such as the warmth or coldness, lightness or darkness, modernity or classicalness of colors, there is not a significant difference in the perception of colors between men and women. However, there is a difference among the perceptions on the basis of countries. Some color perceptions (for example, warm-cold), show cultural independence (Ou, et. al., 2004). Furthermore, four principles are influential in the color preferences based on folklore and tradition. These are forming contrast, the fact that the color is used somewhere else, common preference and availability (Hutchings, 2004). Regional preferences are of extreme importance in the color selection in production based on international trade. The globalization of color selections and color trends first of all facilitates the activities of the companies working on painting and textile manufacturers. However, in every situation, the ethnicity and regional cultures are influential on color preferences (Roberts, 2002). The preferences of university students were studied by putting upper colors having a different tone, intensity and brightness on six ground colors having a maximum intensity and maximum brightness value. Completely intense and bright upper colors on completely intense and bright ground colors are still preferred. Blue is the most preferred color when the ground colors are not taken into consideration (Camgoz and Yener, 2001). According to another study in which the characteristics of preference of the colors applied in different areas were studied, a color that could be defined as being beautiful, select or warm on a chip, does not have the beauty, selectness or warmth as on the chip when it is applied to a cup, t-shirt, sofa or car. In this situation, it is incorrect to apply a color, which is preferred on any product, to another product to create the same effect (Lee, 2001). The effects colors make on people at different light levels and different lighting methods could change. Any product on which any color is applied in a production environment could assume any tone of that color connected to the light in the environment when it is brought to the place of usage. Sometimes this can reach an effect, which does not please the user. For this reason, it is necessary to study the effect of any color in different lighting environments prior to its application on the product and to apply to the product the color tones, which are suitable to the preference of the user (Leta, et. al., 2002). The lighting system used in a space not only affects the visual comfort of those living in that space connected to the concentration of light, it also affects the physiology and psychology of those people. Furthermore, the lighting design of a space should always be treated together with the coloring of the walls, floors and ceilings of that space. Besides this, the colors of the other furnishings, led by furniture, are also important for reflecting the light and the effect set forth is influential on the psychology of people (So and Leung, 1998). The finishing processes applied on the furniture surfaces are in seventh place among the eighteen factors, which are influential on furniture preferences. According to this, color is an important factor in the decision to purchase furniture (Karki, 2000).

As can be seen from the studies mentioned above, the colors applied on the product surfaces are extremely influential on the consumer preferences and on the decisions for purchasing. Accordingly, in this study, the finishing type and color preferences according to demographic characteristics of the consumers have been studied on furniture colored with different finishing types.

Materials and Methods

This study was planned in order to obtain the color preferences of consumers which shall form a basis for the consumer focused design applications.

A survey was conducted with the objective of setting forth the color preferences of the users with different demographic characteristics. Differently finished furniture surfaces were used in the evaluation of these color preferences. The data for potential furniture consumers were gathered from data collection form.

The data collection form was composed of two parts: In the first part, questions aimed at determining some

demographic characteristics of the furniture users, such as gender, marital status, age, educational level, profession, monthly family income and the number of individuals in the family. For the second part of the survey, the finishing applied on furniture with the objective of coloring was collected in three groups:

i. Transparent finishing: In this finishing technique, transparent finishes are used to protect the natural color and grain of wood. Finishes enhance the natural beauty of wood, protect it from excessive wear and abrasion, and make the surfaces easier to clean.
ii. Staining: Staining is extremely important to color harmony of furniture. Changing the kind and color of stain will make the same wood appear entirely different. For example, dark-red stain has been widely used in traditional mahogany furniture. Many people even today think of mahogany as a dark-colored wood. Actually, much contemporary mahogany furniture is light, honey-toned brown. Stains can also be used to make a less expensive wood look like a costly one. Gum, for example, is often stained to imitate mahogany (Feirer, 1970).
iii. Opaque (obscure) painting: In this kind of finishing, finishes totally obscures the wood grain with a coating and achieves a particular color decor.

Visual samples, on which these three finishing type have been applied, were prepared for participants to understand the questions of the survey more accurately. Those samples were shown to the participants at the moment of interviewing. The questions in the second group have been developed to determine the effect of the demographic characteristics on the finishing and color preferences of subjects.

As the area of sampling, 6 central counties (Altındağ, Çankaya, Keçiören, Mamak, Sincan, Yenimahalle) of Ankara Province in Turkey was selected due to the fact that it is the second largest province from the aspect of population density and due to the fact that it has people from all segments of the society because of migration. The set of participants were constituted from the potential furniture buyers visiting the furniture stores. Interviews were conducted on the first 5-person who came to a store in a street of the sampling and accepted to participate in the interview on Saturdays between the hours 10:00 and 18:00. After then, the interviewers passed through a new store by going ahead in clock wise direction on the street to interview with a new group of 5-person. It was interviewed with totally 479 potential furniture buyers selected from the samples environment. The data were obtained by 7 interviewers informed about the data collection forms. It was asked to the participants the question "Are the finishing type and color on furniture, important for you and if important, to choose their three favorite finishings and colors graded as the first, second and third." Numbers of participants according to the counties are given in Table 1.

Table 1. Number of participants according to the counties.

County	Number of Participants	County	Number of Subject
Altındağ	58	Sincan	42
Çankaya	128	Yenimahalle	90
Mamak	67	Keçiören	94
Total	***253***	***Total***	***226***
		Grand Total	***479***

The data were coded in Statistical Package for the Social Sciences (SPSS 17.0) for windows, and evaluated in frequencies, percentages and chi-square (X^2) analysis. Some of the demographic characteristics of the participants are given in Table 2.

Table 2. Some demographic characteristics of the participants.

Consumer Characteristics	N	%	Consumer Characteristics	N	%	Consumer Characteristics	N	%
Age			**Educational Level**			**Monthly Income (US$)**		
Less than 25 years of age	119	24.8	Primary School	55	11.5	Less than US$380	108	22.5
Between 25-35 years of age	183	38.2	High School	167	34.8	Between US$381-635	208	43.4
Between 36-45 years of age	97	20.3	Under Graduate	257	53.7	More than US$636	163	34.1
Over 45 years of age	80	16.7	**Gender**			**Marital Status**		
Total	**479**	**100**	Male	212	44.3	Married	291	60.8
			Female	267	55.7	Single	188	39.2

Results and Discussion

In this section, the finishing type and the color preferences of the participants were evaluated according to their demographic characteristics, and the findings were given in tables. The existences of statistical relationship between the participant's preferences and various demographic characteristics of the groups were analyzed by using the chi-square(X^2) analysis. The relations among the variables were statistically analyzed and the results were interpreted. The tables, showing there was no relation between the variables, were not included in the text.

The Type of Surface Finishings and the Color Preferences Related to These Types of Surface Finishings

When the color preferences according to the type of surface finishings of the consumers are analyzed without taking into consideration any consumer characteristics and order of preference, it was observed that the brown color group of wood on the furniture with transparent finishing was the most preferred group with a share of 29.7% and this was followed with the red color group with a share of 25.3% and with the black color group with a share of 22.1%. Brown and its tones are the most preferred color type with a share of 24.7% on the furniture applied staining. These color preferences are followed by red and its tones with a share of 17.1% and with yellow and its tones with a share of 13.9%. On the furniture surfaces coated with opaque paints, brown is the most preferred color with a share of 24.9% and this is followed by blue and its tones with a share of 20.4% and by red and its tones with a share of 18.7% (Table 3).

There does not appear to be a significant difference in the general color preference tendencies in case any of the consumer characteristics are not taken into consideration, but the color preferences according to the finishing type are taken into consideration. On the furniture surfaces coated with transparent finishes, the brown color group wood types were in the forefront in all of the preferences in first, second and third places with 35.3%, 29.0% and 24.8%, respectively. On the furniture applied staining, brown and its tones were the colors preferred the most at 51.4% and this was followed by red and its tones at 23.0% and blue and its tones at 19.8%. On the furniture with opaque painting, the same order of preference emerges with different percentages. In this type of furniture as well, brown and its tones are the colors preferred the most at 44.9%, red and its tones are in second place at 23.2% and blue and its tones are in third place at 25.9% (Table 3).

Table 3. Color preferences of the consumers on the furniture according to the type of surface finishing and according to the order of preferences

Colors According to the Type of Surface Finishing		Order of Preference							
		First		Second		Third		Total	
		N	%	N	%	N	%	N	%
Transparent Finishing	White Color Group Wood	48	10	30	6.3	46	9.6	124	8.6
	Yellow Color Group Wood	46	9.6	75	15.7	84	17.5	205	14.3
	Brown Color Group Wood	**169**	**35.3**	**139**	**29**	**119**	**24.8**	**427**	**29.7**
	Red Color Group Wood	112	23.4	135	28.2	117	24.5	364	25.3
	Black Color Group Wood	104	21.7	100	20.8	113	23.6	317	22.1
Staining	White and its Tones	48	10	45	9.4	67	14	1,600	11.1
	Yellow and its Tones	42	8.8	81	16.9	77	16.1	200	13.9
	Black and its Tones	30	6.3	57	11.9	39	8.2	126	8.8
	Red and its Tones	52	10.9	**110**	**23**	84	17.5	246	17.1
	Blue and its Tones	33	6.9	67	14	**95**	**19.8**	195	13.6
	Brown and its Tones	**246**	**51.4**	64	13.4	45	9.4	**355**	**24.7**
	Green and its Tones	16	3.3	38	7.9	55	11.5	109	7.6
	Two Compatible Colors	12	2.4	17	3.5	17	3.5	46	3.2
Opaque Painting	Black	51	10.6	57	11.9	40	8.4	148	10.3
	Green	43	9	63	13.2	73	15.2	179	12.5
	Red	65	13.6	**111**	**23.2**	93	19.4	269	18.7
	Blue	70	14.6	99	20.6	**124**	**25.9**	293	20.4
	Brown	**215**	**44.9**	75	15.7	68	14.2	**358**	**24.9**
	Yellow	35	7.3	74	15.4	81	16.9	190	13.2

Note: The percentages of the columns were taken.

The Effects of the Demographic Characteristics on Consumer Color Preferences
The Effect of Age on Color Preferences on the Furniture Applied Transparent Finishing

The brown color group woods are preferred the most in all of the age groups when the general color preference tendencies are considered on the furniture surfaces coated with transparent finishing applications of the age groups separated as those who are younger than 25 years of age, those who are between 25-35 years of age, those who are

between 36-45 years of age and those who are older than 45 years of age. The type preferred in second place from the aspect of color is the brown color group in those who are younger than 25 years of age and in those who are between 36-45 years of age and the red color group is preferred by those who are between 25-35 years of age and those who are older than 45 years of age. From the aspect of third preference, the yellow color group of wood type is preferred the most by those who are younger than 25 years of age, the brown color group of wood type is preferred the most by those who are between 25-35 years of age and the red color group wood type is preferred the most by those who are 36 years of age and older.

A significant difference was not found ($p>0.05$) among the color preferences according to age groups in the first and second preferences related to the furniture with transparent finishing and a significant difference was found ($p=0.028<0.05$) for the third preferences (Table 4). According to this, age was found to be ineffective in the first and second preferences on color preference on the furniture surfaces coated with transparent finishes and was found to be effective in the third preferences.

Table 4. The color (wood type) preferences according to age on the furniture applied transparent finishing

Age	Order of Pref.	White Color Group Wood		Yellow Color Group Wood		Brown Color Group Wood		Red Color Group Wood		Black Color Group Wood		Total	Results		
		N	%	N	%	N	%	N	%	N	%	N	x^2	SD	p
Less than 25	1	10	8.4	13	10.9	**33**	**27.7**	31	26.1	32	26.9	119	19,556	12	0.076
Between 25-35		26	14.2	20	10.9	**64**	**35.0**	40	21.9	33	18.0	183			
Between 36-45		10	10.3	10	10.3	**38**	**39.2**	19	19.6	20	20.6	97			
Over 45		2	2.4	3	3.8	**34**	**42.5**	22	27.5	19	23.8	80			
Less than 25	2	11	9.2	14	11.8	**42**	**35.3**	30	25.2	22	18.5	119	16,749	12	0.159
Between 25-35		10	5.5	29	15.8	47	25.7	**62**	**33.9**	35	19.1	183			
Between 36-45		8	8.3	17	17.5	**30**	**30.9**	20	20.6	22	22.7	97			
Over 45		1	1.3	15	18.8	20	25.0	**23**	**28.6**	21	26.3	80			
Less than 25	3	11	9.2	**29**	**24.4**	28	23.5	25	21.1	26	21.8	119	22,982	12	***0.028***
Between 25-35		11	6.0	26	14.2	**55**	**30.1**	41	22.4	50	27.3	183			
Between 36-45		9	9.3	16	16.5	19	19.6	**29**	**29.9**	24	24.7	97			
Over 45		15	18.6	13	16.3	17	21.3	**22**	**27.5**	13	16.3	80			

1: First Preference, 2: Second Preference, 3: Third Preference. Note: The percentages of the rows were taken.

The Effects of Age on Color Preferences on the Furniture Applied Staining

Brown and its tones are in the forefront as first preferences in all of the age groups at 48.7%, 53.6%, 50.5% and 51.3%, respectively, when the color preferences according to age on the furniture applied staining are analyzed. In the second preferences, red and its tones are in the forefront up to 45 years of age at 19.3%, 29.0% and 21.6%, respectively, and black and its tones are the second preferences of those older than 45 years of age. In the third preferences, white and red colors and their tones are preferred by those who are younger than 25 years of age at 18.5%, red and its tones are preferred by those between 25-35 years of age at 20.8% and blue and its tones are preferred by those between 36-45 years of age at 22.7% and by those older than 45 years of age at 25.0% (Table 5).

Table 5. Color preferences according to age on the furniture applied staining.

Age	Order of Pref.	White and its Tones		Yellow and its Tones		Black and its Tones		Red and its Tones		Blue and its Tones		Brown and its Tones		Green and its Tones		Two Compat-ible Colors		Total	Results		
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	x^2	SD	p
Less than 25	1	14	11.8	11	9.2	8	6.7	16	13.4	6	5.1	**58**	**48.7**	1	0.8	5	4.3	119	19,83	21	0.53
Between 25-35		21	11.5	11	6.0	8	4.4	19	10.4	15	8.2	**98**	**53.6**	7	3.7	4	2.2	183			
Between 36-45		7	7.2	11	11.4	7	7.2	8	8.3	7	7.2	**49**	**50.5**	7	7.2	1	1.0	97			
Over 45		6	7.5	9	11.2	7	8.8	9	11.2	5	6.3	**41**	**51.3**	1	1.3	2	2.4	80			
Less than 25	2	14	11.8	21	17.6	17	14.3	**23**	**19.3**	17	14.3	17	14.3	7	5.9	3	2.5	119	23,67	21	0.30
Between 25-35		19	10.4	30	16.3	15	8.2	**53**	**29.0**	27	14.8	19	10.4	13	7.1	7	3.8	183			
Between 36-45		7	7.2	16	16.5	8	8.2	**21**	**21.6**	15	15.5	16	16.5	11	11.3	3	3.2	97			
Over 45		5	6.3	14	17.4	**17**	**21.3**	13	16.3	8	10.0	12	15.0	7	8.7	4	5.0	80			
Less than 25	3	**22**	**18.5**	17	14.3	11	9.3	**22**	**18.5**	16	13.4	10	8.4	16	13.4	5	4.2	119	40,25	21	***0.007***
Between 25-35		22	12.0	33	18.1	15	8.2	**38**	**20.8**	37	20.2	15	8.2	22	12.0	1	0.5	183			
Between 36-45		11	11.3	9	9.3	7	7.2	13	13.4	**22**	**22.7**	17	17.5	9	9.3	9	9.3	97			
Over 45		12	15.0	18	22.5	6	7.5	11	13.8	**20**	**25.0**	3	3.7	8	10.0	2	2.5	80			

1: First Preference, 2: Second Preference, 3: Third Preference. Note: The percentages of the rows were taken.

A significant difference was not found ($p>0.05$) among the color preferences according to age groups in the first and second preferences but a significant difference was found ($p=0.007<0.05$) in the third preferences (Table 5). In this situation, age was ineffective for the first and second preferences on the furniture applied staining and age was an effective factor for the third preferences.

The Effect of Age on the Color Preferences on the furniture Applied Opaque Painting

Brown and its tones were also the most preferred colors in all of the age groups on furniture surfaces on which opaque painting were applied at 42.9%, 45.4%, 45.3% and 46.3%, respectively. The distribution was not homogeneous in the second preferences. Those younger than 25 years of age and those older than 45 years of age preferred red and its tones in their second preferences, those between 25-35 years of age preferred blue and its tones and those between 35-45 years of age preferred yellow and its tones. As a third preference, those who are younger than 25 years of age preferred red and its tones at 22.7%, those older than 45 years of age preferred yellow and its tones at 22.5% and those in all of the other age groups preferred blue and its tones at 27.9%, 36.1% and 22.5%, respectively.

For all of the orders of preference on the furniture applied opaque painting, there was not a significant statistical difference ($p>0.05$) among the color preferences according to age groups. In this situation, it appears that age is not an effective factor on the color preferences on the furniture applied opaque painting.

The Effect of Gender on Color Preferences
The Effect of Gender on Color Preferences on the Furniture Applied Transparent Finishing

The brown color group wood was preferred by males at 36.3% and by females at 34.4% as their primary preferences when the color preferences of the consumers according to the gender are considered on furniture surfaces on which the transparent finishing was applied. As their second preferences, males preferred the red color group wood at 29.2% and females preferred the brown color group wood at 30.0%. As their third preferences, males preferred the red color group wood at 26.9% and females preferred the brown color group wood at 25.5% (Table 6).

In the statistical analysis made for determining whether or not gender was effective in color preferences on the furniture applied transparent finishing, it was determined that for all of the order of preferences, the differences between the color preferences of males and females were insignificant ($p>0.05$) (Table 6) and it was observed that gender is not a significant factor in color preferences.

Table 6. Color preferences according to gender on the furniture applied transparent finishing

Gender	Order of Pref.	White Color Group Wood		Yellow Color Group Wood		Brown Color Group Wood		Red Color Group Wood		Black Color Group Wood		Total	Results		
		N	%	N	%	N	%	N	%	N	%	N	x^2	SD	P
Male	1	13	6.1	17	8.1	**77**	**36.3**	56	26.4	49	23.1	212	8,691	4	0.069
Female		35	13.1	29	10.8	**92**	**34.5**	56	21.0	55	20.6	267			
Male	2	7	3.3	35	16.6	59	27.8	**62**	**29.2**	49	23.1	212	6,749	4	0.150
Female		23	8.6	40	15.0	**80**	**30.0**	73	27.3	51	19.1	267			
Male	3	23	10.8	31	14.6	51	24.1	**57**	**26.9**	50	23.6	212	3,494	4	0.479
Female		23	8.6	53	19.8	**68**	**25.5**	60	22.5	63	23.6	267			

1: First Preference, 2: Second Preference, 3: Third Preference. Note: The percentages of the rows were taken.

The Effect of Gender on Color Preferences on the Furniture Applied Staining

Brown and its tones were still the most preferred color at 46.3% in males and at 55.4% in females when the first preferences are taken into consideration. For the second preferences males and females preferred red and its tones at 23.6% and 22.5%, respectively. For the third preferences males and females preferred blue and its tones at 21.2% and 18.7%, respectively.

The differences among the color preferences according to gender in all the order of preferences are insignificant ($p>0.05$). According to this, gender is insignificant in the color preferences on the furniture applied staining.

The Effect of Gender on Color Preferences on the Furniture Applied Opaque Painting

The color preferences on the furniture applied opaque painting are given in Table 7. According to this, it appears that brown and its tones are the first preference for males and females at 37.7% and 50.6%, respectively. Blue and its tones are the second preference of males at 24.1% and red and its tones are the second preference of females at 24.3%. Blue and its tones are the third preference of males at 26.9% and of females at 25.1%.

According to the data obtained at the end of the statistical analysis, there is a significant difference among the color preferences according to gender in the first preferences ($p=0.023<0.05$) and the differences for the second and third preferences were found to be insignificant ($p>0.05$) (Table 7). According to this, gender is an effective factor on the color preferences on the furniture surfaces applied opaque painting.

Table 7. Color preferences according to gender on the furniture applied opaque painting

Gender	Order of Pref.	Black and its Tones		Green and its Tones		Red and its Tones		Blue and its Tones		Brown and its Tones		Yellow and its Tones		Total	Results		
		N	%	N	%	N	%	N	%	N	%	N	%	N	x^2	SD	p
Male	1	25	11.8	19	9.0	35	16.5	31	14.6	**80**	**37.7**	22	10.4	212	12,129	5	***0.033***
Female		26	9.7	24	9.0	30	11.2	39	14.6	**135**	**50.6**	13	4.9	267			
Male	2	25	11.8	27	12.7	46	21.7	**51**	**24.1**	38	17.9	25	11.8	212	7,064	5	0.216
Female		32	12.0	36	13.4	**65**	**24.3**	48	18.0	37	13.9	49	18.4	267			
Male	3	15	7.1	33	15.6	42	19.7	**57**	**26.9**	35	16.5	30	14.2	212	4,091	5	0.536
Female		25	9.4	40	15.0	51	19.1	**67**	**25.1**	33	12.3	51	19.1	267			

1: First Preference, 2: Second Preference, 3: Third Preference. Note: The percentages of the rows were taken.

The Effect of Marital Status on Color Preferences
The Effect of Marital Status on Color Preferences on the Furniture Applied Transparent Finishing

The brown color group wood is the first preference in married people at 37.1% and in single people at 32.4%. As second preferences, married people prefer the red color group wood at 28.5% and single people prefer the brown color group wood at 31.4%. As third preferences, married people prefer the brown color group wood at 25.8% and single people prefer the black color group wood at 25.0%.

According to the statistical analysis, the differences among the color preferences emerging according marital status are insignificant ($p>0.05$) in all orders of preferences. According to this, marital status is not an effective factor on the color preferences on the furniture surfaces coated with transparent finishes.

The Effect of Marital Status on the Color Preferences on the Furniture Applied Staining

Brown and its tones are the first preferences of married people at 55.7%, red and its tones are their second preferences at 25.1% and blue and its tones are their third preferences at 23.7%. Brown and its tones are the first preferences of single people at 44.7%, yellow and its tones are their second preferences at 22.8% and white and its tones are their third preferences at 18.1%.

Differences in color preferences according to marital status in all of the orders of preference are insignificant ($p>0.05$). According to this, it appears that marital status is not an effective factor on color preferences on the furniture surfaces coated with stains.

The Effect of Marital Status on Color Preferences on the Furniture Applied Opaque Painting

Brown and its tones were the first preferences of married people at 50.2%, red and its tones were the second preferences at 25.1% and blue and its tones were the third preferences at 28.6%. Brown and its tones were the first preferences of single people at 36.7%, red and its tones were the second preferences at 20.2% and blue and its tones were the third preferences at 21.8% (Table 8).

The differences among the color preferences, which emerge according to marital status for the first preferences, are significant ($p=0.031<0.05$) and the differences are insignificant ($p>0.05$) for the second and third preferences (Table 8). According to this, marital status is effective on the color preferences for the first preferences and is ineffective for the second and third preferences.

Table 8. Color preferences according to marital status on the furniture applied opaque painting

Marital Status	Order of Pref.	Black and its Tones		Green and its Tones		Red and its Tones		Blue and its Tones		Brown and its Tones		Yellow and its Tones		Total	Results		
		N	%	N	%	N	%	N	%	N	%	N	%	N	x^2	SD	p
Married	1	31	10.7	27	9.3	34	11.7	33	11.3	146	**50.2**	20	6.8	291	12,26	5	***0.031***
Single		20	10.6	16	8.5	31	16.5	37	19.7	69	**36.7**	15	8.0	188			
Married	2	30	10.3	35	12.0	73	**25.1**	66	22.7	38	13.1	49	16.8	291	9,04	5	0.108
Single		27	14.4	28	14.9	38	**20.2**	33	17.5	37	19.7	25	13.3	188			
Married	3	23	7.9	39	13.4	56	19.2	83	**28.6**	42	14.4	48	16.5	291	3,93	5	0.560
Single		17	9.0	34	18.1	37	19.7	41	**21.8**	26	13.8	33	17.6	188			

1: First Preference, 2: Second Preference, 3: Third Preference. Note: The percentages of the rows were taken.

The Effect of Educational Level on Color Preferences
The Effect of Educational Level on Color Preferences on the Furniture Applied Transparent Finishing

The first preferences of the primary school graduates were the brown color group wood at 50.9%, the second preferences were the black color group wood at 32.7% and the third preferences were the red color group wood at 30.9%. The first preferences of the high school graduates were the brown color group wood at 32.3%, the second preferences were the red color group wood at 32.9% and the third preferences were the brown color group wood at 26.8%. The first, second and third preferences of the university graduates were the brown color group wood at 33.8%, 30.4% and 24.5%, respectively. Among the university graduates, the black color group wood was also preferred at the same ratio as the brown, as their third preferences.

Differences among color preferences according to educational level in all orders of preferences are insignificant ($p>0.05$). According to this, educational level is not an effective factor on the color preferences on the furniture surfaces coated with transparent finishes.

The Effect of Educational Level on the Color Preferences on the Furniture Applied Staining

According to the color preferences connected to educational level given in Table 9, the first preferences of the primary school graduates were brown and its tones at 36.4%, their second preferences were red and its tones at 34.5% and their third preferences were blue and its tones at 34.5%. The first preferences of the high school graduates were brown and its tones at 53.8%, their second and third preferences were red and its tones at 21.5% and 19.8%, respectively. The first preferences of the university graduates were brown and its tones at 52.9%, their second and third preferences were red and its tones at 21.4% and 16.7%, respectively. However, in their third preferences, their red color preferences and their black and yellow color preferences were equal to each other at 16.7%.

Differences among the color preferences according to educational level for the first preferences on the furniture applied staining are significant ($p=0.012<0.05$), and the differences for the second and third preferences are insignificant ($p=0.05$) (Table 9). According to this, educational level is effective in the color preferences for the first preferences and it is ineffective for the second and third preferences.

Table 9. The effect of educational level on the color preferences on the furniture applied staining

Educational Level	Order of Pref.	White and its Tones		Yellow and its Tones		Black and its Tones		Red and its Tones		Blue and its Tones		Brown and its Tones		Green and its Tones		Two Compa-tible Colors		Total	Results		
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	x^2	SD	p
Primary	1	2	3.6	11	20.0	7	12.7	10	18.2	3	5.5	20	**36.4**	2	3.6	0	0.0	55	28,26	14	***0.012***
High School		18	10.8	12	7.2	6	3.6	21	12.6	13	7.8	90	**53.8**	4	2.4	3	1.8	167			
University		28	10.9	19	7.4	17	6.6	21	8.2	17	6.6	136	**52.9**	10	3.9	9	3.5	257			
Primary	2	2	3.6	6	10.9	3	5.5	19	**34.5**	7	12.7	10	18.2	5	9.1	3	5.5	55	19,56	14	0.145
High School		17	10.2	30	18.0	20	12.0	36	**21.5**	32	19.2	19	11.4	10	6.0	3	1.7	167			
University		26	10.1	45	17.5	34	13.2	55	**21.4**	28	10.9	35	13.6	23	8.9	11	4.4	257			
Primary	3	3	5.5	8	14.5	3	5.5	8	14.5	21	**38.2**	7	12.7	4	7.3	1	1.8	55	20,11	14	0.127
High School		24	14.4	26	15.6	12	7.2	33	**19.8**	31	18.6	12	7.2	23	13.7	6	3.5	167			
University		40	15.6	43	**16.7**	24	9.4	43	**16.7**	43	**16.7**	26	10.1	28	10.9	10	3.9	257			

1: First Preference, 2: Second Preference, 3: Third Preference. Note: The percentages of the rows were taken.

The Effect of Educational Level on Color Preferences on the Furniture Applied Opaque Painting

The color preferences according to educational level on the furniture applied opaque paintings are given in Table 10. According to this, the first preferences of primary school graduates were brown and its tones at 38.2%, their second preferences were red and its tones at 21.8% and their third preferences were blue and its tones at 25.5%. The first preferences of high school graduates were brown and its tones at 44.8%, their second preferences were red and its tones at 28.1% and their third preferences were yellow and its tones at 24.0%. The first preferences of the university graduates were brown and its tones at 46.4% and their second and third preferences were blue and its tones at 24.9% and 28.0%, respectively.

Table 10. Color preferences according to educational level on the furniture applied opaque painting

Educational Level	Order of Pref.	Black and its Tones		Green and its Tones		Red and its Tones		Blue and its Tones		Brown and its Tones		Yellow and its Tones		Total	Results		
		N	%	N	%	N	%	N	%	N	%	N	%	N	x^2	SD	p
Primary		4	7.3	6	10.9	13	23.6	7	12.7	21	**38.2**	4	7.3	55			
High School	1	13	7.8	21	12.6	23	13.8	28	16.8	75	**44.8**	7	4.2	167	18,56	10	***0.046***
University		34	13.2	16	6.2	29	11.3	35	13.6	119	**46.4**	24	9.3	257			
Primary		11	20.0	7	12.7	12	**21.8**	11	20.0	9	16.4	5	9.1	55			
High School	2	13	7.8	22	13.2	47	**28.1**	24	14.4	29	17.3	32	19.2	167	17,54	10	0.063
University		33	12.8	34	13.2	52	20.3	64	**24.9**	37	14.4	37	14.4	257			
Primary		4	7.3	7	12.7	13	23.6	14	**25.5**	10	18.2	7	12.7	55			
High School	3	17	10.2	18	10.7	36	21.6	38	22.8	18	10.7	40	**24.0**	167	17,97	10	0.056
University		19	7.4	48	18.7	44	17.1	72	**28.0**	40	15.6	34	13.2	257			

1: First Preference, 2: Second Preference, 3: Third Preference. Note: The percentages of the rows were taken.

Differences among the color preferences according to educational level for the first preferences were significant ($p=0.046<0.05$) and the differences for the second and third preferences were insignificant ($p=0.05$) (Table 10). According to this, the educational level is effective on the color preferences for the first preferences and it is ineffective for the second and third preferences.

The Effect of Income Level on Color Preferences
The Effect of Income Level on Color Preferences on the Furniture Applied Transparent Finishing

The color preferences according to income level of the individuals, who were the subject of the survey, on the furniture surfaces coated with transparent finishes, are given in Table 11. According to this, the first preferences of the individuals who participated in the survey and who have an income of US$380 and less, were the brown color group wood at 44.4% and their second and third preferences were the red color group wood at 28.7% and 26.9%, respectively. The first preferences of those who have an income between US$381-635 were the brown color group wood at 38.5%, the second preferences were brown at 31.3% and the third preferences were the black color group wood at 24.0%. The first preferences of those who have an income of US$636 and above were the black color group wood at 28.8% and the second and third preferences were the brown color group wood at 31.3% and 29.4%, respectively.

Table 11. The wood type (color) preferences according to income level on the furniture applied transparent finishing

Monthly Income	Order of Pref.	White Color Group Wood		Yellow Color Group Wood		Brown Color Group Wood		Red Color Group Wood		Black Color Group Wood		Total	Results		
		N	%	N	%	N	%	N	%	N	%	N	x^2	SD	p
US$380 and less		15	13.9	10	9.3	48	**44.4**	24	22.2	11	10.2	108			
Between US$381 - 635	1	20	9.6	18	8.6	80	**38.5**	44	21.2	46	22.1	208	22,64	8	***0.004***
US$636 and above		13	8.0	18	11.0	41	25.2	44	27.0	47	**28.8**	163			
US$380 and less		5	4.6	22	20.4	23	21.3	31	**28.7**	27	25.0	108			
Between US$381 - 635	2	12	5.8	26	12.4	65	**31.3**	64	30.8	41	19.7	208	9,52	8	0.300
US$636 and above		13	8.0	27	16.6	51	**31.3**	40	24.5	32	19.6	163			
US$380 and less		6	5.6	23	21.2	22	20.4	29	**26.9**	28	25.9	108			
Between US$381 - 635	3	24	11.5	40	19.3	49	23.6	45	21.6	50	**24.0**	208	10,04	8	0.262
US$636 and above		16	9.8	21	12.9	48	**29.4**	43	26.4	35	21.5	163			

According to the statistical analysis made, differences according to the different income groups in the first preferences among the color preferences were significant ($p=0.004<0.005$) and the differences in the second and third preferences were insignificant ($p>0.05$) (Table 11). According to this, the income level was effective on the color preferences in the first preferences and it was ineffective in the second and third preferences.

The Effect of Income Level on the Color Preferences on the Furniture Applied staining

The first preferences of the individuals who participated in the survey and who were in all of the income groups were brown and its tones at 43.5%, 50.0% and 58.3%, respectively. The second preferences in all of the income groups were red and its tones and at the same time, the preferences of the individuals who have an income level of US$636 and above were black and its tones. The third preferences of those having an income of US$380 and less, were blue and its tones at 23.1%, the third preferences of those having an income of US$381 - 635, were red and its tones at 21.2% and the third preferences of those having an income of US$636 and above, were blue and its tones and yellow and its tones at 19.0% each.

Differences according to the different income groups of the color preferences in all of the preferences were insignificant ($p>0.05$). According to this, the income level is ineffective on the color preferences on the furniture applied staining.

The Effect of Income Level on Color Preferences on the Furniture Applied Opaque Painting

The first preferences of those having an income of US$380 and less were brown and its tones at 40.7% and their second and third preferences were blue and its tones at 20.4% and 23.1%, respectively. The first preferences of those having an income between US$381 - 635 were brown and its tones at 47.1%, the second preferences were red and its tones at 25.0% and the third preferences were blue and its tones at 27.9%. The first preferences of those having an income of US$636 and above were brown and its tones at 44.8%, the second preferences were red and its tones at 24.5% and the third preferences were blue and its tones at 25.2%.

Differences according to the different income groups among the color preferences for all of the preferences on the furniture applied opaque painting were insignificant ($p>0.05$). In this situation, the income level of the individuals is not an effective factor on color preferences on the furniture coated with these type of surface finishes.

Conclusion

According to the findings, the type of surface finishings applied to the furniture surfaces and/or the color applied on these surfaces is important for the consumers. Furthermore, the opaque painting on the furniture surfaces is preferred less compared to the other finishing types. Accordingly, it can be deduced that the consumers seek a wood appearance on the furniture surfaces and that it is definitely necessary to take this wish into consideration in standard furniture production.

Brown and its tones are the most preferred colors in all kinds of surface finishings when the color preferences of the consumers are analyzed according to the type of surface finishing, without taking into consideration any consumer characteristics and orders of preference. This is followed by red, yellow, black and blue colors and their tones.

There is not much difference in color preferences and priorities given above, excluding extraordinary situations, when the general preferences emerging according to the general consumer characteristics, such as age, gender, education, marital status and income level are considered. Brown and red are still the first and second preference colors according to all of the consumer characteristics. Yellow, blue and black are in the forefront as the third preferences according to different consumer characteristics. Blue and its tones are the second preferences of males on the furniture applied opaque painting. Black and its tones are the second preferences of primary school graduates on the furniture surfaces coated with transparent finishes. Blue and its tones are the second preferences of university graduates on the surfaces coated with opaque painting. Black and blue colors and their tones are the first preferences for those who have an income of US$636 and above on furniture applied transparent finishing and staining and their preferring these is exceptional situations.

The fact that Beech and Pine are species of wood used a lot in Turkey, that furniture produced from these types of wood stems from the fact that beech in particular is suitable for finishing with every color and that they are put into the market as mahogany, walnut and hazelnut colors, could have been influential in the formation of a color culture in which brown and red are predominant. Furthermore, it is thought that the fact that the walls in housing estate and in the housing built by contractors is generally finished with white or light colored paint could be

influential in the selection of these colors on the furniture surfaces for contrast. In the same manner, the use of pine wood materials with a natural color in construction, interior design and furniture could be effective in preferring yellow the most. The use of black a lot in office furniture in the past and the fact that the Wenge wood is used a lot more in the building of furniture in recent years could be effective in the preferences for black.

According to the statistical analysis made to determine whether or not consumer characteristics are influential in the preference of color, it was found that age was effective on the third preferences in all of the surface finishing applications, that income level was effective on the first preferences in the transparent finishing applications, that gender was effective on the first preferences in the opaque painting applications, that marital status was effective on the first preferences in the opaque painting applications and that educational level was effective on the first preferences in the staining and opaque painting applications. According to this, a market segmentation should be made according to the findings above for the color preferences of the consumers according to income level in the transparent finishing applications, according to gender, marital status and educational level in the surface finishings with opaque paints, and according to educational level in the staining applications. Color and finishing preferences of the consumers connected to the customer characteristics specified should be taken into consideration in the user-oriented design applications and in the design activities, which keep consumer satisfaction in the forefront.

It was determined that age was ineffective on the color preferences of the consumers in all of the surface finishing applications, that gender and marital status were ineffective on the color preferences of the consumers in the surface applications made with transparent finishes and staining, that educational level was ineffective on the color preferences of the consumers in the transparent finishing applications and that income level was ineffective on the color preferences of the consumers in the staining and opaque painting. In this situation, there is no need for special color applications according to these variables. The most preferred colors satisfy all of the consumers.

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THE ECAT SOFTWARE PACKAGE TO ANALYZE EARTHQUAKE CATALOGUES

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Abstract: Earthquakes are one of the most damaging natural disasters. Accordingly, earthquake phenomenon has been an important subject in seismology and earthquake engineering. In order to have insight on earthquakes, they have been compiled over the past years in databases called as earthquake catalogues. In seismic hazard studies, earthquake catalogues are of prime importance as they provide the most important features of earthquakes such as date, time, location, magnitude, depth etc. Accordingly, earthquake catalogues are often utilized to model seismicity. However, before such an implementation, earthquake catalogues need to be undergone several analyses such as seismic declustering, assessment of completeness periods and calculation of magnitude recurrence parameters. In order to perform these analyses, several software packages are available for users on different programming platforms. Vast majority of these software are only applicable to earthquake catalogues that are complete over the time period they extend. However, most of the earthquake catalogues are incomplete in terms of small and moderate size events particularly in the early years of instrumental period. This paper illustrates some of the useful features of the software package called as ECAT that is generated to compute completeness and magnitude recurrence parameters of earthquake catalogues whose completeness periods are unequal for different magnitudes.

Keywords: Earthquake Catalogue, Catalogue Completeness, Calculation of Magnitude Recurrence Parameters

Introduction

Turkey is located on a highly seismically active region where many devastating earthquakes take place. Only in the last 20 years, more than 10 earthquakes with $M_w \geq 6$ hit the country. Among them, in particular, Kocaeli and Düzce earthquakes served as a landmark for a better understanding of earthquake hazard and earthquake risk in Turkey. Accordingly, considerable effort has been given on assessment of seismic hazard on the basis of continually updated and improved seismic data. Considering seismic data, the contribution of earthquake catalogues in earthquake engineering is significant as the most important information on earthquakes such as location, time, magnitude and depth are compiled in these documents. Accordingly, seismic catalogues are often utilized to model and investigate seismic sources. To achieve this goal, however, further analysis steps such as seismic declustering, completeness analysis and magnitude-recurrence model analysis are essential. Considering these tasks, computer software is considerably necessary due to the utilized methods that either require back and forth computation or reapplication of the procedure several times for different sets of data and condition. Moreover earthquake catalogues are often lack of some small and moderate size events. This fact is mainly attributed to poor seismic networks in the early years of instrumental period. Accordingly, completeness periods of small, moderate or big size events in an earthquake catalogue may differ. Although there exist several methods to deal with the catalogues with unequal completeness periods, handy computer programs that incorporate such methods are either limited or not very well-known.

Recently, a national project supported by AFAD (Disaster and Emergency Management Authority of Turkey) has been completed with the collaboration of several universities and public institutions. As the final product, probabilistic seismic hazard maps for peak ground acceleration (PGA) and 5 % damped spectral acceleration (SA) at T= 0.2s and 1.0s were produced for 475- and 2475-year return periods considering the administrative borders of Turkey. These maps were generated by considering two different sets of seismicity models namely 1-area source model and 2-fault source + smoothed seismicity model that were developed under the light of the updated Turkish earthquake catalogue and active fault map of the region. In line with the demands encountered during the course of the project, a software package called as ECAT (**E**arthquake **C**atalogues **A**nalysis **T**ools) has been developed for assessing completeness periods of the Turkish earthquake catalogue and calculating magnitude recurrence parameters of earthquakes.

This study presents some of the useful features of the ECAT software that is applicable to earthquake catalogues

with unequal completeness periods. In the first part of the paper, capabilities of the software will be presented overall while the developed tools will be addressed in the subsequent sections.

General capabilities of the ECAT Software Package

The ECAT software is developed by making use of MATLAB® programming language and it provides a user-friendly environment for earthquake catalogue operations while letting users filter events in terms of date, location, magnitude and hypocentral depth. The main window of the software is based on a map in geospatial format that covers Turkish territory and its surroundings. The opening window of the software first asks for a catalogue file in the desired file format. Accordingly, all the events in the catalogue are plotted on the map in the main window of the program. Figure 1 illustrates the general view of the main window of the ECAT software.

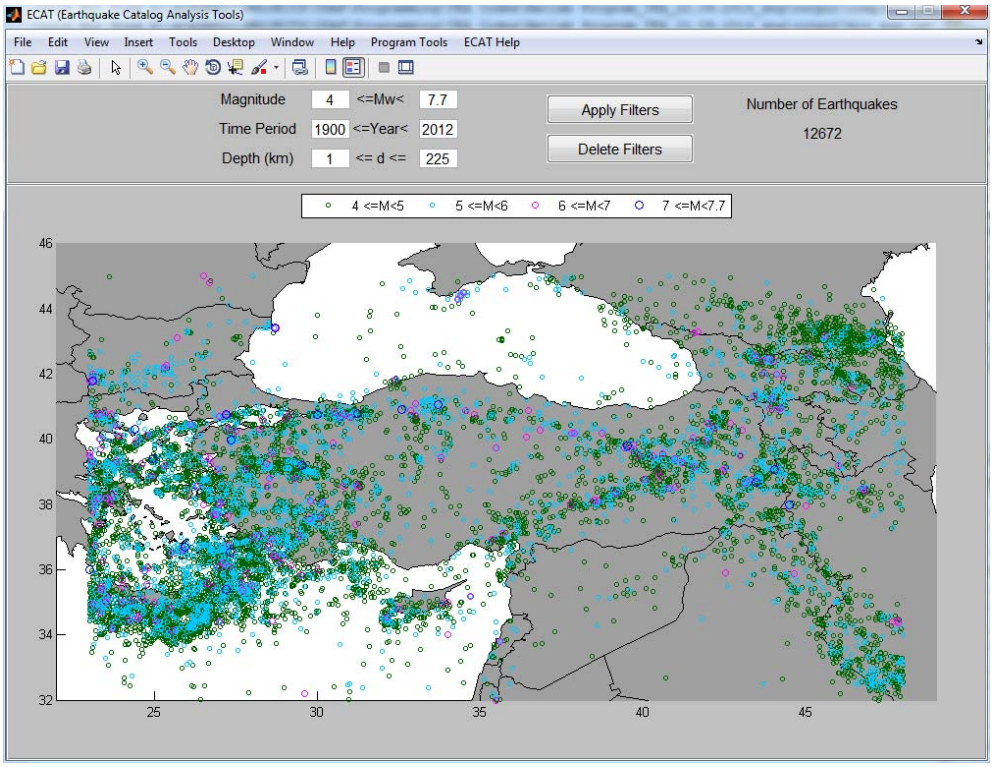

Figure 1. Main window of the ECAT software

As it can be seen in Figure 1, the earthquakes are plotted in terms of magnitude bins that are established with unit magnitude by default. On the upper panel, the extents of the selected catalogue are presented with upper and lower values in terms of magnitude, time and hypocentral depth. The user can limit and replot the earthquakes in terms these 3 constraints with the “Apply Filters” and “Delete Filters” buttons. Upon the each mouse click on “Apply Filter” and “Delete Filter” buttons, the earthquakes on the map are replotted. Similarly, the number of events that fulfil the selected criterion are automatically refreshed on the right hand side of the buttons.

The developed tools within the ECAT software are grouped under the “Program Tools” menu on the menu bar. Under the “Program Tools” menu, the tools for region selection, completeness analysis and magnitude recurrence analysis are available. The general view of the “Program Tools” menu and cascading view of the “Select Region” menu are given in Figure 2. The operations related with these tools will be presented in the following sections.

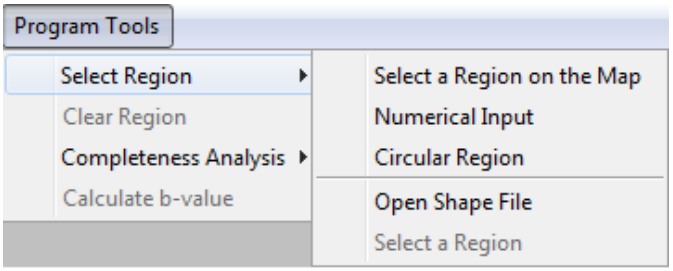

Figure 2. The submenus under "Program Tools" menu

Selection of a region

The ECAT software provides 4 different options for region selection. As the first option under the menu, users can define a region with an arbitrary shape by selecting the "Select a region on the map" command. By this command any shape with any number of points can be defined by clicking on the mouse buttons. A sample view of a user-defined region is presented in Figure 3.

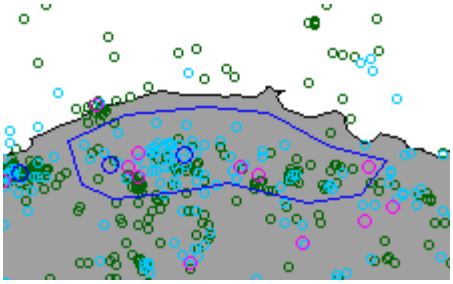

Figure 3. Region with an arbitrary shape

As the secondary option, users can define a rectangular region by selection the "Numerical input" command. Figure 4 illustrates the pop-up window where corner points of a rectangle can be entered.

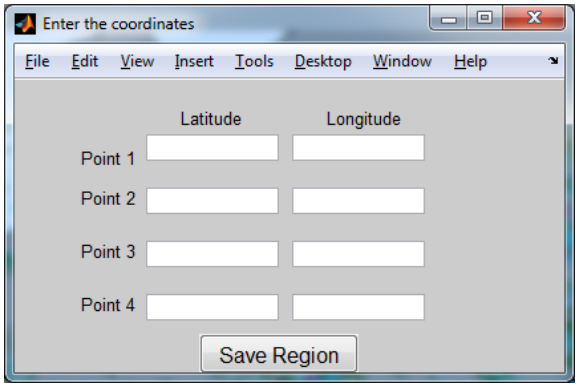

Figure 4. Rectangular region definition

The ECAT software also enables to define circular regions. By clicking on the "Circular region" option under the region selection menu, a pop-up window appears. On this window, users can define the central coordinates of a circle either by keyboard entry or mouse click on the main window. The radius of the circle is also defined on the circular region pop-up window.

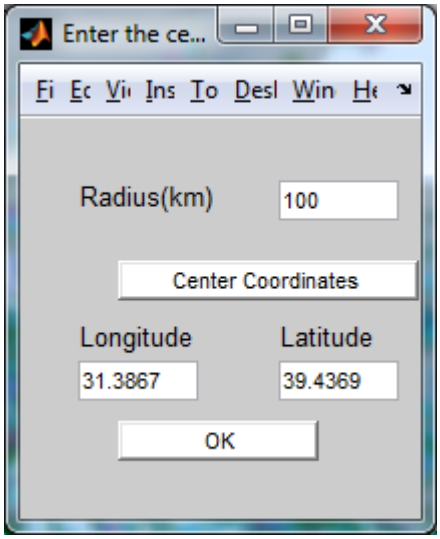

Figure 5. Pop-up menu for circular region selection

As the last option, region data can also be loaded from geospatial data files. Figure 6 illustrates a sample view of a loaded shape file that is plotted on top of the earthquake map. As it can be seen from the pop-up window

appearing in front of the main window, the program allows users to select a region out of several regions. Thus, a loaded shape file does not necessarily have to incorporate single region data.

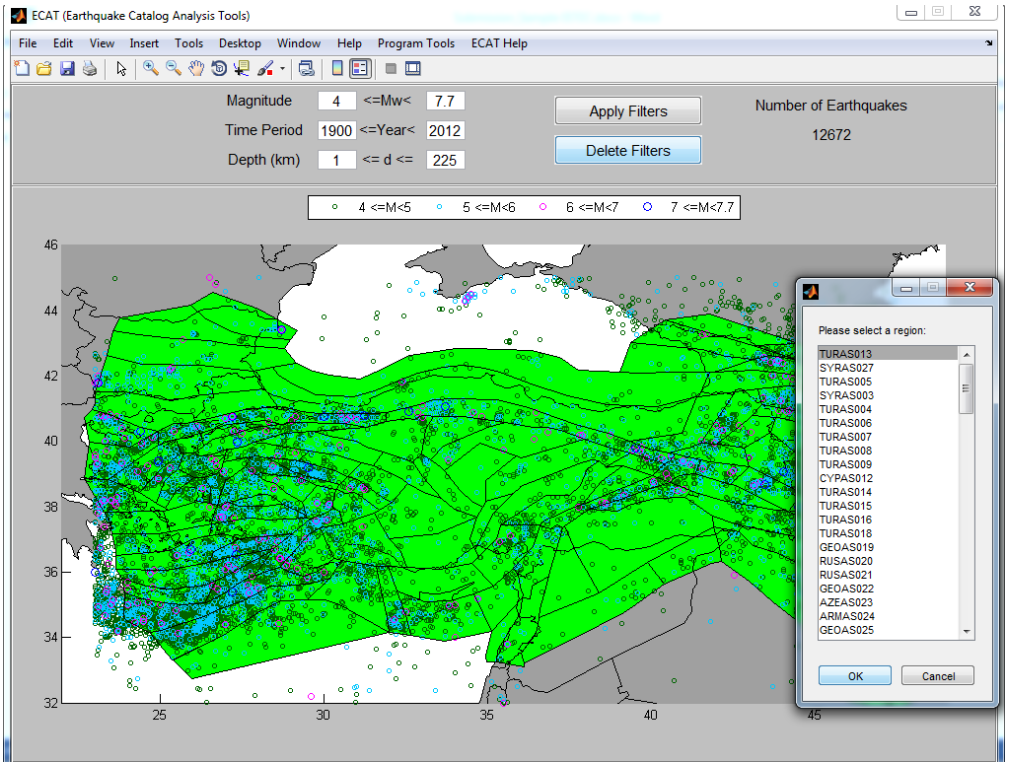

Figure 6. Selection of the region from a loaded shape file

After defining a region, users can proceed with the completeness analysis and magnitude recurrence relation tool.

Completeness Analysis Tool

As mentioned in the previous sections, earthquake catalogues are often lack of some events particularly in the early period of instrumental period. This fact complicates determination of completeness periods of catalogues as in this case one needs to investigate catalogue events in terms of subgroups of magnitude classes. Bearing on this idea, Stepp (1972) proposed a method to assess completeness periods of catalogues with unequal completeness periods. According to this method, the mean earthquake rate of each magnitude class is calculated for expanding time windows established from the last record backwards the first one. Then, scatter plots of standard deviation of the mean of the annual number of events are plotted against sample lengths for each magnitude class. Finally, completeness period of each magnitude class is assessed upon the stability of the estimates in the subintervals. The ECAT software enables users to decide on the duration of temporal window as well as magnitude interval to establish magnitude classes. The default values of these parameters are considered as 5 years and M_w 0.5 for time and magnitude increments respectively. The program also asks for lower, intermediate and upper magnitudes to be considered while constructing magnitude bins. Here, the intermediate magnitude is intended to separate moderate and big size events so that a single magnitude class can be established for big events regardless of the bin size. Figure 7 illustrates the main window of completeness analysis tool. On this window, users can zoom in and out on the plots and decide on the completeness periods of each magnitude class with the help of the auxiliary tools that can be utilized to draw/clear reference lines and trace on data.

The secondary method integrated into the ECAT software to assess completeness periods is based on the study by Mulargia et al. (1987). Similar to Stepp (1972) method, all selected earthquakes are grouped in terms of magnitude classes that are established according to the user's definitions. Then, cumulative number of events in each magnitude class is plotted against time starting from the first record towards the last one. Completeness period of each magnitude class is decided upon the stationarity of cumulative number of events. A sample plot of completeness analysis tool is illustrated in Figure 8 if the method by Mulargia et al. (1987) is selected.

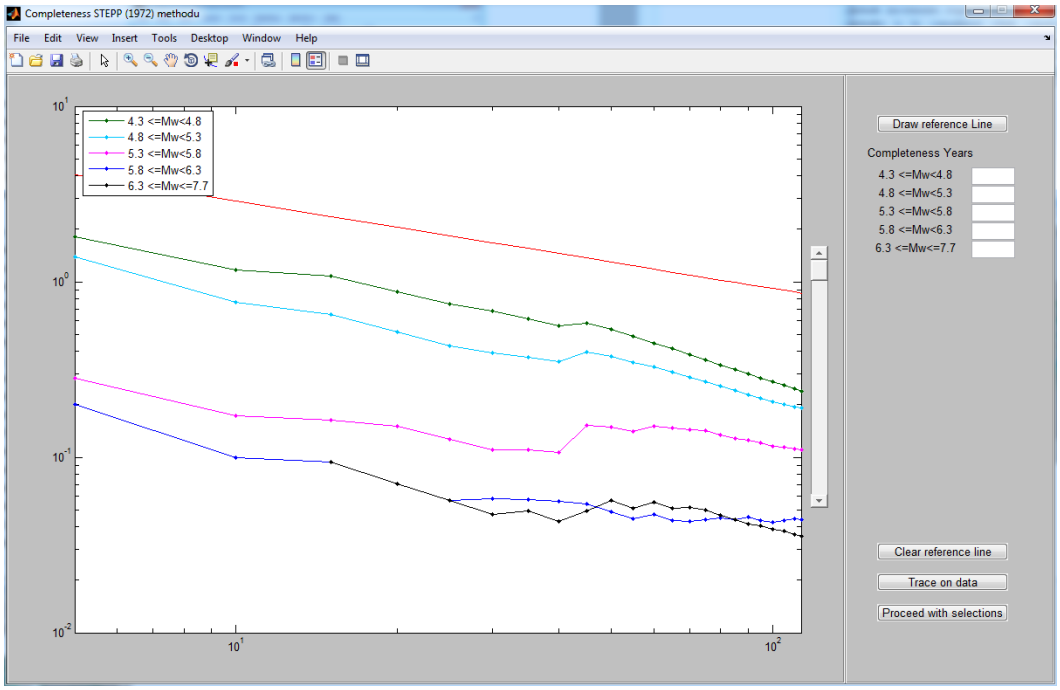

Figure 7. The main window of completeness tool for Stepp (1972) method

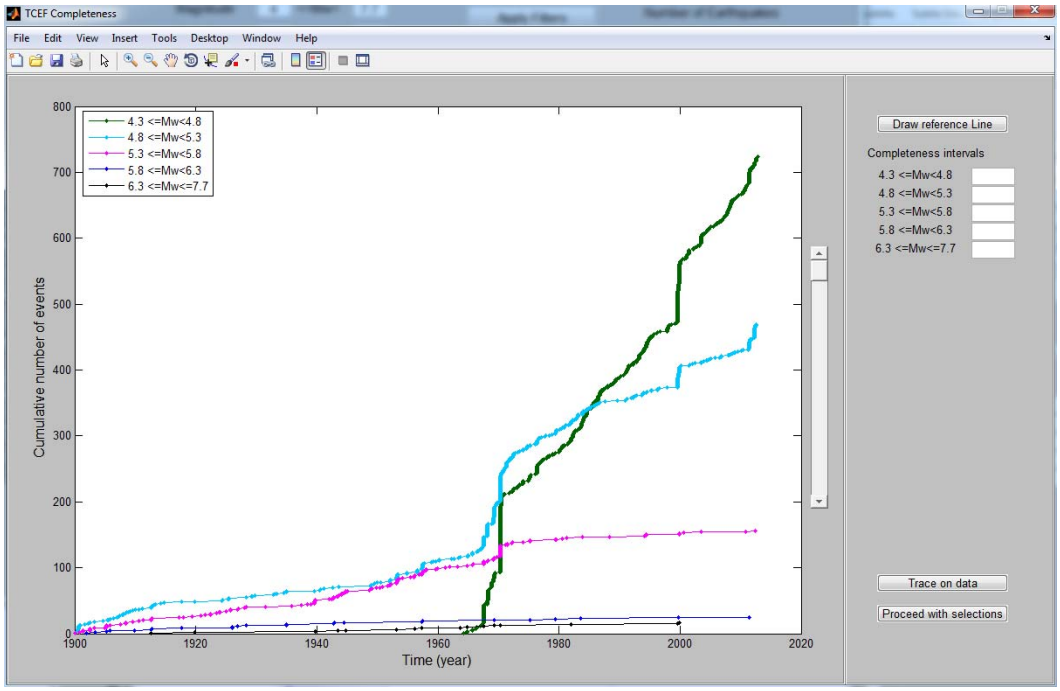

Figure 8. The main window of completeness tool for Mulargia et al. (1987) method

For both methods, completeness analysis is completed if "Proceed with selections" button is pressed. After this selection, the completeness analysis results are saved automatically as a text file under the main folder of the program. This file updates itself if the completeness analysis repeated. Once completeness analysis is completed, users can proceed with the magnitude recurrence tool.

Magnitude Recurrence Relation Tool

The ECAT software provides 3 methods for calculation of magnitude recurrence parameters. Among these methods, two of them can be applied to catalogues with unequal completeness periods. In the program, the magnitude recurrence tool can be accessed under the "Program Tools" menu. After choosing this tool, a pop-up window appears (Figure 9). On this window, the required inputs differ in accordance with the selected method.

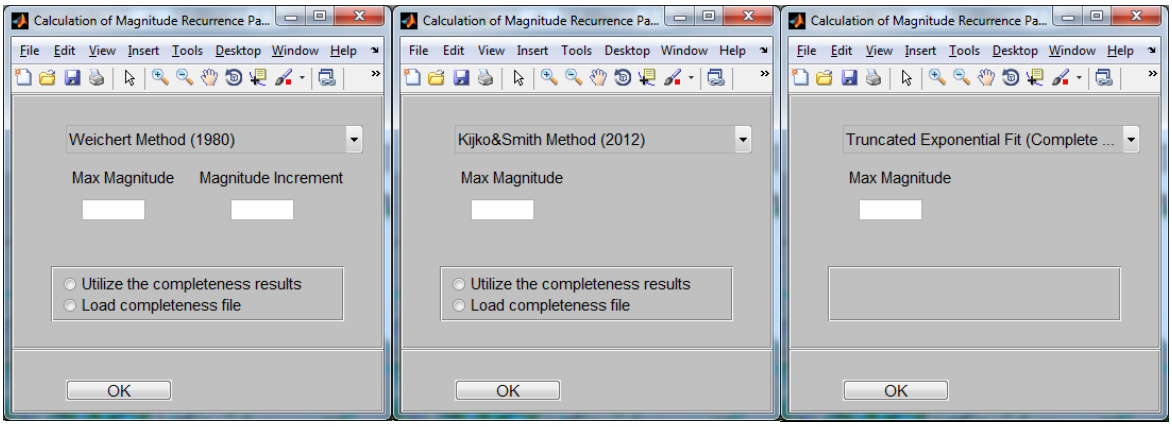

Figure 9. Appearance of the input window of magnitude recurrence tool in case (from left to right) Weichert (1980), Kijko and Smith (2012) and Truncated Exponential Fit method is selected.

According to Weichert (1980) method, maximum likelihood method is utilized to estimate magnitude recurrence parameters (ν and β) that are connected to the constants (a and b) of the Richter's (1958) equation (Eq. 1) for exponential distribution of earthquake magnitudes. Readers are referred to McGuire (1977) for the equivalent form of Eq.1 in case the equation is rearranged in terms of ν and β.

$$Log_{10}N(m) = a - bM \qquad \text{Eq.1}$$

As one can infer form Figure 9, for the case of Weichert (1980) method maximum magnitude and magnitude increment values are decided by the user. Here, the user can either utilize the completeness analysis results of the latest completeness analysis or load a previously saved completeness file. In this method, the magnitude increment that is utilized to construct successive magnitude bins is considerable important. According to Bender (1983), the magnitude increment must be kept small enough in order to not create bias in estimates. To this end, the value of magnitude increment is considered as 0.1 M as default. However, users can define values different than the default value. Another important parameter utilized in Weichert (1980) method is the maximum magnitude. It is well known that maximum magnitude has a great effect on magnitude recurrence parameters. In this sense, decision on maximum magnitude needs to be made under the light of state-of-art geological and seismological (McGuire, 1977). After deciding on magnitude related entries and selecting completeness file, maximum likelihood estimates of magnitude recurrence model is calculated. After that, the exponential fit is illustrated together with earthquake recurrence data on a new window as given in Figure 10.

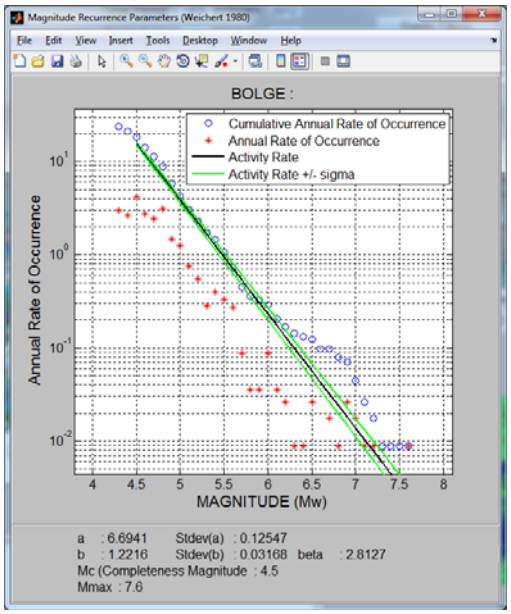

Figure 10. The fitted curve on earthquake recurrence data together with +/-1 σ

As the secondary method, users can utilize the method by Kijko and Smith (2012) to estimate magnitude recurrence parameters of the selected set of earthquakes. Similar to the pervious method, maximum magnitude is

decided by the user. However, this method does not require any other input other than completeness data file. According to this method, selected set of earthquakes are divided into sub-catalogues so that each sub-catalogue established according to the completeness periods. Then, each sub-catalogue is treated as a complete catalogue and maximum likelihood estimates of recurrence parameters of each sub-catalogue are calculated on the basis of Richter's (1958) equation. The recurrence parameters of each sub-catalogue are then combined by a joint function and magnitude recurrence parameters are derived for the entire set of earthquake. The ECAT program does not provide a plot for the results if Kijko and Smith (2012) is utilized. The results are displayed on the command window.

As the final method, users can also select to proceed with truncated exponential fit option where selected earthquakes are considered as complete in each magnitude bin. Accordingly, the maximum likelihood estimates of magnitude recurrence parameters are calculated on the basis of Richter's (1958) relationship. A sample view of the fitted function is displayed in Figure 11 where circles red dots correspond to annual rate of occurrence and blue circles designate cumulative annual rate of occurrence.

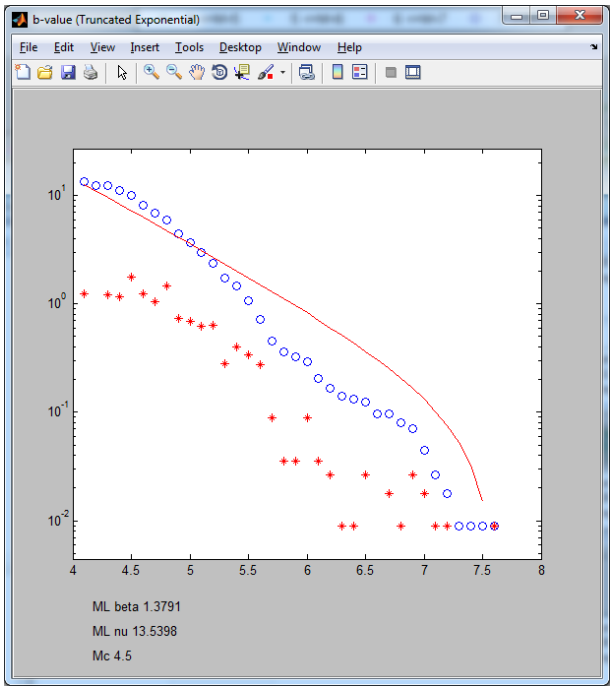

Figure 11. A sample view of fitted exponential curve in case truncated exponential fit option is selected

Concluding Remarks

This paper presents capabilities of the ECAT software that is developed to assess completeness of earthquake catalogues that have unequal completeness periods. In the recent version of the program, the completeness tool incorporates routines for Stepp (1972) and Mulargia et al. (1987) methods. The program also incorporates magnitude recurrence calculation tool that offers 3 methods to calculate maximum likelihood estimates of earthquake recurrence parameters. Among these methods, two of them are applicable to earthquake catalogues with unequal completeness periods. In the current version, the methods by Weichert (1980) and Kijko and Smith (2012) are integrated in the software. It is believed that the ECAT software will be a useful tool for researchers and engineers particularly for those who deal with earthquake catalogues that have unequal completeness periods.

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THE EFFECTS OF DENSIFICATION AND HEAT TREATMENT ON THERMAL CONDUCTIVITY OF FIR WOOD

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Abstract: The goal of this study was to determine the effect of densification and heat treatment on thermal conductivity properties of fir (*Abies bornmulleriana* Mattf.) wood. Fir wood specimens were densified with compression ratios of 25% and 50%, and at 100 °C or 140 °C. Then, the heat treatment was applied to the fir specimens at 185 ºC and 212 ºC for 2 hours according to ThermoWood® method. The study results showed that, densification and thermal treatment applications was effected thermal conductivity of the fir specimens. The thermal conductivity increased based on compression ratios and temperatures in the densified specimens. The thermal conductivity in the compressed specimens at high ratio (50%) was found higher than other specimens. After densification, additionally, thermal conductivity increasing on the radial surface was higher compared to the tangential surface. After heat treatment, thermal conductivity of the all specimens decreased significantly depending on the increase in treatment temperature. Particularly, the heat-treated fir specimens at 212 °C may considerated where thermal insulation is important.

Keywords: Fir Wood, Densification, Heat Treatment, Thermal Conductivity

Introduction

The properties of wood depend on its chemical and structural characteristics. These can be changed using different and/or new wood modification techniques. Thus, wood can be made more resistant to destructive environmental factors (Bami and Mohebby, 2011). The mechanical properties of wood positively correlate with its density, and the mechanical strength can be improved by increasing the density. An increment of density is particularly important for low-density wood species (Laine et al., 2013; Sandberg et al., 2013). Wood can be densified by applying mechanical high-pressure compression with heat and/or steam. In addition, wood can be densified by saturating its pore volume with natural or synthetic resins (Kamke, 2006; Kutnar et al., 2008). A main disadvantage of mechanically densified wood is the recovery of its initial dimensions after exposure to water or heat (Seborg et al., 1956; Morsing, 2000; Blomberg et al., 2006; Pelit et al., 2014, 2016). One of the wood modification processes whose usage is increasing day to day and which are performed for extending their usage fields by enhancing some properties (stability, durability, etc.) of wood, is heat-thermal treatment.

The heat treatment process results in a modification in the molecular structure of the wood and thus improves its performance. The properties potentially improved by heat treatment are: biological resistance to fungi and insects, low equilibrium moisture content, increased dimensional stability with respect to the decrease in contraction and expansion, increased resistance to weathering, and increased thermal insulation capacity (Korkut and Kocaefe, 2009). On the other hand, the density and mechanical strength properties of heat-treated wood decrease due to mass loss and thermal degradation of the wood structure (Bekhta and Niemz 2003; Yıldız et al. 2006; Korkut et al., 2008; Pelit et al., 2015; Perçin et al., 2015). The decline in the strength properties of wood is the primary disadvantage of the heat treatment application. This situation restricts the sectors in which heat-treated wood may be used (Boonstra 2008).

As it is known, wood material that has a wide usage area as a natural raw material is a good insulator because of its structure (Aytin et al., 2016). Thermal conductivity of a material can be defined as the rate of heat transfer through a unit thickness of the material per unit area per unit temperature difference. The thermal conductivity of a material is a measure of how fast heat will flow in that material. A large value of a thermal conductivity indicates that the material is a good heat conductor, and a low value indicates that the material is a poor heat conductor or insulator (Şahin Kol and Sefil, 2011). The thermal properties of wood are affected by various factors. The more important influencing factors are species, density, moisture content, direction of heat flow (anisotropy), inclination of grain, and relation of volume or thickness of the sample to moisture content (Suleiman et al., 1999). In addition, have an influence on thermal conductivity of wood material factors like kiln-drying operations, glueing of wood, preservation impregnation, hot pressing of wood based composites, and wood thermal degradation (Şahin Kol, 2009). In light of literature informations, the purpose of this study was to determine the thermal conductivity

properties of the fir (*Abies bornmulleriana* Mattf.) wood specimens modified by densification and heat post-treatment applying.

Materials and Methods

Wood material

In this study, Uludağ fir (*Abies bornmulleriana* Mattf.) wood were used. The fir tree were supplied as logs from a lumber yard in Düzce, Turkey. The sapwood was cut from the logs with an automatically controlled band saw. Rough-scale planks were formed, the cuts being determined by considering the annual rings parallel to the surface (tangent section) and the sample dimensions. Attention was paid to ensure that no rot, knot, crack, color, or density differences were present in the specimens (TS 2470, 1976). The specimens were initially subjected to natural drying to approximately 12% moisture content, and then were cut to the dimensions of 420 × 95 mm (length-longitudinal direction × width-tangential direction) and two different thicknesses 26.7 and 40 mm (radial direction). Before the densification process, the specimens were held in a conditioning cabin (RH 65 ± 3% and 20 ± 2 °C) until they reached a stable weight (TS 2471, 1976).

Thermo-mechanical densification and heat treatment

The thermo-mechanical densification process was done with a hydraulic press at compression ratios of 25 and 50%, with temperatures of 100 and 140 °C for 10 min. After thermo-mechanical densification, heat post-treatment was carried out on the wood specimens to provide dimensional stability. The heat treatment was conducted under the protection of water vapor at the temperatures 185 and 212 °C for 2 h. The thermo-mechanical densification and heat post-treatment processes have been described in detail in a previous study by the authors (Pelit et al., 2016). After heat post-treatment, specimens remained in a conditioning cabin (RH 65 ± 3% and 20 ± 2 °C) until they reached a stable weight (TS 2471, 1976). The densified and heat treated specimens were then cut into smaller specimens in the dimensions of 100 × 20 × 20 mm^3 (longitudinal direction × tangential direction × radial direction). Test specimens were prepared in a number sufficient to accommodate 10 repetitions (n=10) for each variable.

Measurement of thermal conductivity

Thermal conductivity values of fir specimens was determined according to ASTM C 1113-99 (2004) by using hot-wire method. Measurements were made using QTM 500 (Quick Thermal Conductivity) device which is a product of Kyoto Electronics Manufacturing, Japan. PD-11 box probe sensor (constantan heater wire and chromel-alumel thermocouple) was used. After the completion of the device calibration, measurements performed on the surface of each sample for a period of one minute.

Statistical analyses

The MSTAT-C package program was used for statistical evaluations. Analysis of variance (ANOVA) was performed between factors, and differences between Duncan test results and mean values were compared when significant differences were detected within obtained data. Therefore, success ranking among the factors included into the experiment was determined by separating them into homogeneous groups according to Least Significant Difference (LSD) critical values.

Results and Discussion

Analysis of variance results of thermal conductivity values of fir wood specimens thermo-mechanically densified and heat treated are given in Table 1.

Table 1: Analysis of variance results for thermal conductivity values

Factors	Degrees of freedom	Sum of squares	Mean square	F-value	Level of significance ($P \leq 0.05$)
Measuring surface (A)	1	0.007	0.007	200.2131	0.0000*
Densification (B)	4	0.028	0.007	189.6054	0.0000*
Interaction (AB)	4	0.010	0.002	66.7987	0.0000*
Heat treatment (C)	2	0.070	0.035	947.1696	0.0000*
Interaction (AC)	2	0.000	0.000	5.0091	0.0073*
Interaction (BC)	8	0.001	0.000	2.6475	0.0082*
Interaction (ABC)	8	0.001	0.000	4.8366	0.0000*
Error	270	0.010	0.000		
Total	299	0.128			

*Significant at 95% confidence level

According to analysis of variance results; measuring surface, densification, and heat treatment factors on thermal conductivity values of fir wood specimens and their reciprocal interactions were found to be significant ($P \leq 0.05$). Mono comparison results of Duncan test, which was conducted by using LSD critical value at measuring surface, densification and heat treatment level, are shown in Table 2.

Table 2: Mono comparison results of Duncan test for thermal conductivity values at measuring surface, densification and heat treatment level

Measuring surface	Mean	HG	
Tangential section	0.1280	b	*LSD* ± 0.002273
Radial sections	0.1379	a*	
Densification	**Mean**	**HG**	
Undensified	0.1172	e	*LSD* ± 0.003595
100 ˚C / 25%	0.1291	d	
100 ˚C / 50%	0.1410	b	
140 ˚C / 25%	0.1327	c	
140 ˚C / 50%	0.1448	a*	
Heat treatment	**Mean**	**HG**	
Untreated	0.1497	a*	*LSD* ± 0.002784
185 ˚C	0.1365	b	
212 ˚C	0.1127	c	

HG: Homogeneous group; *: the highest value

According to the results of the comparisons in Table 3, thermal conductivity value of fir wood specimens was higher in radial sections (0.1379) than tangential section (0.1280). Regarding densification conditions, the highest thermal conductivity value (0.1448) was found in the specimens densified by compression 50% at 140 ºC and the lowest (0.1172) in the undensified specimens. As for the heat treatment level, the highest thermal conductivity value (0.1497) was seen in the untreated specimens, while the lowest (0.1127) was in the specimens subjected to heat treatment at 212 ºC. Multiple comparison results of the Duncan test conducted by using the LSD critical value at measuring surface-densification-heat treatment trio interaction level are given in Table 3.

Table 3: Comparison results of Duncan test for thermal conductivity values at measuring surface-densification-heat treatment trio interaction level

Densification	Heat treatment	Measuring surface					
		Tangential section			Radial sections		
		Mean	SD	HG	Mean	SD	HG
Undensified	Untreated	0,1393	0,007	hı	0,1324	0,008	ijk
	185 ˚C	0,1243	0,004	kl	0,1114	0,004	no
	212 ˚C	0,1019	0,003	pq	0,0937	0,002	q
100 ˚C / 25%	Untreated	0,1406	0,009	ghı	0,1524	0,008	cde
	185 ˚C	0,1298	0,004	jkl	0,1333	0,006	ij
	212 ˚C	0,1046	0,007	op	0,1140	0,006	mn
100 ˚C / 50%	Untreated	0,1552	0,009	bcd	0,1591	0,006	abc
	185 ˚C	0,1424	0,004	fgh	0,1489	0,004	defg
	212 ˚C	0,1140	0,002	mn	0,1262	0,002	jkl
140 ˚C / 25%	Untreated	0,1445	0,008	efgh	0,1559	0,008	bcd
	185 ˚C	0,1212	0,003	lm	0,1496	0,003	def
	212 ˚C	0,1032	0,008	op	0,1215	0,003	lm

140 ˚C / 50%	Untreated	0,1506	0,009	cdef	0,1669	0,008	a*
	185 ˚C	0,1404	0,004	ghı	0,1635	0,008	ab
	212 ˚C	0,1078	0,004	nop	0,1400	0,006	hı
				LSD: ± 0.008805			

SD: Standard deviation; HG: Homogeneous group; *: the highest value

According to results shown in Table 3, the highest thermal conductivity value (0.1669) was obtained in radial section of specimens without heat treatment that were densified by compression 50% at 140 ºC, and the lowest value (0.0937) was obtained in radial section of the specimens for which heat treatment was applied at 212 ºC and they were undensified. Thermal conductivity values of densified specimens increased depending on compression ratio and temperature. Thermal conductivity values was highest at each measured section of 50% compressed specimens. In terms of compression temperature, the highest thermal conductivity values was obtained from specimens compressed at 100 °C for the tangential section and specimens compressed at 140 °C for radial section. After compressing process, the thermal conducitivity values increased up to %11 on tangential section and up to %26 on the radial section compared with control specimens. The higher increase of thermal conducitivity on the radial section (surface) is related with compression of specimens at radial direction. In addition, the increase of thermal conductivity can be explained by decrease of void volume (porosity) and increase of density of fir specimens. In the denfication process, it was determinated in previous studies that the void volume of wood decreased and the amount of cell wall per unit volume increased according to compression ratio (Blomberg et al., 2005; Ünsal et al., 2011; Ülker et al., 2012; Arruda and Menezzi, 2013; Pelit et al., 2014). The thermal conductiviy of wood is closely related with the density and porosity. It was reported that thermal conductivity increases proportionally with density and increases in inverse proportion to the porosity (Suleiman et al.,1999; Rice and Shepard, 2004; Şahin Kol et al., 2008; Örs and Keskin, 2008).

Thermal conductivity decreased in all heat treated specimens. In addition, the increase in the temperature of the heat treatment significantly decreased thermal conductivity values. However, the thermal conducitivity values of densified (especially on the radial seciton) specimens influenced less by the application of heat treatment than control specimens. In the previous studies conducted in parallel to this study, it was determined that the values of equilibrium moisture content (Pelit et al., 2016) and air-dry density (Pelit et al.,submitted for publication) of heat-treated fir wood specimens decreased depending on the increase of heat. In addition, it was reported that the hygroscopicity, equilibruim moisture content (EMC) and density of heat-treated specimens decreased (Tjeerdsma and Militz, 2005; Esteveset al., 2007; Boonstra, 2008; Esteves and Pereira, 2009; Korkut and Kocaefe, 2009; Aydemir et al.,2011; Pelit et al., 2014; Aytin et al., 2015; Kocaefe et al., 2015). After heat treatment process, the significant decrease in the thermal conductivity values can be explained by the reduction in the EMC and density. The results are compatible with the literature (Şahin Kol and Sefil, 2011; Aytin et al., 2016). In literature stated that there is a very strong correlation between moisture content and thermal conductivity and the thermal conductivity increases with increasing moisture content. Because the thermal conductivity of water is much higher than wood (Gu and Hunt, 2007;Şahin Kol, 2009; Şahin Kol and Sefil, 2011).

Conclusion

After densification precess, thermal conductivity values of fir specimens increased depending on the compression ratio and temperature. The thermal conductivity values was higher in the specimens compressed at high ratio (50%). In terms of compression temperature, the highest thermal conductivity values was obtained from specimens compressed at 100 °C for the tangential section and specimens compressed at 140 °C for radial section. The thermal conductivity values of densified specimens increased up to 11% on tangential section and up to 26% on the radial section compared with control specimens. After heat treatment process, thermal conductivity values of all specimens decreased significantly depending on the increase of the process temperature. However, the thermal conducitivity values of densified specimens (particularly in the radial section) influenced less by the application of heat treatment compared with control specimens.

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THE EFFECTS OF SOCIAL MARKETING EFFORTS ON CONSUMERS: THE ICE BUCKET CHALLENGE

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Abstract: Marketers try to create behavioral changes by sending messages to the customers. Sometimes various institutions and governments also present some messages in order to raise awareness on social issues. These kind of marketing efforts are associated with social marketing. Social marketing campaigns involve messages such as giving up smoking, avoid using alcohol etc. In this study, it is aimed to determine the major effects of social marketing efforts on consumers' behaviors and thoughts. In order to find out these effects, the Ice Bucket Challenge campaign was employed. In this research content analysis was applied to evaluate the consumers' thoughts in Turkey. For that purpose, various dictionaries such as "Eksi Sozluk", "ITU Sozluk" and "Uludag Sozluk" were used. Frequency analyses were performed to analyze the consumers' thoughts about Ice Bucket Challenge. At the end of the study it was determined that Ice Bucket Challenge campaign influenced the consumers in different ways.

Keywords: Marketing, Social Marketing, Consumers

Introduction

Especially in recent years, firms and associations have started to focus on the long term benefits and the welfare of the society. These key points affect the marketing activities of the businesses. Social marketing gets more importance in the marketing programs of the firms. Social marketing campaigns enable to attract the attention of the customers to the topics related with social subjects such as giving up smoking, drawing attention to healthy nutrition, discouraging society from drinking alcohol and drugs, environmental protection etc. In other words, for the well-being of society, marketers have started to promote some ideas as well as goods and services. At this point, proper planning of social marketing campaigns, which can easily draw the attention of the consumers become more important. This study investigates how social marketing campaigns affect the consumers' thoughts, beliefs and attitudes in Turkey. To determine these effects well-known social marketing campaign, the Ice Bucket Challenge is used. The study reveals the influences of the Ice Bucket Challenge campaign on consumers. For this purpose, most famous dictionaries such as "Eksi Sozluk", "ITU Sozluk" and "Uludag Sozluk" were used to introduce the thoughts of the consumers. The remainder of the paper is organized as follows. First, social marketing is introduced. Next, it is highlighted how and for which purposes Ice Bucket Challenge campaign is publicized. Further, content analysis is used in order to state the consumers' thoughts and feelings about the campaign. Finally, the results and the impacts of the campaign are highlighted.

Social Marketing

Social marketing is the concept appeared in the early 1970s. In the emergence of this concept; Levy, Zaltman and Kotler have contributed a lot. They advocated that by the help of the social marketing programs, it is possible for consumers to adopt the social ideas that the businesses try to present. As a matter of fact, the major aim of the social marketing efforts is to influence the target consumers' behavior to increase the welfare of the society (Saunders, Barrington & Sridharan, 2015).

By the late 1960s and early 1970s, health sector have benefited from the social marketing efforts. In the 1980s, especially health promotion campaigns were frequently used to promote health. Furthermore, many campaigns were emerged such as anti-tobacco campaign, campaigns related with obesity etc. (Singaiah & Laskar, 2015)

In the literature it is possible to find several definitions on social marketing. According to Kotler and Zaltman (1971: 5) "social marketing is the design, implementation and control of programs calculated to influence the acceptability of social ideas and involving considerations of product planning, pricing, communication, distribution, and marketing research." Andreasen (1995: 7) defined that "social marketing is the application of commercial marketing technologies to the analysis, planning, execution and evaluation of programs designed to influence the voluntary behaviour of target audiences in order to improve their personal welfare and that of society." Lefebvre (2013: 4) stated that "social marketing is the application of the marketing discipline to social

issues and causes that provides a framework for developing innovative solutions to social problems that have long perplexed and frustrated us."

The keys of creating successful social marketing programs require focusing on the major benchmarks, including the following:

- Behavior change
- Consumer research
- Segmentation and targeting
- Exchange
- Competition
- Marketing mix

Behavior change is one of the aims of social marketing efforts. The major goal of the social marketing effort is to create behavioral changes after the campaign was presented to the target consumers. Besides, formative research must be made to understand the values of the consumers. Focus groups, interviews are some of the data collection methods in consumer research. This research enables to pretest the intervention elements with the target group. Segmentation and targeting are the important parts of the social marketing efforts since target group is selected according to the various segmentation variables like age, income etc. An exchange criterion is also important to reveal the motivating factors. It is known that the motivating factors can be either tangible or intangible. In other words, after participating to a social marketing campaign consumer can gain rewards or only personal satisfaction can be provided after the attendance. Competition is the benchmark related with analyzing the internal and external forces that creates the behavioral changes. The last criteria, marketing mix, is related with the application of marketing mix elements such as product, price, place and promotion (Stead, Gordon, Angus & McDermott, 2007; Luca & Suggs, 2010).

It is understood that social marketing activities are more different from business marketing activities. The reason is that in business marketing, artificial preferences are the main subject of the marketing activities whereas in social marketing society's welfare and beliefs get more importance in the marketing activities of the businesses. In other words, social marketing is the efficient and striking way of creating society's concern to the social issues and also can be regarded as a good option in performing the social objectives (Kotler & Zaltman, 1971).

The Ice Bucket Challenge

Ice Bucket Challenge is an important campaign started on July 2014 to create awareness on amyotrophic lateral sclerosis (ALS) disease. ALS is the motor neuron disease which causes the muscles to be damaged. In ALS, sensory nerves work well whereas the patients cannot be able to command voluntary muscles (Handa & Ebisawa, 2008).

The aim of the Ice Bucket Challenge campaign was either donating money to ALS Association or uploading a video on social media. To promote awareness of this disease, plenty of people have dumped a bucket of ice and water on their heads.

Figure 1. The Ice Bucket Challenge Campaign.

Ice Bucket Challenge Campaign is the interesting way to draw people's attention to ALS disease. The campaign has attracted many people's attention and more than 17 million people share their videos in social media. Hereby, 440 million people watched these videos a total of 10 billion times. Especially the celebrities have important contributions in attracting interest to the campaign all over the world. Owing to this campaign, ALS Association has received $ 115 million in 2014 (http://www.alsa.org/about-als/, 27.06.2016).

Results and Discussions

A content analysis was used in order to investigate the consumers' thoughts about Ice Bucket Challenge. To determine these thoughts online dictionaries such as "Eksi Sozluk", "Uludag Sozluk" and "ITU Sozluk" were used. Content analysis is a research methodology that is used to codify the existing texts according to fewer content categories (Stemler, 2001).

The population of the study is Turkish online dictionaries whereas the sample of the study includes three most popular Turkish dictionaries called "Eksi Sozluk", "Uludag Sozluk" and "ITU Sozluk". These dictionaries were searched according to the keyword "Ice Bucket Challenge". Entries between July 2014 and October 2014 were taken into consideration just because these dates are the most popular times of the campaign. It was determined that 585 entries were made between this period of time (Table 1).

Table 1: Number of the Ice Bucket Challenge entries in online dictionaries between July 2014 and October 2014.

Dictionary	Number of the Entries
Eksi Sozluk	298
Uludag Sozluk	127
ITU Sozluk	160
Total Entries	**585**

In the study three basic questions were examined. These questions can be listed as follows:

- What are the feelings of the consumers about the Ice Bucket Challenge Campaign?
- How the consumers' feelings about the Ice Bucket Challenge Campaign change within the considered time interval?
- Which phrases are frequently encountered in entries related with the Ice Bucket Challenge Campaign?

The descriptive statistics about the first question is given in Table 2. Entries for each dictionary were grouped as "positive feelings", "neutral feelings" and "negative feelings". It is found that the majority of the dictionary authors have negative opinions about the campaign. Among the dictionaries analyzed, "Uludag Sozluk" entries are found to have the highest number of negative entries while "Eksi Sozluk" contains the lowest number of negative entries. On the other hand, "Eksi Sozluk" has the highest number of positive feelings among all. Besides, it is shown that the minority of the dictionary authors have neutral feelings about the Ice Bucket Challenge Campaign.

Table 2: Feelings of the consumers about Ice Bucket Challenge.

Dictionary	Positive Feelings		Neutral Feelings		Negative Feelings	
	n	%	n	%	n	%
Eksi Sozluk	98	32,9	52	17,4	148	49,7
Uludag Sozluk	16	12,6	19	15	92	72,4
ITU Sozluk	40	25	38	23,8	82	51,2

The dictionary entries were also analyzed in terms of cumulative counts. The following figures (Figure 2, Figure 3, and Figure 4) illustrate the line plots of cumulative counts related to positive, neutral and negative feelings. In these figures, horizontal axes refer to the sequence of dictionary entries in chronological order while the vertical axes indicate the cumulative counts. It is observed that positive feelings are shown to be dominant nearly in all dictionaries in former entries. However, in latter entries, negative feelings tend to surpass the others. This can be explained that the campaign was found to be creative and attractive by society in the beginning. However, as time passes, the campaign was criticized due to some negative aspects such as waste of time, waste of water and regarding this campaign as a show especially after the attendance of celebrities.

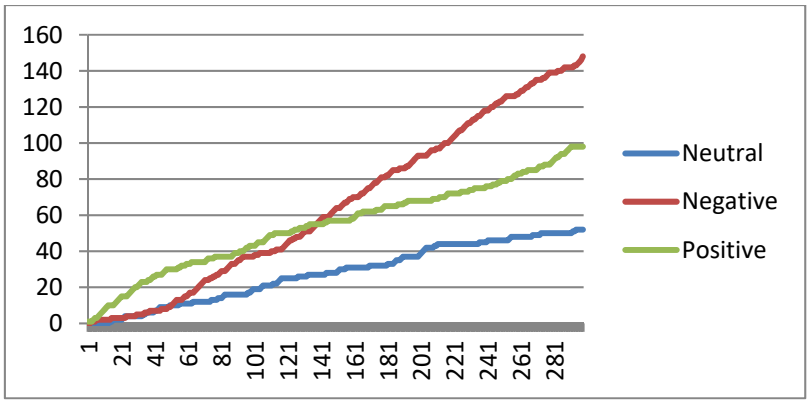

Figure 2. Cumulative count of the feelings for "Eksi Sozluk".

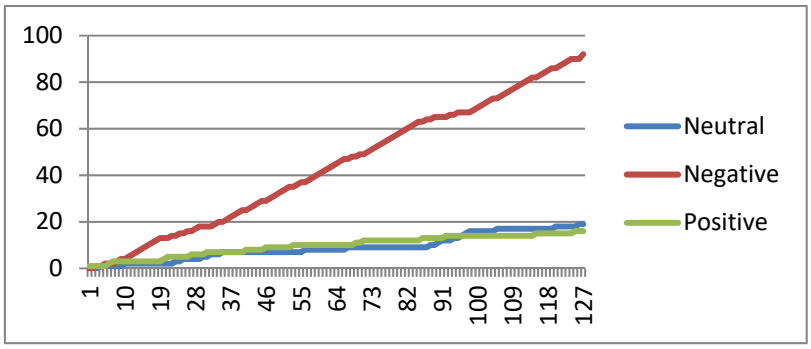

Figure 3. Cumulative count of the feelings for "Uludag Sozluk".

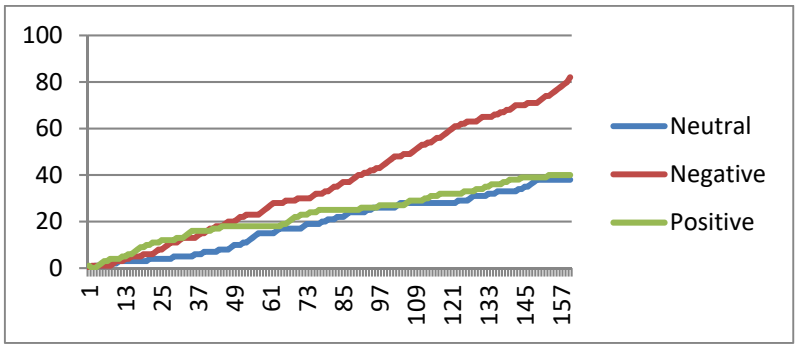

Figure 4. Cumulative count of the feelings for "ITU Sozluk".

The frequently used phrases were analyzed to answer the last research question. The phrases were determined after a preliminary work and chosen as distinguishing as possible. The list of phrases and their frequencies for each online dictionary are shown in Table 3. "Raise awareness" is the most encountered phrase among the entries of three dictionaries. On the other hand, "social responsibility project" is the rarely encountered phrase. The phrases such as "raise awareness", "fun" and "charity" can be observed as the most frequently encountered phrases taking place in positive feelings. Similarly, "show", "advertisement" and "waste of water" are the prominent phrases contained within negative feelings.

Table 3: Frequently used phrases about Ice Bucket Challenge.

Phrases	Eksi Sozluk	ITU Sozluk	Uludag Sozluk	Total
Raise Awareness	57	45	27	**129**
Fun	48	21	15	**84**
Charity	37	14	11	**62**
Show	23	23	12	**58**
Advertisement	31	8	12	**51**
Admirable	37	9	4	**50**
Popular	14	13	10	**37**
Sensibility	22	5	7	**34**
Trend	10	3	5	**18**
Waste of Water	11	5	0	**16**
Bad	10	1	0	**11**
Unnecessary	2	2	5	**9**
Efficient	4	2	0	**6**
Social Responsibility Project	0	3	0	**3**

Conclusion

Social marketing has an important role to attract the awareness of the society to the social problems and issues. In this study, Ice Bucket Challenge was examined to state the society's feelings about the campaign. For this purpose, three famous online dictionaries called "Eksi Sozluk", "ITU Sozluk" and "Uludag Sozluk" were analyzed. It was found that 26% of the entries have positive opinions about the campaign while 55% and 19% of the entries have negative and neutral opinions, respectively. It is revealed that the general opinion converges to negative feelings about the campaign. The negative feelings reflected by the dictionary authors are mainly based on excessive water usage, turning out to be a show instead of a campaign etc. On the other hand, it is appeared that the campaign has several positive aspects such as drawing attention to a disease, collecting donations etc. As a future work, involving the large variety of dictionaries (national and international) might be useful to enrich the present study and following similar studies.

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THE LABORATORY IMPLICATIONS BASED ON ARGUMENTATION OF PRE-SERVICE SCIENCE TEACHERS

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Abstract: The purpose of current study is to determine the effect of laboratory implications based on argumentation on the pre-service science teachers' logical thinking abilities and critical thinking tendencies. The sample group of the study consists of a total of 64 pre-service teachers (32 for the experimental group, 32 for the control group) who are in their fourth year in the Science Education Program at a state university. The pre-test/ post-test control group experimental design model was used that current research. In the experimental group, the experiments were conducted using worksheets based on argumentation, whereas in the control group the experiments were conducted in the form of a close-ended experiment. In this quasi-experimental designed research, the "Logical Thinking Abilities Test" and "The California Critical Thinking Disposition Inventory" were used as data collection tools. As a result of this study, it was found that the logical thinking ability and critical thinking tendency levels of the experimental group were higher than those of the control group. Accordingly, it can be argued that laboratory activities conducted with argumentation-based worksheets are more effective than laboratory activities conducted with the use of close-ended experiment in terms of developing logical thinking abilities and critical thinking tendencies on the part of pre-service science teachers.

Keywords: Pre-service science teachers, argumentation, science laboratory implications

Introduction

As is known, it is vital to design a learning environment based on research-inquiry in order to provide students with permanent learning. In a leaning environment based on research and inquiry, students ask questions, formulate arguments and structure information by supporting their arguments with proofs (Günel, Kıngır and Geban, 2012). The teacher helps students to develop their high level cognitive skills such as analysis, synthesis and evaluation by providing a suitable environment in which students can make scientific debates (Duschl and Osborne, 2002). In the study they carried out to support the use of argumentation teaching by teachers in a scientific context, Simon, Erduran and Osborne (2006) stated that motivating students for the process and occupational development of the teachers might have an impact on the quality of argumentation. Specifically, scientific debates have recently become a notable practice (Driver, Newton and Osborne, 2000). One of the reasons for this is that students can carry out studies which are similar to those of scientists and have the opportunity to structure information in the way scientists do in the teaching environments in which scientific debate strategies are used (Brown, Collins and Duguid, 1989). In addition, the fact that students think about the link between the argument that is formulated during scientific debates and the proof put forward to support this argument will improve their abilities of critical thinking (Erduran, Ardaç and Güzel, 2006). As a result, the students will have the opportunity not only to learn scientific concepts but also to appreciate the nature of science (Driver et al., 2000). With this in mind, Keys, Hand, Prain and Collins (1999) devised the approach of learning science based on argumentation as a learning and teaching approach based on written and oral argumentation which allows students to experience the processes that scientists go through while solving real-life problems they face and which provides the students with the opportunity to structure information during this process in science classes. There are various definitions as to what an argument means. Toulmin (1958) defines argument as an assertion and demonstrating its validity. Driver et al. (2000), on the other hand, defines argument as an individual or a group activity, a social activity done through thought or writing. While argument defines as claims, data, grounds and the backings contributing to an idea, argumentation signifies compiling these constituents (Simon, Osborne and Erduran, 2003). It is striking that Toulmin model is frequently used in the studies conducted in recent years. Toulmin model is comprised of six elements. While data, claims and grounds are the main elements of an argument, backing, qualifiers and rebuttals are auxiliary elements. In Toulmin's model, grounds verify the course from the data to the result, whereas the backings are assumptions that demonstrate the validity of grounds (Jimenez-Aleixandre and Pereiro-Munoz, 2002). The main structure of this model has been formulated as because (data) is…… in terms of ……. (grounds), then ……. (backing); therefore, ……. (result). Zohar and Nemet (2002) expressed that argumentation plays an

important part in science education in that it encourages scientific thinking and development of a qualified conceptual understanding in students. Teaching argumentation skills in science classes as a way of developing reasoning skills has been a focal point of studies on science education that adopt argumentation (Acar, 2008).

Numerous studies conducted in the field of science education conclude that integration of argumentation into the education and training environments may benefit students in many respects (Berland & Reiser, 2011; Sampson & Clark, 2011). In the study carried out by Çetin, Kutluca and Kaya (2013), it was concluded that, at the end of the process, there is an increase in the quality of the argumentation performed by the students involved in the process of argumentation as compared with the beginning of the process. Also, the researchers stated that students can formulate more quality arguments and can learn science concepts more effectively thanks to the science classes based on argumentation. Especially, the presentation of argumentation in combination with laboratory is invaluable with regard to science education. In this way, students will both have the opportunity to put theoretical knowledge into practice in laboratory environment and find the chance to debate their arguments with their friends in their groups. Laboratory practices based on argumentation are a strategy devised by Sampson, Grooms and Walker (2011). In this practice, students try to explain a problem, a phenomenon or an observation by working in small groups. While doing this, they design their own experiment settings, share their results with other groups in a certain format and get feedback from their peers. Groups reassess their views and try to explain different views in the light of feedbacks they get. The students are asked to write any hypothesis/claim in small groups in a laboratory environment and to design an experiment with regard to this and also they are asked to discuss their own designs with other groups (Osborne, Erduran and Simon, 2004). In addition, the groups are expected to prepare reports while sharing their results. Moreover, the students get the chance to be evaluated by their teachers/instructors or their peers by being observed during the process. During evaluation, how students form arguments such as claim, data, backing (qualifier), grounds (proofs), limiters, rebuttals (exceptions) is of importance. In such practices, there are also some reasoning activities in which students express especially how the proofs and the explanation are connected. When the body of literature is examined, we come across studies with regard to argumentation based laboratory practices (Demircioğlu, 2008). Demircioğlu (2011) carried out a study to examine the effect of laboratory education based on the approach of "Argument Based Inquiry" during "General Physics Laboratory III" classes on the academic success of pre-service science and technology teachers, their tendencies towards discussion, scientific process skills and their level of argumentation. The study concluded that laboratory education based on the approach of "Argument Based Inquiry" increases the academic success and scientific process skills of pre-service science and technology teachers as compared to traditional classes, but it doesn't provide any change as to their tendency towards discussion. During the implementation of the study, the quality of argumentation was seen to increase in the reports of the students in the experimental group, while the quality of argumentation does not change in the reports of the students in the control group.

When the body of literature especially in our country (in Turkey) is examined, we see that the positive effects of argumentation based practices on high level mental skills (such as scientific process skills, critical thinking skills, logical thinking skills etc.) are mentioned and the studies scrutinizing these skills (Aydın and Kaptan, 2014; Çınar, 2013; Demiral, 2014; Gültepe, 2011, Koçak, 2014; Şahin, 2016; Tonus, 2012; Tümay, 2008) stand out. However, a study that deals with the development of critical thinking disposition and logical thinking skills which lead to the development of the skills in students mentioned above through argumentation based learning practices does not exist. With this in mind, we aim to study the effects of argumentation based laboratory practices on the logical thinking skills and critical thinking disposition of pre-service science teachers. To this end, we have formulated two hypotheses and tested these hypotheses. These hypotheses are as such:

1. There is a significant difference between the logical thinking skills of the pre-service teachers in the experimental group to whom argumentation based laboratory practices were applied and that of the pre-service teachers in the control group to whom close-ended experiments were applied and the difference is in favour of the experimental group.
2. There is a significant difference between the critical thinking disposition of the pre-service teachers in the experimental group to whom argumentation based laboratory practices were applied and that of the pre-service teachers in the control group to whom close-ended experiments were applied and the difference is in favour of the experimental group.

Method

In this study, a quasi-experimental design with a pre-test post-test control group was used. The experimental design classified as test model is a quantitative research model "which is directly controlled by the researchers and in which the desired data are produced with the aim of identifying cause-effect relationships" (Karasar, 2011).

In experimental studies, terms such as participants or study group are preferred instead of population and sample because the aim of experimental studies is to demonstrate the circumstances that are studied rather than generalize (Sönmez, 2005). Within this context, the term of study group was preferred in this study rather than population-sample. The study group of this study is comprised of the students who are attending the Department of Science Teaching for Elementary Schools in the Faculty of Education in Afyon Kocatepe University during the spring semester of the 2015-2016 academic year. The study group is made up of 64 pre-service teachers in their senior year (4th year) who are either in experimental group or in control group.

Data Collection Tools:
"Logical Thinking Ability Test (LTAT)" and "California Critical Thinking Disposition Inventory (CCTDI)" have been used in this study as data collection tools.

"Logical Thinking Ability Test (LTAT)" was devised by Tobin and Capie (1981) and was adapted to Turkish by Geban, Aşkar and Özkan (1992). The test consists of 10 questions, 8 of which are multiple-choice questions, which measure the abilities of defining and controlling variables, calculating probability, developing relations and using ratio. The first 8 multiple-choice questions each have one correct answer and an explanation that leads to this correct answer. In order for the answer to be rendered correct, both the answer and the explanation must be correct. The last two questions which are not multiple-choice ones certain probabilities must be stated in full. The highest point one can get on this test is 10. The reliability of the test is 0.81. In this study, it has been found out that the KR-20 coefficient obtained in the pre-test results of LTAT is 0.61.

"California Critical Thinking Disposition Inventory (CCTDI)" was originally formulated by Facione, Facione and Giancarlo in 1998 as a Likert-type scale comprised of 75 items. The validity and reliability studies of the scale in its translated form into Turkish were conducted by Kökdemir (2003). It was noted that the structure of factors that constitute CCTDI which was reduced to 51 items are not very different from its original form, that some items were moved between factors and that two factors were combined into one. The scale is comprised of 51 items and 6 sub-scales in total (Truth-seeking, Open-mindedness, Analyticity, Systematicity, Self-confidence, Inquisitiveness). "Analyticity" of these sub-scales expresses watching out for situations which tend to be problematic, logical thinking in tough problems and using objective evidence. "Open-mindedness" signifies an individual's being tolerant of different approaches, his/her taking others' views and ideas into consideration while making decision and be mindful of his/her own mistakes. "Inquisitiveness" means an individual's disposition to obtain information and to learn new things without expecting any gain from this. "Self-confidence" refers to the confidence a person has in his/her own logical thinking processes. "Truth-seeking" measures the disposition to evaluate different ideas. "Systematicity" refers to the disposition to use a decision-making strategy based on information and that follows a specific method; in other words disposition to making research in an organised, planned and careful manner. This new form of CCTDI has an internal consistency reliability of 0.88 and the total variance that the scale explains is 36,13. The internal consistency coefficient of CCTDI used in this study has been found to be 0.85.

The Implementation Process
The participants in the study group are made up of two groups, one experimental group (n=32) and one control group (n=32). Before the implementation process, "Logical Thinking Ability Test (LTAT)" and "California Critical Thinking Disposition Inventory (CCTDI)" were applied to both groups as a pre-test. During the implementation process, worksheets based on argumentation were used in the laboratory activities of the experimental group, while close-ended experiment techniques were used in the laboratory activities of the control group. While preparing the worksheets based on argumentation, experiments that would attract students' attention were especially chosen. 8 activities were made during the implementation process. When the process was completed, "Logical Thinking Ability Test (LTAT)" and "California Critical Thinking Disposition Inventory (CCTDI)" were applied this time as a post-test.

Analysis of the Data
The data obtained was analysed with the help of statistics packet program in order to compare the results of the pre-test and the post-test. Independent sample t-test was used to determine the differences between the post-test scores of the pre-service teachers which was aimed at identifying the logical thinking abilities of the pre-service teachers in the experimental group and the control group. Similarly, independent sample t-test was used to determine the differences between the post-test scores with regard to the critical thinking disposition of the pre-service teachers in the experimental group and the control group.

Findings

In this section, we have examined whether there are significant differences in the logical thinking ability and critical thinking disposition between the experimental group in which open-end argumentation based laboratory applications were used and the control group in which close-ended experiment technique was used and the results have demonstrated in tables in detail. It has been found out that the data obtained from LTAT and CCTDI scales has a normal distribution. Therefore, unrelated samples t-test and related samples t-test were used in the analysis of the data.

Table 1 shows the independent samples t-test results regarding the pre-test scores that the students in the experimental group and the control group got on LTAT.

Table 1. Independent samples t-test results of the pre-test scores that the students in the experimental group and the control group got on LTAT.

Test	Groups	N	Mean	SD	t	P
LTAT	Experimental (Pre-test)	32	6.59	1.68	-0.483	0.631
	Control (Pre-test)	32	6.84	2.39		

When we examine Table 1, we can note that there isn't a statistically significant difference between the LTAT pre-test scores of the students in the experimental group and the control group.

Table 2 shows the independent samples t-test results regarding the pre-test scores that the students in the experimental group and the control group got on CCTDI.

Table 2. Independent samples t-test results of the pre-test scores that the students in the experimental group and the control group got on CCTDI.

CCTDI sub-scales	Groups	N	Mean	SD	t	P
Analyticity	Experimental (Pre-test)	32	57.84	6.37		
	Control (Pre-test)	32	59.56	6.65	-1.06	0.295
Open-Mindedness	Experimental (Pre-test)	32	46.78	8.55		
	Control (Pre-test)	32	47.71	6.85	-0484	0.630
Inquisitiveness	Experimental (Pre-test)	32	38.75	6.26		
	Control (Pre-test)	32	41.28	4.33	-1.879	0.065
Self-Confidence	Experimental (Pre-test)	32	24.78	4.75		
	Control (Pre-test)	32	26.37	5.24	-1.275	0.207
Truth-Seeking	Experimental (Pre-test)	32	25.43	4.55		
	Control (Pre-test)	32	25.81	4.46	-0.332	0.741
Systematicity	Experimental (Pre-test)	32	26.53	3.12		
	Control (Pre-test)	32	25.68	4.47	-0.875	0.385
CCTDI	Experimental (Pre-test)	32	220.12	20.91		
	Control (Pre-test)	32	226.43	17.27	-1.316	0.193

When we examine Table 2, we can see that there aren't any statistically significant differences between the pre-test scores of the students in the experimental group and the control group with regard to the sub-scales of CCTDI and the overall scale.

Table 3 demonstrates the paired samples t-test results in terms of the pre-test post-test scores on LTAT of the students in the experimental group.

Table 3. Paired samples t-tests results in terms of the pre-test and post-test scores on LTAT of the students in the experimental group.

Test	Groups	N	Mean	SD	t	P
LTAT	Experimental (Pre-test)	32	6.59	1.68	-1.180	0.247
	Experimental (Post-test)	32	7.09	1.51		

When we examine Table 3, we see that there aren't any statistically significant differences between the pre-test and the post-test scores that the students in the experimental group obtained on LTAT.

Table 4 shows the paired samples t-test results with regard to the pre-test scores that the students in the experimental group obtained in CCTDI.

Table 4. Paired samples t-test results with regard to the pre-test scores that the students in the experimental group obtained on CCTDI

CCTDI sub-scales	Groups	N	Mean	SD	t	P
Analyticity	Experimental (Pre-test)	32	57.84	6.37	-1.884	0.069
	Experimental (Post-test)	32	60.28	5.97		
Open-Mindedness	Experimental (Pre-test)	32	46.78	8.55	-0.299	0.767
	Experimental (Post-test)	32	47.25	5.58		
Inquisitiveness	Experimental (Pre-test)	32	38.75	6.26	-3.303	0.002*
	Experimental (Post-test)	32	43.84	5.91		
Self-Confidence	Experimental (Pre-test)	32	24.78	4.75	-2.266	0.031*
	Experimental (Post-test)	32	27.15	3.42		
Truth-Seeking	Experimental (Pre-test)	32	25.43	4.55	-0.422	0.676
	Experimental (Post-test)	32	26.00	5.70		
Systematicity	Experimental (Pre-test)	32	26.53	3.12	-0.918	0.366
	Experimental (Post-test)	32	27.46	3.94		
CCTDI	Experimental (Pre-test)	32	220.12	20.91	-2.868	0.007*
	Experimental (Post-test)	32	232.00	17.81		

*p<0.05

When we examine Table 4, we can see that there are statistically significant differences in favour of the post-tests between the pre-test and post-test scores of the students in the experimental group in the "Inquisitiveness" and the "Self-confidence" sub-scales of CCTDI and in the overall scale.

Table 5 shows the paired samples t-test results regarding the pre-test and post-test scores that the students in the control group got on LTAT.

Table 5. Paired samples t-test results regarding the pre-test and post-test scores that the students in the control group obtained on LTAT

Test	Groups	N	Mean	SD	t	P
LTAT	Control(Pre-test)	32	6.84	2.39	-.158	.876
	Control(Post-test)	32	6.93	1.79		

When we examine Table 5, we can see that there aren't any statistically significant differences between the pre-test and the post-test scores that the control group students obtained on LTAT.

Table 6 exhibits the paired samples t-test results regarding the pre-test and the post-test scores that the control group students obtained on CCTDI.

Table 6. Paired samples t-test results regarding the pre-test and the post-test scores that the control group students obtained on CCTDI

CCTDI sub-scales	Groups	N	Mean	SD	t	P
Analyticity	Control (Pre-test)	32	59.56	6.65	-0.174	0.863
	Control (Post-test)	32	59.71	4.26		
Open-Mindedness	Control (Pre-test)	32	47.71	6.85	-0.575	0.569
	Control (Post-test)	32	48.62	5.64		
Inquisitiveness	Control (Pre-test)	32	41.28	4.33	-0.860	0.396
	Control (Post-test)	32	42.40	6.45		
Self-Confidence	Control (Pre-test)	32	26.37	5.24	-0.173	0.864
	Control (Post-test)	32	26.56	2.92		
Truth-Seeking	Control (Pre-test)	32	25.81	4.46	-0.595	0.556
	Control (Post-test)	32	26.50	5.21		
Systematicity	Control (Pre-test)	32	25.68	4.47	-1.679	0.103
	Control (Post-test)	32	27.59	4.19		
CCTDI	Control (Pre-test)	32	226.43	17.27	-1.926	0.063
	Control (Post-test)	32	231.40	16.82		

When we examine Table 6, we see that there aren't any statistically significant differences between the pre-test and the post-test scores that the students in the control group obtained in the sub-scales of CCTDI and the overall scale.

Table 7 shows the independent samples t-test results regarding the post-test scores that the students in both the experimental group and the test-group obtained on LTAT.

Table 7. Independent samples t-test results regarding the post-test scores that the students in both the experimental group and the test-group obtained on LTAT

Test	Groups	N	Mean	SD	t	P
LTAT	Experimental (Post-test)	32	7.09	1.51	0.377	0.708
	Control (Post-test)	32	6.93	1.79		

When we examine Table 7, we can see that there aren't any statistically significant differences between the scores that the students in the experimental group and the control group obtained on LTAT.

Table 8 shows the independent samples t-test results regarding the post-test scores that the students in the experimental group and the control group obtained on CCTDI.

Table 8. Independent samples t-test results regarding the post-test scores that the students in the experimental group and the control group obtained on CCTDI

CCTDI sub-scales	Groups	N	Mean	SD	t	P
Analyticity	Experimental (Post-test)	32	60.28	5.97	0.433	0.666
	Control (Post-test)	32	59.71	4.26		
Open-Mindedness	Experimental (Post-test)	32	47.25	5.58	-0.979	0.331
	Control (Post-test)	32	48.62	5.64		
Inquisitiveness	Experimental (Post-test)	32	43.84	5.91	0.929	0.357
	Control (Post-test)	32	42.40	6.45		
Self-Confidence	Experimental (Post-test)	32	27.15	3.42	0.745	0.459
	Control (Post-test)	32	26.56	2.92		
Truth-Seeking	Experimental (Post-test)	32	26.00	5.70	-0.366	0.716
	Control (Post-test)	32	26.50	5.21		
Systematicity	Experimental (Post-test)	32	27.46	3.94	-0.123	0.903
	Control (Post-test)	32	27.59	4.19		
CCTDI	Experimental (Post-test)	32	232.00	17.81	0.137	0.891
	Control (Post-test)	32	231.40	16.82		

When we examine Table 8, there aren't any statistically significant differences between the post-test scores that the students in the experimental group and the control group obtained in the sub-scales of CCTDI and on the overall scale.

Conclusion

This study aims to identify the effects of argumentation based laboratory practices on the logical thinking ability and the critical thinking disposition of pre-service science teachers. In parallel with this aim, implementation process was conducted on the 64 pre-service teachers who are attending the Department of Science Teaching in this study in which quasi-experimental design with a pre-test and post-test control group was used. Before the implementation process, "Logical Thinking Ability Test (LTAT)" and "California Critical Thinking Disposition Inventory (CCTDI)" were applied to both groups as a pre-test. As a result of the analyses conducted, it was found out that there wasn't a statistically significant difference in the pre-test scores that the students in the experimental group and the control group obtained on LTAT. Similarly, it was observed that there aren't any statistically significant differences between the pre-test scores that the students in the experimental group and the control group obtained on the sub-scales of CCTDI and the overall scale. In the study which was carried out with 32 pre-service teachers in each of the experimental group and the control group, close endedf experimental techniques were used in the laboratory activities of the control group, while argumentation based worksheets were used in the laboratory activities of the experimental group. At the end of the 8-week long implementation process, measuring tools were used as post-test. It was found out that there isn't a statistically significant difference in the pre-test and pot-test scores that the students in the control group obtained on LTAT, the sub-scales of CCTDI and overall CCTDI. Likewise, it was seen that there isn't a statistically significant difference in the pre-test and the post-test scores that the students in the experimental group obtained on LTAT. On the other hand, it was observed that there are statistically significant differences between the pre-test and post-test scores that the students in the experimental group obtained on the "Inquisitiveness and "Self-Confidence" sub-scales of CCDTI and the overall scale and the differences are in favour of the post-tests. When the post-test scores that the students in the experimental group and the control group obtained on LTAT and the sub-scales of CCDTI and overall CCDTI were compared, it was also observed that there aren't any statistically significant differences between the scores.

A significant difference in logical thinking ability of the students in the experimental group and the control group did not emerge as a result of the argumentation based laboratory activities. It can be assumed that this outcome arose because the 8-week implementation process was not enough. This is because argumentation based laboratory practices are not what students are accustomed to. When we take the fact that close-ended experiments or open-end experiments without argumentation are conducted in laboratory classes into consideration, it is true that it will take pre-service teachers to get used to this new practice. When the body of literature is studied, we can see that logical thinking skills are dealt with rather than logical thinking ability in the studies carried out with regard to argumentation. For instance, the study conducted by Aydın and Kaptan (2010) concludes that while the logical thinking skills of the pre-service teachers aren't significantly affected in classes in which the argumentation is readily presented, the logical thinking skills of the pre-service teachers are significantly affected in the group that had an argumentation based class.

We have concluded that there isn't a statistically significant difference between the post-test scores that the students in the experimental group and the control group obtained on the sub-scales of CCTDI and the overall scale. This conclusion we have made corresponds to the conclusion that there isn't a statistically significant difference in the critical thinking disposition between the post-test scores of the students in the experimental group and the control group which was drawn in a study titled the effects of argumentation based science learning on the success of the pre-service teachers in the subject of solutions and their critical thinking disposition conducted by Koçak (2014). Similarly, the study carried out by Qing, Jing, Yazhuan, Ting and Junping, (2010) demonstrates that a statistically significant difference between the average scores that the experimental and the control group students obtained with regard to their critical thinking disposition does not exist. We can see that, among the studies that deal with the argumentation based learning approach, there are also studies that examine the effects on critical thinking skills apart from critical thinking disposition. One such study is the experimental study that Çınar (2013) carried out argumentation based science teaching for 5th graders. This study also concluded that there isn't s significant difference between the experimental group and the control group students with regard to the development of their critical thinking skills.

Although there isn't a significant difference between the experimental group and the control group in this study, a significant difference in the critical thinking disposition of the students in the experimental group emerged at the end of the process of argumentation based laboratory activities. Especially, the strikingly significant difference in the Inquisitiveness and Self-confidence makes us think that argumentation based laboratory practices attract the attention of the pre-service teachers and that it helps them gain self-confidence over time. When we study the body

of literature, we see that the studies dealing with argumentation practices focus on critical thinking skills rather than critical thinking disposition. Within this context, we can cite the study conducted by Eirexas and Jiménez Aleixandre (2007) as an example to this in that it deals with skills rather than disposition. In the study mentioned above, students were encouraged to put forward their arguments in written and oral debates and its was observed that the critical thinking skills of students improved thanks to these debates at the end of the implementation process. In parallel with this, Tümay (2008) conducted the study in "Chemistry Teaching with a Focus on Argumentation" classes which aimed to examine the growing understanding of argumentation in science and science education that pre-service chemistry teachers have. At the end of the implementation process, it was concluded that teaching with a focus on argumentation is an effective way of improving the thinking skills of pre-service teachers. In a study conducted by Gültepe (2011), it emerged that the teaching approach based on scientific discussion is more effective than traditional teaching approach in improving critical thinking skills of students. Tonus (2012) found out that there is a significant difference between the pre-test and the post-test measuring critical thinking skills of the students after the argumentation process. In the study in which Şahin (2016) examined the effects of Argumentation Based Science Learning approach (ABSL) on the academic success, metacognition and critical thinking skills of gifted students, it was found out that there is a statistically significant difference in favour of the experimental group when the results of critical thinking skills tests were compared. The results obtained from these studies have parallels with each other.

In this study, logical thinking ability test and critical thinking disposition inventory were used with a view to identifying the effects of the argumentation based laboratory activities of pre-service teachers on high level thinking. In other studies to be carried out in the future, logical thinking skills and critical thinking skills tests directly aimed at skills rather than ability or disposition could be used. This study was carried out for a period of 8 weeks. In order to better identify the effects of argumentation based laboratory practices, longer-termed studies spanning a whole academic year could be conducted. Quantitative research method was used in this study. Mixed method studies could be designed in future studies to be conducted by integrating qualitative aspects.

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THE NEUTRON MACROSCOPIC CROSS SECTIONS CALCULATION OF SOME MINERALS BY USING FLUKA MONTE CARLO METHOD

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Abstract: Because of neutrons are uncharged particles, they are powerful in terms of penetration into the material. Recently shielding is an important issue because of neutrons which have many applications today do not harm living tissue. Different compounds, alloys and composites are usually preferred against neutrons as shielding material. The aim of this project is to determine minerals(Veatchite($Sr_2B_{11}O_{16}(OH)_5*(H_2O)$, Sussexite($Mn^{+2}BO_2(OH)$ and Vimsite($CaB_2O_2(OH)_4$),based new shielding materials against neutron particles using by Fluka Monte Carlo method and then to obtain neutron total macroscopic cross sections and several shielding parameters by experimentally.

Key words: Neutrons, Macroscopic Cross Section , Fluka Monte Carlo

Introduction

Ordinary time, the neutron shielding effects of materials were examined for nuclear reactor shielding design and many shielding experiments and calculations were performed to obtain the removal cross sections of the materials. The neutron attenuations of materials were evaluated with the cross sections. After that, benchmark or mock-up experiments on the multi-layer problem to confirm the shielding characteristics or to evaluate analysis accuracy were reported recently, the need to transport spent nuclear fuels is increasing due to the current limited storage capacity. Considering that the existing storage facilities will be full by 2016, a national policy for spent fuel urgently needs to be established Nowadays, the application field of neutron particles has increased and new scientific studies about discovering materials with higher performance that the material which are already used and can be used as a shield against neutrons has been prepared. A fast neutron loses their energy basically by the elastic crashes with atomic nucleus. In recent years, there has been rapid growth of electron accelerator based neutron sources for medical and industrial applications because of their compactness (Patil B.J.,Chavan ,S.T,Pethe S.N.,Krishnan R.,Dhole S.D.,2010) .In this study, neutron shielding for mineral appearance is seen in Figure-1(a,b,c) http:\\www.mindat.org; http:\\webmineral.com\data).

A neutron can come to the thermal balance with the centre periphery of the atom by reaching 0.04 eV energy at ambient temperature after a lot of crashes. In these contributions, it is always valid as a simple and clear way to use Fluka Monte Carlo simulation techniques. It is possible to work intuitively on a neutron ray reaching the thermal balance.

a) Vimsite

b)Sussexite

c)Veatchite

Fig1. Neutron Shielding For Materials .(http:\\www.mindat.org; http:\\webmineral.com\data)

Methodology of the Monte Carlo FLUKA

Monte Carlo codes are extensively used for probabilistic simulation of various physical systems .These code are widely used in calculations of neutron radiation shielding and gamma ray transport in materials (Wielopolski L.,Song,Z.,Orion,I,Hanson A.L.,Hendrey,G.,2005).Monte Carlo methods are very different from deterministic transport methods. Deterministic methods, the most common of which is the discrete ordinates method, solve the trans port equation for the average particle behavior The other hand, Monte Carlo does not solve an explicit equation, but rather obtains answers by simulating individual particles and recording some aspects of their average behavior .Monte Carlo is well suited to solving complicated 3-D time-dependent problems (Bremister,J.1993,). FLUKA code is a sub-program of the Monte Carlo code .It is a general purpose tool for calculations of particle transport and interactions with matter, covering an extended range of applications (Korkut,T. ,Karabulut, A.,Budak ,G. et al..,2012).Fluka is a multipurpose transport Monte Carlo Code ,for calculations of particle transport and interactions with matter from electron and proton accelerator shielding to target design, calorimetry ,activation, dosimetry ,detector design ,ADS systems ,neutrino physics ,radiotherapy ,shielding design etc. Therefore , Fluka is a tool that is constantly employed in the majority of CERN applications where energy deposition has to be calculated through beam-matter interactions ,as well as for radiation protection and shielding simulations . Fluka program works with Fortran Software written with machine code. The developments of Fluka program started with being used for Monte Carlo application for protons with high energy by J. Ranft and H. Geibel in 1962..Monte Carlo technique is randomly number selection technique from one or more probabilistic distribution in a special trial or simulation study(Hançerlioğulları ,A. 2006).The Mcnp code was used for reactor designs and calculations. the Monte Carlo simulation code Geant developed at CERN , allows the simulation of the particle shower generation and propagation inside a medium with a complicated geometry or composition. To follow hadrons inside matter, Geant is interfaced to Fluka ,Gheisha and Micap codes. In particular ,MICAP allows the simulation of neutron propagation and interaction within an energy region from 20 MeV down to 10^{-5} eV The flux calculation has been completely carried out in the framework of the FLUKA Monte Carlo code(Battistoni ,G., Ferrari A.,Montraruli T.,Sala P.R.,2003; Battistoni, G., Francesco, B. ,Markus, B., Mauro C. ,et al..,2011). The Fluka collaboration ensures the constant update of the code with the most advanced physics and features .Fluka is based, as far as possible, on original and well tested microscopic models. Due to microscopic approach to hadronic interaction modeling. FLUKA features a combinatorial geometry which is constantly enhanced in order to cope with new demands for more complex detector descriptions .The FLUKA simulations are carried out for a detailed description of an ideal calibration set up, exposing the detector only to direct collimated and monochromatic neutron beams avoiding any diffused radiation contribution(Borio di tigliole,A.,Cesana ,A.,Dolfini R.et al.,2001).

Shielding Applications and Material

The development of medical technology and medical equipment using radiation has played a key role in the diagnosis and treatments of many diseases .In particular, the utilization of radiation for invasive procedures, such as angiography ,has been expanded so that the exposure of patients and medical staff to radiation also tends to increase, making individual radiation protection a very important issue(Seon-Chil ,K.,Kyung-Rae ,D.,Woon-Kwan,C.,2012). Shielding must be provided around a reactor to protect both personnel and material. Shielding that is adequate for neutrons and gamma rays will also stop alfa and beta particles. The weight of shielding to be used is almost independent of the shielding material itself. This study aims to evaluate the neutron shielding effects of tree materials, Veatchite , Sussexite and Vimsite by using a neutron source. Properties of minerals are shown table-1. The attenuation effects through shielding materials were investigated for various thicknesses of the materials. Neutrons are uncharged particles are powerful in terms of penetration into the material. Neutrons, which has many applications today .In shielding design it is often useful to perform a first assessment of the required shielding thickness by using a simplified approach based ,for example ,on a point nsource line of sight model, to be verified at a more advanced stage of the project with a Monte Carlo simulation ia a more realistic geometry of the facility (Agosteo S.,Magistris M.,Mereghetti, 2007).Neutron sources are more important in neutron shield measurements. The neutrons originate from spontaneous fission and from some (a,n) reactions in the source materials. The spontaneous fission and (a,n) neutron source terms are dependent on the kind of isotope and the decay time .For the prevent harm living tissue, shielding is anImportant issue.There are different compounds, alloys or composites are preferred against neutron particles using like shield.The purpose of this study was to shield against neutron radiation can be used as a material in three different mineral containing boron and hydrogen, and the evaluate of interaction these minerals with 4.5 MeV energy neutron using Monte Carlo simulation method. Neutron shielding is most effective is the nucleus of the shield material has about the same mass as the neutron. This makes hydrogen rich materials excellent neutron shits. It needs also to be something to absorb the neutrons, boron being the poison of choice .Conversely gamma shielding requires neutrons with very high mass. Were it not for the presence of the neutrons, depleted or native uranium would be the best choice (in fact depleted uranium is commonly used as shielding material for X-ray machines and radiography sources), but since neutrons and uranium shielding would

be counterproductive, lead is used instead. This nuclear code enables the use of possibility for particles from thermal energy neutrons to all other particles having energy and extensive radiation ranges.

Table1: Properties of minerals(http:\\www.mindat.org; http:\\webmineral.com\data).

Properties	**Vimsite**	**Sussexite**	**Veatchite**
Formula	$(CaB_2O_2(OH)_4)$	$(Mn^{+2}BO_2(OH))$	$(SR_2B_{11}O_{16}(OH)_5*(H_2O)$
Color	Colorless	white, green pink,straw yellow	Colorless, Pearl White
Density	2.54 gr/cm^3	3.12gr/cm^3	2.62gr/cm^3
Diaphaneity	Transparent	Translucent	Transparent
Hardness	4-Fluorite	3-Calcite	2-Gypsum
Luster	Glassy	Pearly	Vitreous-Pearly
Streak	White	White	White
Cleavage	Perfect	Perfect	Perfect
Locality	Siberia-Russia, Buriatia	South Africa, Kalahari	USA,TickCanyon, Losangeles,Califonia
Molecular Weight	CaO % 34.67, B_2O_3%43.05, 22.28 % H_2O	MnO %61.82 ,B_2O_3 %30.33 H_2O %7.85	SrO % 31.73%, B_2O_3 % 9.65 H_2O %58.62
Magnetism	no	no	no
Radioactivity	no	no	no

General Equation for calculating shielding

In simplest form shielding involves interposing distance and materials between the source and recipient of radiation. Design considerations and the calculation of resultant dose complicate the problem. To gain some insight into shielding into shielding calculations we shall consider an oversimplified situation which involves a point source of radiation (National Council on Radiation Protection and Measurements,1977).

According to the inverse-squre law, the ,the intensity of radiation on the surface of a sphere of radius R will be where P is the source strength(number of particle

$$I=P/4\Pi R^2 \quad (1)$$

If we place enough distance between ourselves and the source, the intensity of radiation will be reduced to safe levels .However ,if we place material between ourselves and the source, we can take advantage of a collimated beam of gammas. The intensity of radiation follows an exponential curve

$$I=I_0 e^{-\mu x} \quad (2)$$

where μ is linear absorption coefficient and has dimensions of reciprocal centimeters. A mass absorption coefficient may be defined by $\mu_m=\mu/\rho$, Equation -2 then becomes where D is the absorber thickness.

$$I=I_0 e^{-\mu_m D} \quad (3)$$

For a sphere of radius R ,If put X=R, equation-2 will became

$$I=I_0\, e^{-\mu R} \qquad (4)$$

applies strictly to a collimated beam and only when scattered radiation is removed from the beam .In a thick shield such as that equation -4 would give a low result because some of the radiation is backscattered into the path. When primary neutrons dominate the shielding situation, the shielding transmission ratio for neutrons,

B_n, can be derived from the neutron fluence rate,$Ø_0$ The various types of interactions of neutrons with matter are combined into a total macroscopic cross sections value (Korkut,T.,Karabulut, A.,Budak ,G. et al.., 2012;. Korkut,T ,Korkut,H., Karabulut, A ,Budak ,G.2011).

$$\sum_{TOTAL} = \sum_{fission} + \sum_{capture} + \sum_{scatter} + \ldots\ldots\ldots \qquad (5)$$

The fundamental purpose of radiation shielding is to reduce the dose-equivalent index from all sources of radiation that converge on a particular reference point, so that the dose-equivalent index rate at the reference point does not exceed the applicable H_m or dose-limit value mathematically, this can be stated as follows:

$$\dot{H}_{Ld} \leq \dot{H}_m \qquad (6)$$

Where, $\dot{H}_{Ld}$ is the sum of dose-equivalent index rates at the reference point, $\dot{H}_m$ is the applicable H_m or dose-limit rate and Fj is the maximum absorbed dose rate or particle fluence rate from the j th, ,Bj is the shielding transmission ratio for the radiation from the jth source,T is the occupancy factor of the area represented by the reference point ,Kj is dimension-converting constant pertaining to radiation from the jth source.Dj is the distance between the jth radiation source and the reference point .

$$\dot{H}_{Ld} = \sum_{ji} \frac{Fj\ Bj\ T}{KjDj^2} \qquad (7)$$

Monte Carlo methods can calculate directly the self-shielding factor taking into account the multiple scattering. The resonance self-shielding factor ,T r_{es}(R),in wires of radius R, is defined as the ratio between the reaction rates per atom in the real sample and in a similar and infinitely diluted sample,.

$$T_{res}(R) = \frac{\int_{c1}^{c2} \phi(C)\sigma(C)dE}{\int_{c1}^{c2} \phi 0(C)\sigma(C)dE} \qquad (8)$$

where $\phi 0(C) \propto \frac{1}{C}$ is the original no-perturbed, epitermal neutron flux per unit energy interval inside the infinitely diluted sample, $\phi(C)$,represents the perturbed epithermal neutron flux inside the real sample, $\sigma(C)$,denotes the (n,γ)cross-section ,and C_1 and C_2 are ,respectively ,the lower and the upper limits around the resonance energy C_{res} (Gonçalves,I.F., Martinho,E.,Salgado J.,2001; Gonçalves,I.F.,Martinho,E.,Salgado J.,2001).

Calculations

In this study the effects of cross section for high performance materials such as Veatchite, Sussexite and Vimsite were calculated, and also the parameters of the neutron armor of these materials were measured .There are many advantage using materials having hydrogen and boron in terms of neutron shielding technology because the neutron shielding capability

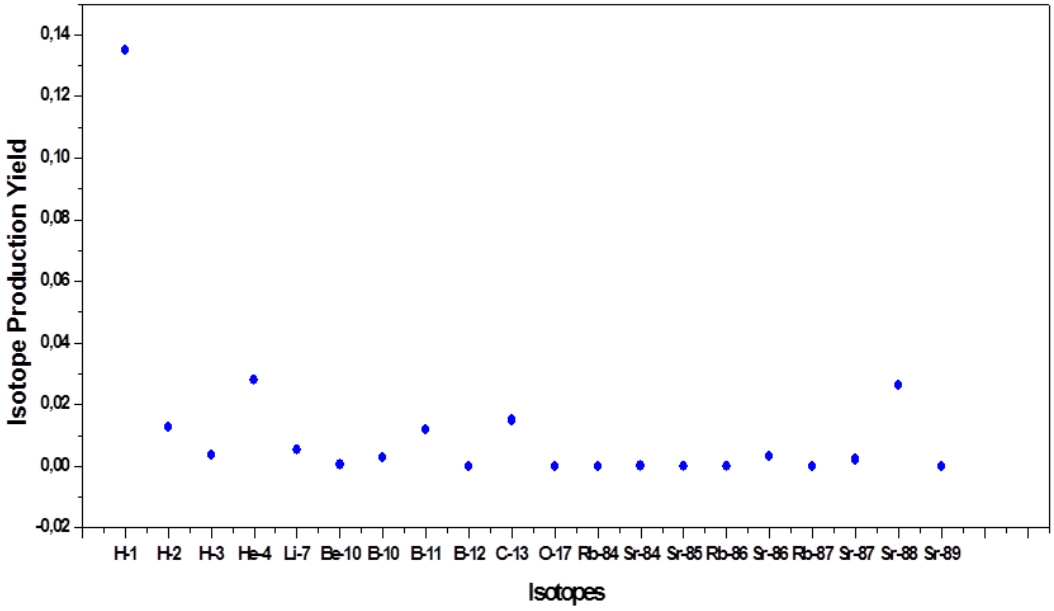

Fig2. Isotope production for mineral Veatchite

depends heavily on the hydrogen concentration .As a shield material against neutron
the interactivities with neutron particles with 4.5 MeV by the Fluka simulation method of three different minerals containing boron and hydrogen. A Comparison of double differential fluency predicted by FLUKA at various at a neutron energy. The Isotope production are shown in Fig 2-4 . The effectiveness of different types of neutron shielding for the ATLAS forward region has been studied by means of Monte Carlo simulations and compared with the results of an experiment performed at the CERN PS (Štekl ,I.,Pospısil S.,Kovalenko, V.K et al.,2000.)

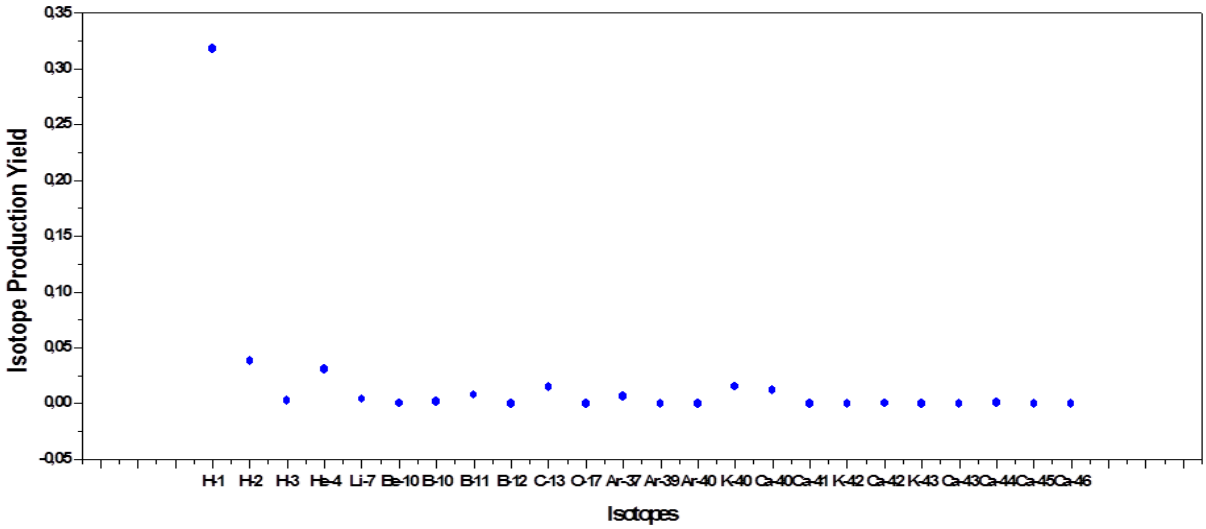

Fig3. Isotope production for mineral Vimsite

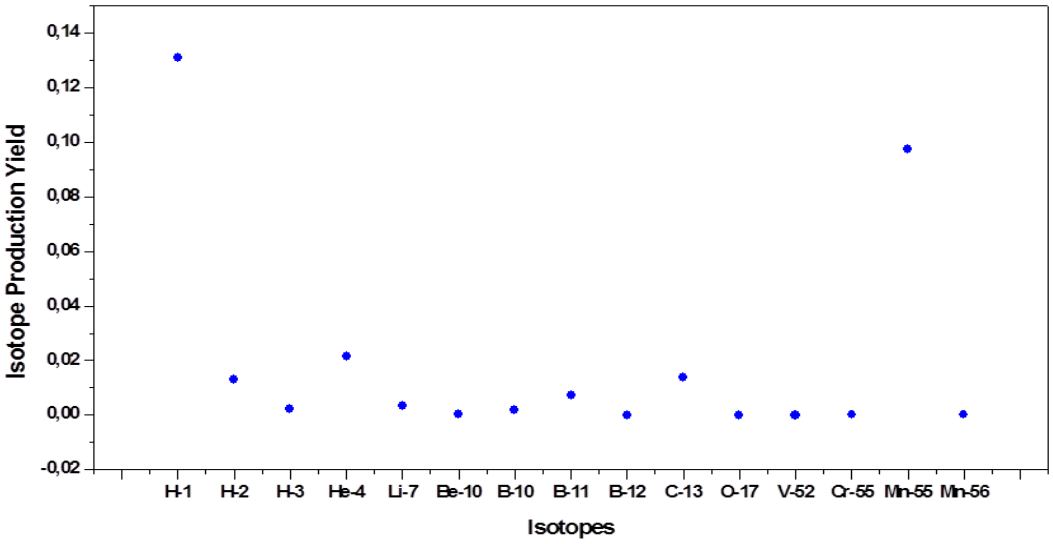

Fig4. Secondary radiation curve for mineral Vimsite

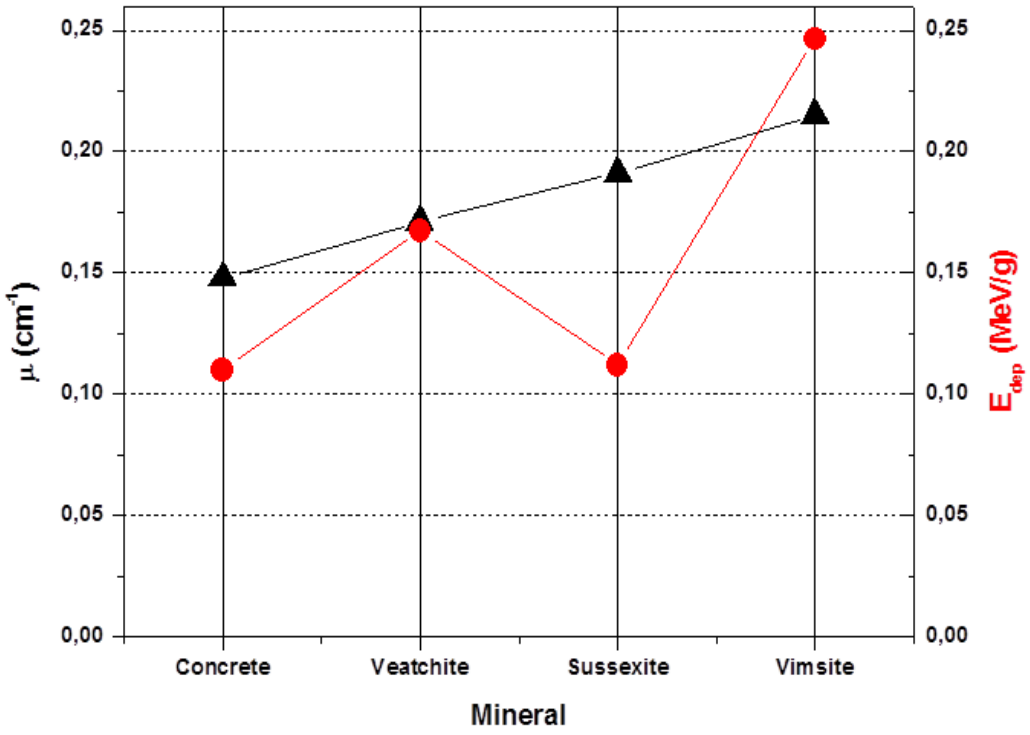

Fig5. Compared neutron absorption cross sections minerals and concrete

Results and Conclusions

In our working, we have investigated fast neutron shielding properties of Vimsite , Sussexite and Veatchite samples simulation process. The results of this investigation have provided new information about the total macroscopic cross sections ,secondary radiation , neutron flow absorbed doses and deposited energies by low energy neutron interaction of fast neutrons through materials including different amounts of boron and hydrogen atoms per unit volume. Absorbed dose per primary particle(in GeV/g) by samples calculated over Fluka. Simulation results are shown Fig-5. According to these results, the highest performance among the minerals is vimsit for the neutron shielding .Interaction of three different boron-containing mineral particles and 4.5 MeV energy neutron were simulated by Monte Carlo techniques .As a result of simulation studies minerals isotope production rates for the neutron radiation, flows and secondary curves were obtained. As a result of interactions has not found radioactive isotopes. It also was not detected in the secondary radiation with high stream. Evaluation of the total macroscopic cross sections for neutron shielding minerals (μ) and the stored energy values were determined. For frequently used in studies of neutron shielding concrete were calculated of the same values.Al three minerals has been identified as a better neutron shield material than concrete.

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THE REFLECTION OF URBAN POVERTY ON CHILD POVERTY

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Abstract: The most active and vulnerable subjects of the problems and challenges in urban areas are children. Urban areas impact child development negatively. In various studies conducted, it has been proven that child development and behaviour formation are determined by the spaces interacted with rather than the intelligence and character. Therefore, the environment with which the child interacts plays a crucial role in child development and growing to be healthy individuals. This study aims to identify the negative impacts of shortcomings in the planning of spaces and the lack of psycho-social support in this processes as well as the negative impacts of urban poverty on children based on the interaction between children and urban areas in order to ensure high benefit of children. This study has been prepared within the scope of literature review. As the result of literature review conducted, it has been identified that the risk of facing poverty and being affected by poverty is higher among children compared to adults. Furthermore, it is stated that poverty experienced during childhood could often be the indicator of poverty to be experienced during adulthood, as well.

Keywords: Urban Poverty, Child Poverty, Urbanization, Child Welfare

Introduction

The phenomenon of urbanization which emerged after industrialization depending on migration from rural to urban, has led to reveal urban poverty as a multidimensional concept. globalization that came in view with urbanization, has extended the sphere of influence of poverty. The globalization, the neoliberal policies and privatization emerged with urbanization has extended the syphere of influences. It, also has spread and increased urban poverty.

Problems such as social and economic inequalities, structural problems, inadequate urban policies, lack of sanitation, low education levels, unemployment, deficiencies of housing and social integration are among the most important causes of urban poverty. Urban poverty is also the source of many social problems as inability to adapt to the urban areas in terms of social, cultural, economic and psychological aspects, squatting, dysfunction of urban transformation and urban design process, the growth of the informal sector, the increase in crime rates, increase in domestic and communal violence, the inability to prevent the street working children and child labor. The children.are the most active and the most defenseless subject of urban space difficulties and problems. The aim of this study is reveal the negative effects of urban poverty on children. This study was prepared within the literature research. As a result of the literature research, it is reported that the risk of encountering poverty and its negative effects is higher for children than adults.. Moreover, it is stated that the poverty in the period of childhood, may be a heraldist of poverty in adulthood.

Urban poverty-stricken children become improvished in terms of biopsychosocial aspects. Poverty and impossibleness, which caused by urbanization process, can prevent access to the most basic services such as education, nutrition, health. A lot of problems, which resulted from reflections of urban poverty on child poverty, such as opportunities of inequality, social exclusion, social injustice, security-deprived neighborhoods, the differences between living conditions, can cause deprivation, developmental disorders and permanent damage in children's inner world in many aspects. According to result of child welfare researchs, all of this problems have led to serious violation of right because of countries that accepted convention on the rights of the child and have the child protection system.

Literature Review

1. Poverty

Poverty is an old but recently discovered social problem description of which changes depending on the period. Zastrow (1991) identifies two approaches to describe poverty.

The first one is *absolute poverty (in a narrow or traditional sense)* which is described as failure to meet vital needs (such as eating, drinking, clothing and sheltering that will prevent death and enable survival) required to live and to support yourself and your family due to lack of money. The UN Criteria describe absolute poverty threshold as Access to Food, Sheltering, Clean Drinking Water, Hygiene, Health, Education, Information and Services ensuring the continuation of human life while the World Bank describes it as daily intake of minimum 2400 calories.

The second suggested concept is *relative (in a broader sense) poverty*. This concept, in addition to the basic needs stated above, refers to the state of failure to reach to the traditional living standards of the society and lagging behind. This situation reflects the failure to reach the lowest living standard. It only appears when individuals compare their living standards with another's.

Brody (1970), on the other hand, divided poor people into three categories including upper class, middle class and lower class.
In this classification, *upper class* represents poor individuals who do not necessarily have low level of income and whose current income amount equals to the special needs; *middle class* represents poor individuals who have low level of income and who are below the minimum living standard (generally large families); and *lower class* represents poor/ (Poor Poor) individuals who survive with social assistance payments.

Two important concepts related to poverty are income poverty and human poverty. Income poverty is described as the state of failure to achieve sufficient income level in terms of meeting required basic needs of the individual or household in order to survive or meet the minimum living standard. Human poverty, on the other hand, is handled as a concept including absolute and relative poverty descriptions and having a more comprehensive meaning. This concept, accepted by the United Nations, emphasizes the requirement of having financial, political, social and cultural opportunities to meet basic needs in addition to the monetary opportunities with the aim of ensuring human development and living a humane life. As a result of this approach, poverty appears to be a multi-dimensional concept. Human poverty is defined as the situation with lack of education opportunities, malnutrition, short lifespan, lack of employment opportunities, insufficient mother and child health, fear of future, catching preventable diseases, lack of freedom and lack of basic human competencies such as power (Kaya, 2011:37-38).

Amartya Sen, who provides one of the most important conceptualizations regarding poverty, explains that it is possible to handle poverty with both absolute and relative poverty approaches. While economic development defines and measures development through national income increase per capita based on the level of income and consumption, *"human development approach"*, which does not deem an income-oriented development understanding appropriate, places people in the centre of development emphasizing the expansion of all economic, cultural, political and social preferences and options of individuals. In this approach, while increase in the income levels of individuals is accepted as an important factor and a prerequisite for development, it is stated that improvement in the income level is insufficient solely to measure actual welfare, and increase in the health services, education and social safety, etc. directly contributes to the life quality and increasing this quality (Sen, 2004: 202). *Capacity approach* creates a multi-dimensional perspective for human welfare. Rather than concentrating on people's income levels and expenditures, this approach concerns about the question "what is equality" included in political philosophy by focusing on "what people can" and "what they can be" in an effective way. (Nussbaum, 2005; Robeyns, 2005).

Poverty concept is directly related to the unmet needs of individuals or children. Each unfulfilled need constitutes a poverty component. According to Barker, poverty represents the elements desired to be obtained in terms of physical, spiritual and social aspects in order for individuals to continue their lives, maintain their good positions and fulfil their tasks (2003: 56). Deficiencies regarding physical, psychological, economic, cultural and social elements required by individuals to maintain their lives and good positions and to function properly constitute their problems. Therefore, problems are defined by needs.

Poverty problem is faced especially by the elderly, disabled, women and children both in developed and developing countries.

Another important issue is the way of measuring poverty. There is not a standard approach to identify and describe poverty. Discussions on poverty are generally conducted through the measurement of national and international comparisons by benefiting from the reasons of poverty. When poverty are measured in terms of monetary aspect, income increasing policies are considered as solutions. International organizations, on the other hand, handle poverty in a multi-dimensional way especially based on the United Nations human rights (Vandemootele, 2000).

2. Urban Poverty

Urban areas, beyond a physical concept, are the places ensuring shelter, psycho-social interaction and development (such as socialization, playing, gaining self-confidence and feeling safe) while contributing to social interaction and development.

Urbanization phenomenon emerging depending on the migration from rural to urban areas after industrialization caused the appearance of urban poverty which is a multi-dimensional concept.

According to the World Bank, Urban Poverty is described as "limited access to employment opportunities and income, insufficient and unsafe sheltering and services, violence, unhealthy environment, limited or lack of social protection mechanisms and limited access to education and health services". (Zülfikar, 2010:11).

Eight different factors impacting urban poverty are defined as follows (Dinçoflaz, 2009:34-35):

- Insufficient income,
- Insufficient and unstable resource availability,
- Insufficient sheltering,
- Insufficiency of public infrastructure services,
- Deprivation of social safety,
- Failure to sufficiently protect poor people in the functioning of legal system,
- Ineffectiveness and weaknesses of poor people in decision-making processes,
- Silence of poor people.

Alternate poverty (poverty-alternately) is another poverty concept closely related to urban poverty. Alternate poverty (poverty-alternately) represents the increase in wealth and welfare levels of certain groups over others as a result of citizenship and unequal power relations among poor people living in urban areas (Kocatepe, 2011:28). In alternate poverty, poverty is handled within a process on the basis of social relations. According to this concept, poor individuals using right sources and channels transfer their poverty to other poor newcomers. In this approach, poor individuals living in the urban areas rent out or sell the lands they occupied to the poor people recently migrating to the urban areas and therefore, they get rid of poverty and transfer their poverty to the newcomers in time (Işık and Pınarcıoğlu, 2009: 79).

Urban poverty may cause many problems such as irregular urbanization, unplanned growth, triggering socio-economic impossibilities, failure to achieve healthy living conditions, deprivation of public services, exposure to urban safety problems and to the risks in the urban breakdown areas (such as negligence-abuse-drug addiction-violence-being forced to commit crime) and many other impossibilities.

3. Needs of Children and Child Poverty in Urban Sense

It is possible to define children, whose physiological, psychological, cognitive, social and cultural needs cannot be met, who cannot obtain rights defined within the scope of the UN Convention on the Rights of the Child (such as living, participation, protection and development) and fall behind the welfare system, as *Poor Children (child poverty).* Poverty is experienced both in developed and developing countries. Therefore, international organizations such as the World Bank and the United Nations carried out various researches on this issue. When poverty is analysed in more detail, it is observed that it manifests the biggest and the most important impacts on children. Child development is prevented by poverty. Those who experience poverty during childhood are under a higher risk of facing poverty in the future, as well. Due to the vicious cycle emerging at this point, poverty is transferred to the upcoming generations (Durgun, 2011).

Poverty and deprivation concepts in the children's lives cause failure to meet needs of the child. While reviewing the literature, Maslow's (1954) hierarchy of needs model regarding human needs, Max-Neff's (1991) human scale development, Peet and Bossel's (2000) ethics-based system model regarding basic needs as well as models for gender needs appear prominent in the proper identification of children's needs. Being aware of children's needs is important in terms of designing and identifying the features of an urban space in line with the development

processes of children. In accordance with the United Nations Convention on the Rights of the Child, each child has 4 basic needs and rights, namely "living, participation, protection and development". Each child needs feeding, sleeping, moving and to be protected in order to develop as of the moment they were born. In addition, children have basic spiritual needs such as loving, to be loved, to be looked after, feeling successful and sufficient and gaining freedom like other individuals (Uçar, 2013, p. 15). Researchers such as Piaget, Montessori and Werner emphasize in their studies that interaction of children with the environment constitutes the basis of development, and the environment includes measurable physical components on cognitive-perceptual development. Considering that children use observation, exploration, trial and error methods while learning, it is a widely accepted truth that they need a physical environment with various resources (Kirazoğlu, 2012, p. 16).

4. Relation between the Child and City/Space

Spaces hosting daily life, especially the housing areas, do not serve only as shelters but also as natural stages where social interactions and relations are experienced. Differences between the living spaces identify the life quality in terms of accessibility or inaccessibility to public services. Repetition of opportunities and lack of opportunities in the spaces and their results bear important consequences for children living there (Erder,2002:26-30; Ümit,2007:103) Impacts of the spaces on the structure and functioning of society and on children cannot be underestimated. Experiences, emotions, hopes and concerns of children are shaped through spaces (Philo, 2000). As we cannot think children apart from their social relations, it is also not possible to think them apart from the spaces where these relations are shaped (Sibley, 1995). Therefore, the relation of children with the spaces refers to their socialization area beyond a physical space where they establish social relationships and gain social experiences (Moss and Petrie, 2002).

Physical environment and urban spaces (particularly open areas) that children interact with play an important role in child development and growing to be healthy individuals (Zomervrucht, 2005). Physical environment of children includes various active open areas and spaces such as the sheltering area and its surroundings, school and playgrounds in parallel to their physical, perceptive, emotional and social development. These spaces mainly shape children's both social and private lives. However, urban spaces pose dangers for children as a result of decrease in open areas and increase in traffic density and safety problems due to disordered housing caused by rapid and unplanned urbanization. Due to these dangers, children are deprived of open areas and streets where they freely move and develop. This spatial deprivation negatively impacts the development process, personality formation, behaviours, attitudes and reactions of children. Improving life quality of children, whose social, cultural and perceptive development is negatively affected by the reflection of problems caused by urbanization to the spaces, is of crucial importance for the future of the society (Al-Khalaileh, 2004; Tandoğan, 2014: 19-20).

Needs of an adult have an hierarchical structure. Human needs are ranked in the order of importance as biological needs, safety, sense of belonging, bonding, prestige, self-actualization (improving skills) and intellectual, emotional and aesthetic needs (Maslow, 1968). Apart from adult needs, one of the basic vital needs of children is playing. Playing contributes to children's physical development, socialization, perception of life, personality formation and transfer of the culture to the next generations (Çukur, 2009).

For children feeling the challenges of living in urban spaces the most, it is quite important to build child-oriented structures and conduct policies, implementations and designs in urban planning in line with children's needs. Therefore, child-friendly city concept is frequently emphasized and relevant activities are conducted with the aim of making urban spaces more habitable for children. *Child-friendly city* refers to a space with qualities contributing to the physical, psychological and social development of children so that they would become self-valuing individuals in the future. In physical terms, urban spaces should arouse positive feelings among children, provide opportunities for game activities, make them feel safe and an equal part of the society along with other individuals through the behaviours of adults (Churchman, 2003). Furthermore, child-friendly city aims to ensure that "children citizens" are active in the decision-making processes regarding the urban areas they live in; are able to express their desires and thoughts about the urban area; participate in family, society and social life; meet their basic needs such as health, education and sheltering; benefit from healthy water and health services at the maximum level; are protected against abuse, exploitation and violence; walk on the streets safely; meet and play with their friends; have green areas with animals and plants; live in a clean environment; participate in cultural and social activities; and have access to all services regardless of their race, religion, income, gender and disabilities (Unicef, 2004: 1)).

Conclusion and Discussion

The most active and vulnerable subjects of the problems and challenges in urban areas are children. Urban breakdown areas in the centres or periphery of urban areas, which do not have healthy living conditions and public services and where urban safety problems and poverty reach dangerous levels, may cause developmental disorders

and damages in the inner worlds of children in many aspects. These problems caused by urban insufficiency can also be reflected in children's lives by transforming into serious problems such as negligence, abuse, violence, being forced to commit crime, exclusion, othering and impossibilities, and these can cause irreversible severe traumas. As a result of these, children may create insecure bonds with the environment and society; feel hatred, grudge and anger; and many other behavioural disorders such as aggression, stress, loneliness and introversion may arise, and their tendency to fight/conflict may increase. Furthermore, they may be forced to be engaged in illegal affairs and commit crime in order to eliminate social and spatial inequalities they experience in their own way, to fight poverty and to survive.

Realizing required arrangements and practices to make children's living environment more *"child-friendly";* in other words "informative, guiding and advocate " is important in terms of creating spaces that can answer the needs and desires of children. The social and spatial arrangements should be made to get the most basic rights, social integration and healthy development to children. Moreover, while studies about the urban policies and child welfare including the all children are ongoing, safe environment should be provided on every child , based on 'participation, protection, development and survival rights', focusing on the 'social justice and equal opportunities' as stated by United Nations Convention on the Rights of the Child (UNCRC).

Urban areas should provide physical spaces supporting social interaction, equal opportunities, accessibility, self-esteem and cultural identity where children can meet their basic needs such as social justice, equality, sheltering, education, health and playing in accordance with the UN Convention on the Rights of the Child. Besides, children's needs, expectations and desires should be met, and they should be provided with safe environments in the developmental periods. Institutions and civil society organizations responsible for urban safety, urban policies and welfare of children have to carry out comprehensive legislation, policy and planning activities based on social justice, equality, participation of children, children's rights and human rights. Furthermore, it is required to include scientists, academicians, local governments, trade associations, employers and social politicians in these activities to carry out inter-disciplinary professional team works handling children along with their needs using an integrated approach.

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TOKAT – RESTORATION OF THE CARAVANSARAY OF PAZAR MAHPERI HATUN

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Abstract: One can easily find in the city centre of Tokat and nearby towns the fine examples of Anatolian Turkish architecture belonging to the period of Seljuk such as mosques, shrines, baths, fountains, khans and caravansarays which served distinctive functions. Many pieces of art have been regenerated through proper methods of restoration with the contributions of well-informed local authorities and with the awareness of preservation of historic and cultural heritage and desire to transfer them to the future. After the Battle of Manzikert (1071) the Seljukians of Turkey ruled over some parts of Anatolia who attached importance to trade infrastructures building caravansarays, bridges and sebils (wells and fountains) on trade roads and turned Anotolia into Turkish-Islamic nation.
The construction of Seljukian caravansarays, which were the foundation of Anatolian Economy, started during the ruling of Sultan Kılıç Arslan II (1155-1192) and devoloped in a very short time spreading caravansarays all accoss the trade roads of Anatolia. Caravansarays played improrttant role on development and continuity of transit trade in the Anatolian geography as described in the resources of Seljukian period such as inscriptions, literary works and travel books. Carvansarays, magnificient structures with their specific architecture and decoration, were considerably modern stopover destionations according to the conditions of the period. Considering the historical caravansarays as cultural entities to be preserved, it is vital to document and preserve them as well as transfer them to next generations preserving their material, technical and architectural features by means of proper methods of restoration. In this study, a detailed structural survey of the Caravansaray of Mahperi Hatun has been made and projects of restoration and restitution have been prepared. Following this, scientific evaluation and reporting studies were carried out as well as reconstruction and reinforcement processes were selected in the context of intervention types applicable to cultural premises which need to be preserved. In the light of prepared projects and scientific data obtained thereafter, the unusable materials have been selected to be removed from the structure and inventory of the materials has been recorded. However, the usable materials have been enumarated and stockpiled in order to be reused. The study remains faithful to the building survey. In accordance with the inventory of unusable materials, most characteristacly similar natural stones to be used in the materials have been brought from Tokat quarry so as to be applied.

Keywords: Building Survey, Restoration, Caravanseray, Seljuk, the Caravanserai of Mahperi Hatun

Introduction

In the 11th and 12th century the Seljuks, who conquered Anatolia, founded here the Anatolian Seljuk Empire and to strengthen their sovereignty and economy on their newly won land they started to develop commercial activities (Önge, 2007). In this context, they didn't just built orderly roads, walkways and bridges to safely connect the towns, markets and trade routes of their big country, but they also founded certain mansions (ranges), public houses and caravanserais to ensure the absolute safety of their trade journeys (Akok, 1974). The Seljuks, who built various caravanserais and madrasahs in many parts of the country also put great importance on the expansion of the trade routes in Anatolia. This way Anatolia became the haunt of crowded trade caravans and one of the most important centers of world trade.

This prepared study is based on the Tokat-Pazar Mahperi Hatun Caravanserai, which is one of the Seljukian caravanserais that reached our time. The first part contains definitions about the caravanserais that were established because of the interest in trade of the Anatolian Seljuks. In short, concepts such as operating systems and basic planning elements have been analyzed. The second part tries to explain the used methods for the restoration of the

Tokat - Pazar Mahperi Hatun Caravanserai. The third part describes the work steps that have been carried out while working on the Tokat - Pazar Mahperi Hatun Caravanserai. The last part however shows today's status of the Tokat - Pazar Mahperi Hatun Caravanserai by using the information of part two and three.

Caravanserai

The word caravanserai derives from the Farsi word kârban (caravan) and saray (palace). Caravanserais are non-profit institutions that have been built on the main roads between cities for accommodation of caravans and passengers. Although it is not quite possible to say where the first caravanserais have been established, some sources say that caravanserais are based on ribats (Akıl,2006). Two caravanserais in Asia that have been built by the Turks and are called ribat belong to the Ghaznavid and Kara-Khanid Khanate dynasty. Their architecture and plans became later examples for the caravanserais built by the Seljuks (Günel,2010).

Operating System and Plan Samples of the Caravanserais in Anatolia:

The caravanserais that received their essence from solidarity and humanity survived until today thanks to the foundation system and are commercial buildings for the public benefit established on roads. Caravanserais were generally built 8-10 hours (35-40 kilometers) by foot away. The stay up to three days in caravanserais was completely free. Expenses were paid by the Sultans, Lords and their foundations.

Kilij Arslan II started a program that transformed the Anatolian Seljukian caravanserais into cornerstones of the economic policy in order to establish trade in Anatolia, create a connection to the Asian trade routes and to lead them to the Mediterranean and Black Sea ports. The building of caravanserais also continued in the Ottoman Empire after the Seljuks. Caravanserais built during the Ottoman period show to main plan types:

1) Closed caravanserais without courts: A square or rectangle building with only one door forms the basis of the plan. The windows are small and high. The raised benches on either side of the entrance axis serve for accommodation of the guests. The middle part is for animals or cargo.

2) Open caravanserais with courts: This type divides the stables and service departments around the yard and the inside accommodations for the passengers at night. Usually there is a water fountain in the middle of the court (Akıl,2006).

Caravanserais are ostentatious structures with thick and tall walls. Along the boundary walls and at the corners there are strut towers. The main door is called crown door and it is possible to find examples of the beautiful Seljukian stone dressing on these doors (Korkmaz,2009). The stone dressing can usually be found on the frame. The crown door, niches, windows, arches and wall edges are architectural pieces that are used for stone adornments. The crown doors, which catches one's eye between the plain walls, give the feeling as if they are inviting the visitors inside. Limestone is used for most of the structures, sometimes at various colors and tones, sometimes only one color and sometimes a few of them together. Marble was rarely used. Inscriptions and plates with the names of the architects are also placed on the crown doors and the structures walls. The virtuosos also left unique signs and marks on the walls of the structure. Picture-1 A map of the caravan routes that was made via the so far detected Seljukian caravanserais.

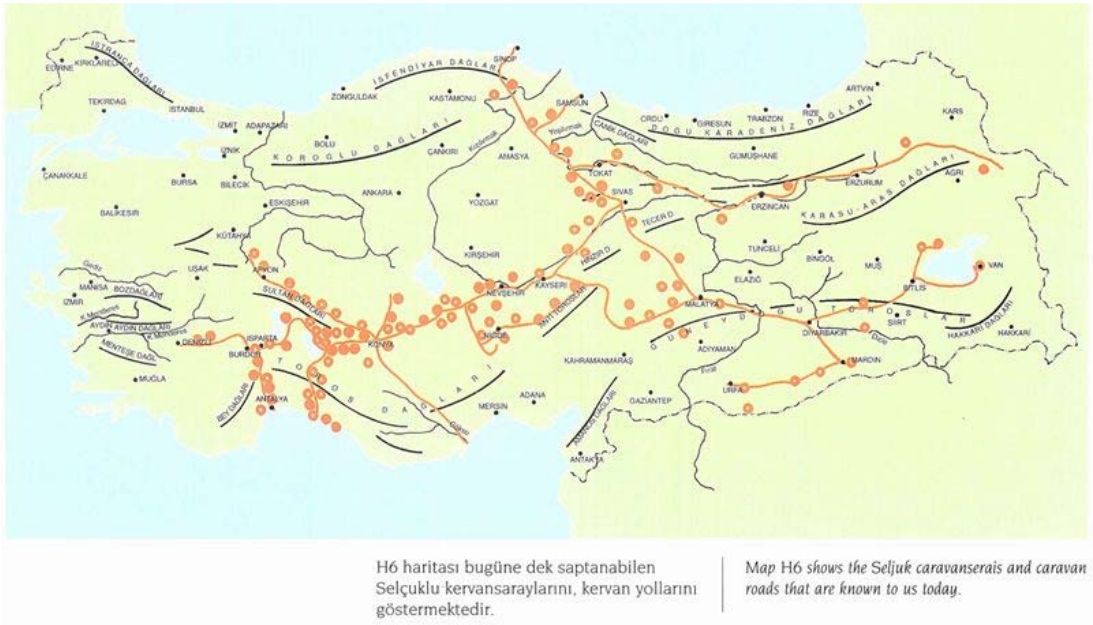


Figure -1: Seljukian caravanserais, caravan routes (Source; Niğde Culture Inventory)

TOKAT-PAZAR MAHPERİ HATUN CARAVANSERAI

Established on the Amasya-Tokat road, 1 km east from the district Pazar, near the Yeşilırmak River; according to two inscriptions the "public house" has been built by Sultan Melike Mahperi Hatun and was finished in the year 636/ 1238-39. (Picture-1). Hall 19.50x28 m (10 stone pedestals), the court is 33x34 m big (Özerkin,1965). Figure 2 shows the site plan of the caravanserai.

Picture -1. Tokat / Pazar Mahperi Hatun Caravanserai

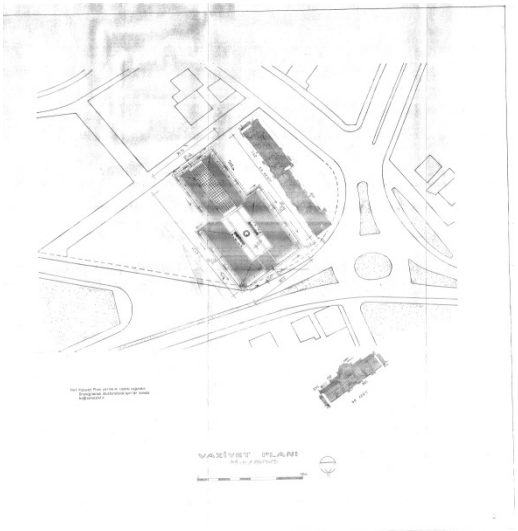


Figure 2: Pazar / Tokat Mahperi Hatun Caravanserai Site Plan

The caravanserai consists of two different sections, one summer and one winter section. The summer section consists of a cloister that is surrounding the court and the parts behind it. The winter section however is divided into three parts by two rows of pillars, the pendentive is covered and completely closed to the outside. The caravanserai consists of cut stones and is rectangular planned. The entrance door is very pompous, has a rectangular shape and stands inside a pointed arched niche. There is a construction inscription above the entrance door. The door inside the niche stands inside a round arch and consists of alternatively different colored stones. It resembles the portals of Anatolian Seljukian madrasahs and caravanserais. The roof of the caravanserai is completely destroyed but the portal and outer walls survived in a good condition until today (www.e-tatih.org,2015).

Picture-2; Tokat - Pazar Mahperi Hatun Caravanserai Main Entrance Facade (Foundations General Directorate-Tokat District Directorate)

Picture-3; Tokat - Pazar Mahperi Hatun Caravanserai Main Entrance (Foundations General Directorate-Tokat District Directorate)

Picture-4; Tokat - Pazar Mahperi Hatun Caravanserai Open Inner Court (Foundations General Directorate-Tokat District Directorate)

Picture-5; Tokat - Pazar Mahperi Hatun Caravanserai Main Entrance of the Inner Court (Foundations General Directorate-Tokat District Directorate)

Restoration Decisions and Application

A scientific restoration begins with an analytical study. This study is carried out from three angles:

a. The historical angle,
b. The aesthetical angle,
c. The technical angle (in terms of structure and construction.)

All three studies are handled at three levels:

a. Interaction of the building with the environment;
b. Totality of the structure;
c. Details of the structure (Kuban,2003).

These repairs on ancient structures are named restoration and are carried out according to type and degree of intervention in order to protect them and extent their life. While restoration means to bring back the original state of the structure to a certain extent and make it stronger in order to ensure that it will last longer, the process also

contains the repair, the maintaining of the old or the giving of a new function. Giving the structure its old function back or creating a new one for it ensures the use of the structure which is an important part of the conservation culture. It is very rare that the structure is transformed completely back to its original state (reconstruction), this is why mostly the protection of the present is intended. Because of these reasons the scope of the repair/completion works is closely linked to the damage ratio of the structure and to the desired restoration level (Yılmaz,2012). This caravanserai on the Tokat-Turhal-Amasya caravan route in the district Pazar of the province Tokat was built by the wife of Sultan Kayqubad I, Mahperi Hatun in the years 1238-1239. The structure was built completely out of fine cut stones. Figure 3 given below shows the building survey of the structure.

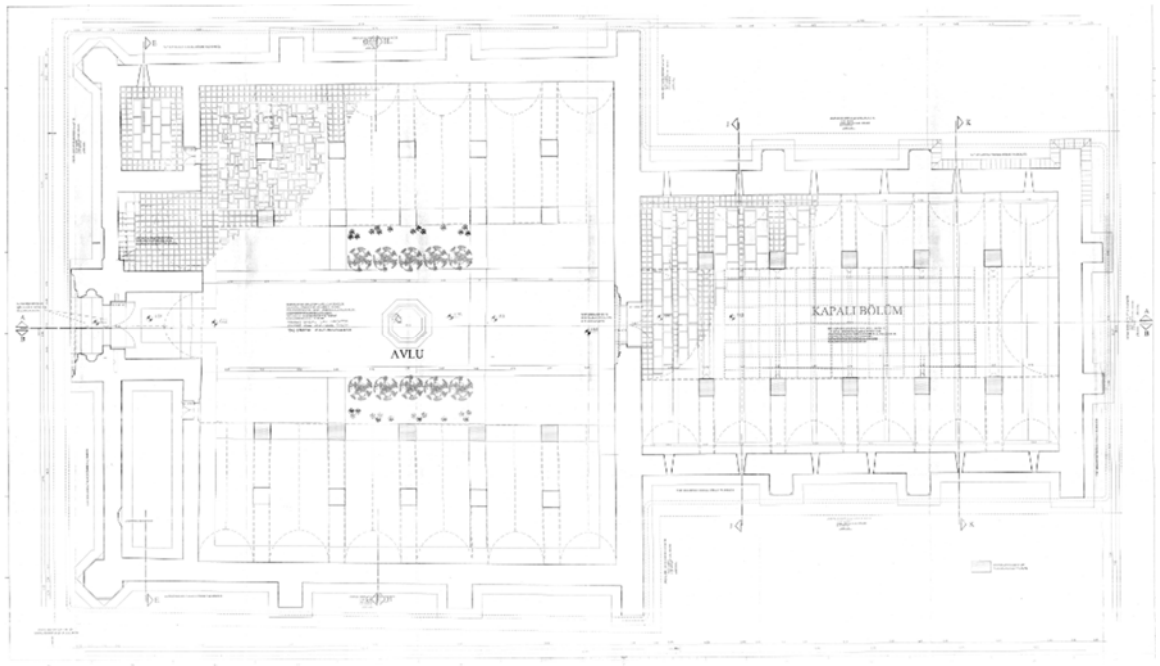
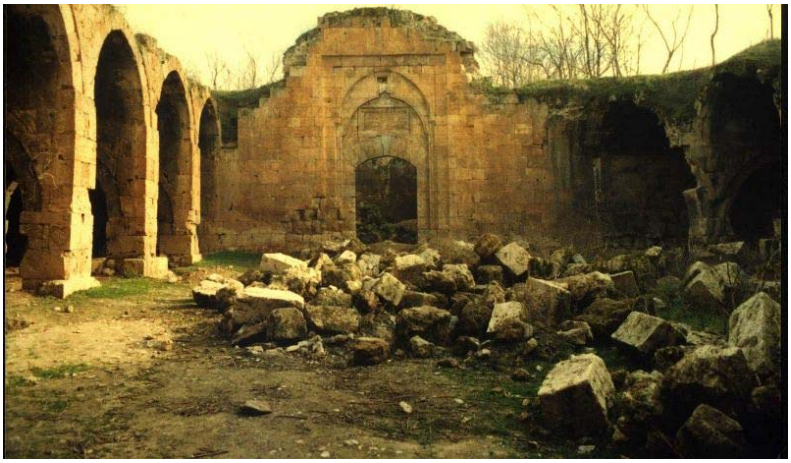


Figure- 3; Tokat - Pazar Mahperi Hatun Caravanserai Building Survey

Like seen in the building survey of the Mahperi Hatun Caravanserai, the bearing stands of the pendentive arches on the right and left of the court have become extremely damaged over the years (Picture 6).



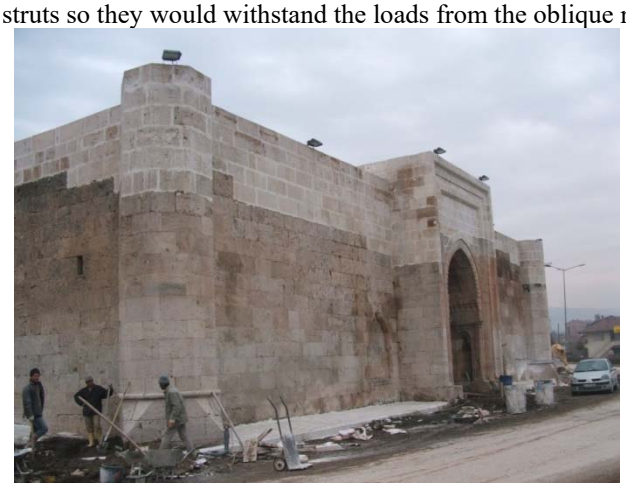
Picture-6; Tokat - Pazar Mahperi Hatun Caravanserai Open Inner Court (Foundations General Directorate-Tokat District Directorate)

Walls and Struts

Bearing walls in historic building are generally made out of cut stone, rough stone, rubble stone, bricks or alternating materials (stone+bricks) and loads from the structure are conducting a continuous basis. The cross-sectional dimensions of the walls together with the oblique loads on it are determined by considering the earthquake loads. The thickness of the walls in historic masonry structures are chosen very big when compared to

the self-weight of plane walls. In order to compare the vertical and horizontal loads of the wall they need to act as a whole.

The bearing walls of the Mahperi Hatun Caravanserai was built with cut stones. The bearing walls, which make up a big part of the outer periphery of the structure was preserved in its original form and was only cleaned up. Walls with missing or insufficient parts were restored according to the building survey. Appropriate stones that fit the texture of the structure were supplied by the quarry in the center of Tokat and by manufacturing them properly the loads provided by the structure were transmitted to the basis (Picture-7). To ensure integrity of the wall, stones were connected with mortar, seam and wood/wrought iron beams on different levels. Some parts of the wall were strengthened with struts so they would withstand the loads from the oblique roof.



Picture-7; Tokat - Pazar Mahperi Hatun Caravanserai Open Outer Walls (Foundations General Directorate-Tokat District Directorate)

Pendentives

Pendentives are architectural elements that connect a series of arches in a row, which then forms a corridor. This way it is possible to create a sturdy but light foundation to carry the upper structure. In historic structures they were used to create a closed volume in rectangular areas.

In the Mahperi Hatun Caravanserai part of the pendentives in the open court and all of the pendentives in the closed area were damaged or collapsed. The pendentives were manufactured by creating supporting molds and they were strengthened with adhesive mortar and wrought iron beams (Picture-8, Picture-9).

Picture- 8; Tokat - Pazar Mahperi Hatun Caravanserai Closed Court Pendentive Manufacture

Picture-9; Tokat - General View of the Pazar Mahperi Hatun Caravanserai Open Inner Court Pendentives

Arches

Arches are architectural elements that are connected to a semicircle or arc-shaped center lock stone, rise up on two feet on which they bear the weight of the upper wall and create an opening with the desired space. The arches here are used as junction points between the pendentive feet and the outer walls of the structure and are located above the main entrance of the structure, the entrance of the open court and the door between the open and closed court (Picture-10/Picture-11). Because they were generally in a better shape than the pendentives, simple refuting and

stones in bad shape were switched out and the transfer of the dome load to the main wall, which is their main task, was made safer.

Picture-10; Tokat - General View of the Pazar Mahperi Hatun Caravanserai Main Entrance Door

Picture-11; Tokat - General View of the Pazar Mahperi Hatun Caravanserai Pendentive Arches

Mahperi Hatun Caravanserai Application Report

A restitution project was prepared according to the presented sources of the said structure, old photographs, information given by the Foundations Tokat District Directorate, new photographs and studies performed on site. Regarding the closed court, pendentive ruins and the exterior wall facades surrounding the structure were used to determine the laying tracks of the pendentive feet (Figure-4).

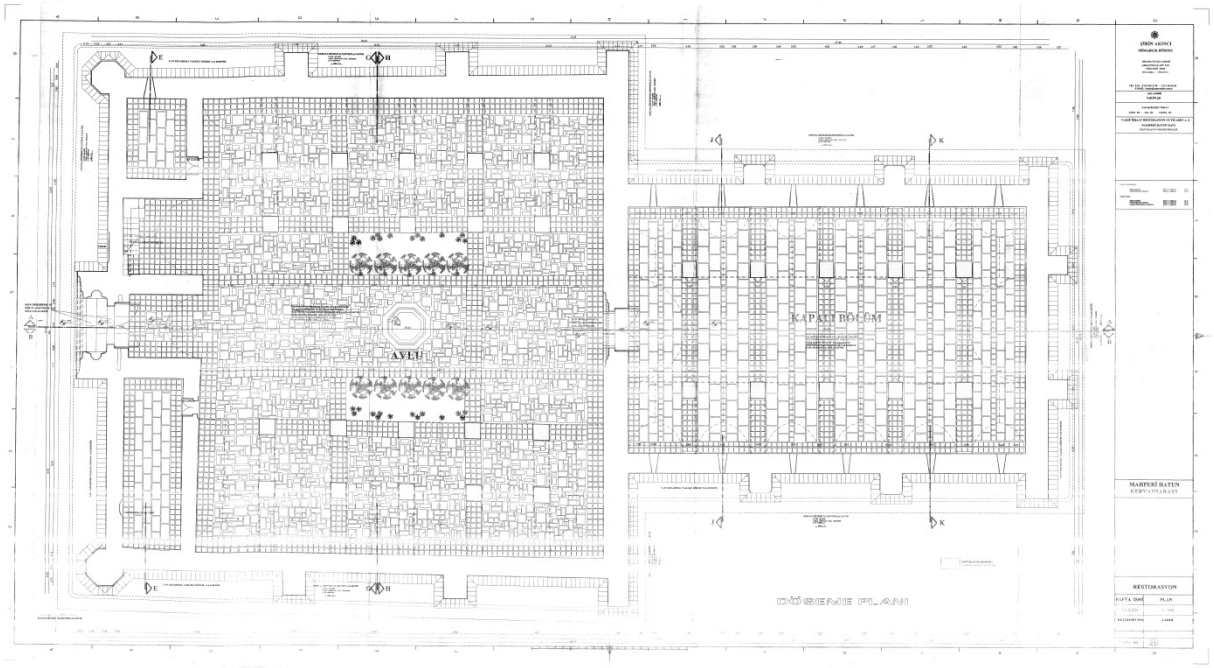


Figure- 4; Tokat - Pazar Mahperi Hatun Caravanserai Restitution Project

By using part of the surviving wall of the closed court, the location and height of the present windows could be calculated (Picture – 12). Because of the height difference of the closed and open court, a concrete floor and stairs were created(Picture – 13).

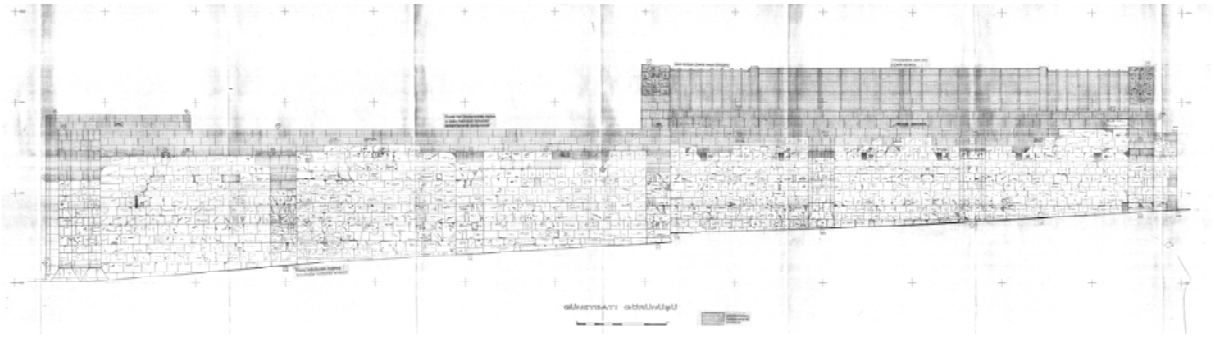


Figure-5; Tokat - Pazar Mahperi Hatun Caravanserai South-West Facade

Picture-12; Tokat - Pazar Mahperi Hatun Caravanserai Height Difference of the Open and Closed Court

The closed court was built in correspondence with the restitution project, which was prepared according to old traces, photographs and bibliographies, with stones from the quarry in the center of Tokat. During the building of the pendentives and the formation of the arches, mortar was used between the stones and iron blades were used as support and connections.
e the inner court of the structure was in better shape than the closed court, application decisions were taken more easily in line with the restitution project. Surviving pendentive ruins were saved and completed with appropriate stone material. Completely destroyed pendentives however were rebuilt in line with the restitution project. The structure system and ruins revealed, that the pavement is made out of stones. Thus the height differences of the structure were evened out with concrete and covered with stones (Picture-13).

Picture-13; Tokat - Pazar Mahperi Hatun Caravanserai Inner Pavement Application

Used Methods

By evaluating the ruins of the Mahperi Hatun Caravanserai and the obtained documents, a restoration project was prepared in line with the prepared restitution project. The stone basis of the building was present and by cleaning up the ruins it was strengthened with appropriate brickdust mortar and cut stones with the same properties of the original material. Present walls of the caravanserai however were numbered, removed and put aside about to be masoned again. Usable stones were separated and insufficient material was substituted with appropriate material by the quarry in the center of Tokat in order to mason the walls (Picture-14). Missing pieces were replaced by new material with the same properties. Since some gutters were in good shape they were used again. Because no wood material was left, new elements were manufactured according to the project.

Picture-14; Tokat - General View of the Pazar Mahperi Hatun Caravanserai

After placing stone blocks for regional repairs of regional/local cracks, the gaps were filled with an appropriate mortar injection. For the repair of fine cracks and cracks and gaps in thick walls the best method is to use a mortar injection with similar properties of the wall. Instead of the renewal of some elements, present elements were repaired and stainless steel was placed in the junction points.

Different from the original structure both parts (Inner court and closed court), the floor and the roof were isolated and protected against water. First the top of the pendentives were filled with light material and the whole structure was covered with stone pavement. The top of the closed court however was covered with polycarbonate material, so it doesn't lie heavy on the structure, and the arched iwan part was covered with lead material. Considering snow and rain falling on the structure, the stone pavement was created beveled and with gutters the water drain was ensured. The Roof Surface of the Mahperi Hatun Caravanserai (Picture-15).

Picture-15; Tokat - General View of the Pazar Mahperi Hatun Caravanserai Roof

Conclusions and Evaluation

The Seljukian caravanserais are formed with art, culture, aesthetics, need, material and construction techniques, are located on historical trade routes and are part of our cultural heritage that needs to be kept alive. Seljukian masterpieces that survived until our days are about to lose their battle against time because of destruction and degradation. Considering the condition of the structure, great importance has been placed on the protection of authenticity, traditional material and application of the technical and constructional system.

By determining that the bearing systems of the Mahperi Hatun Caravanserai consist of cut stone, which was found out via traces identified during the project phase and information of eyewitnesses, the structure was returned to its original sate.

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TORQUE AND FLUX RIPPLE MINIMIZATION OF DTC CONTROLLED IM BY USING FUZZY LOGIC DUTY-RATIO ESTIMATOR AND HYBRID FLUX OBSERVER

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Abstract: Direct Torque Control (DTC) drive allows direct and independent control of flux linkage and electromagnetic torque by the selection of optimum inverter switching tables. There is no need for any complex transformation of current or voltage. However in the conventional DTC induction motor drive there are torque and flux ripples, since none of the inverter switching vectors is able to generate the exact stator voltage required to produce the desired chances in the electromagnetic torque and stator flux linkage. In this study, we propose a method to reduce torque and flux ripples. Two steps were carry out for this purpose. The first step is to use duty-ratio. A selected inverter switching vector not for the entire switching period as in conventional DTC, but only for a part of the switching period which is defined as the duty ratio, δ and by using zero switching vector for the rest of period. The duty ratio determines the average input voltage to the induction motor during the application of each switching vector as δVdc. The duty ratio of each switching state is a non-linear function of the electromagnetic torque error, stator flux-linkage error and a function of the position of the stator flux-linkage space vector. In that case fuzzy-logic based duty-ratio control can be used because of it is difficult to model its non-linear structure. The second step is to use hybrid flux observers. The hybrid flux observer uses two model for high and low speeds. Accurate stator flux estimation is obtained by using the stator voltage equation at high speeds, but low speeds accurate stator flux estimation is obtained by the rotor voltage equation. The proposed method is simulated via using MATLAB Simulink and compared to conventional DTC results. Comparing results suggest that the proposed method reduced the ripples in electromagnetic torque, stator flux linkage, stator currents and speed. Motor parameters, reference flux and torque values of motor and load torque value of conventional and proposed methods are arranged to be same for the comparison.

Keywords: Induction Motor, Direct Torque Control, Duty-Ratio Control, Hybrid Flux Observer, Torque and Flux ripple.

Introduction

Direct torque control method (DTC) is a vector control system because it allows calculating motor's flux and torque with the help of measurable magnitudes by motor parameters. The method is based on applying a switching series, which shall directly eliminate errors, which shall occur in torque, through the reference given as value and the calculated flux, to the power switching elements in the inverter (Vasudevan, 2004).

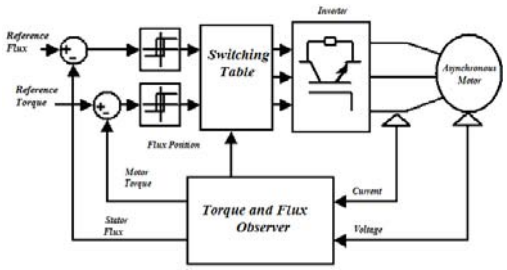


Fig. 1. DTC method block diagram

$$v_{s\beta} = R_s i_{s\beta} + \frac{d\psi_{s\beta}}{dt}\ ,\ v_{s\alpha} = R_s i_{s\alpha} + \frac{d\psi_{s\alpha}}{dt} \quad (1)$$

$$\psi_{s\alpha} = \int (v_{s\alpha} - R_s i_{s\alpha})dt\ ,\ \psi_{s\beta} = \int (v_{s\beta} - R_s i_{s\beta})dt \quad (2)$$

$$M_e = p\left(i_{s\alpha} i_{s\beta} - i_{s\beta} i_{s\alpha}\right), \quad \left|\vec{\psi}_s\right| = \sqrt{\left(\psi_{s\alpha}^2 + \psi_{s\beta}^2\right)} \tag{3}$$

This may be realized by using motor model on the α-β axis set. Stator flux, torque and stator flux sector zone may be calculated with the help of currents and voltages measured in the motor's stator as mentioned above equations (Depenbrock, 1988).

To accomplish switching process, one of the 8 different voltage vectors consisting of 8 different switching is selected as seen in Figure 2. Vi (Sa, Sb, Sc) (i=0,1,2…7) Besides 6 switching levels, there are V0(0,0,0) and V7(1,1,1) levels not producing a voltage at the output when they are applied. Table 1 may be useful to determine that the flux in which zone.

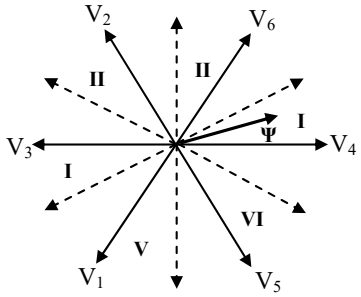


Fig.2 Switching Positions of DTC

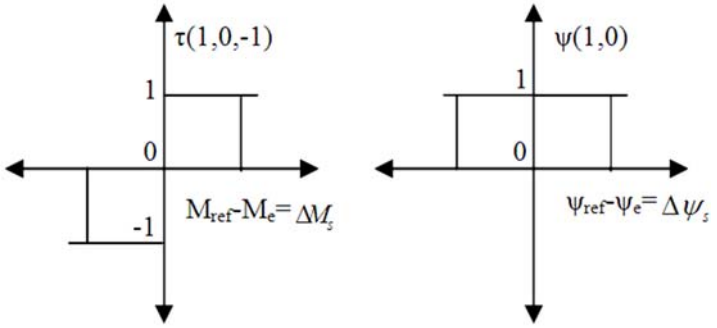


Fig.3 Hysteresis blocks which are Flux and torque error

Figure 3 is hysteresis block schema on which flux and torque errors are applied. Flux and torque errors are applied on hysteresis blocks and the signs produced by these blocks are used in addressing switching board. Hysteresis band widths are symbolized with and for flux and torque respectively. Table 1, which is seen below, shows switching logics when the motor is desired to rotate clockwise and counter-clockwise (Sarioglu, 2003).

Table 1: Optimal Switching Logics For Motor Rotating

		θ(1)	θ(2)	θ(3)	θ(4)	θ(5)	θ(6)
ψ =0	τ =1	V_5	V_1	V_3	V_2	V_6	V_4
	τ =0	V_7	V_0	V_7	V_0	V_7	V_0
	τ=-1	V_6	V_4	V_5	V_1	V_3	V_2
ψ =1	τ =1	V_1	V_3	V_2	V_6	V_4	V_5
	τ =0	V_0	V_7	V_0	V_7	V_0	V_7
	τ=-1	V_2	V_6	V_4	V_5	V_1	V_3

Material and Methods

In the conventional DTC induction motor drive a voltage vector is applied for the entire switching period and this causes the stator current and electromagnetic torque to increase over the whole switching period. Thus for small errors, the electromagnetic torque exceeds its reference value early during the cycle, and continues to increase, causing a high torque ripple. A solution can be obtained where the ripples in the torque and flux can be reduced by employing a selected inverter switching vector not for the entire switching period, as in the conventional DTC induction motor drive, but only for a part of the switching period (which is defined as the duty ratio, δ) and by using the zero switching vector for the rest of the period. The duty ratio is selected to give a voltage vector whose average over the switching cycle gives the desired torque change, thus resulting in reduced torque ripples(Vas, 1989).

The duty ratio of each switching state is a non-linear function of the electromagnetic torque error and stator flux-linkage error, and it is also a function of the position of the stator flux-linkage space vector. Thus it is difficult to model this non-linear function. However, by using a fuzzy logic based DTC system, it is possible to perform fuzzy logic based duty-ratio control, where the duty ratio is determined during every switching cycle. In such a fuzzy-logic system, there are two inputs, the electromagnetic torque error ete=teref - te and the stator flux linkage position ρs . The output of the fuzzy-logic controller is the duty ratio(δ). The fuzzy-logic duty-ratio estimator is shown in Fig.4. The fuzzy logic controller is a Mamdani-type of controller and contains a rule base. As shown Table II There are 18 simple rules and there are only a minimal number (three) fuzzy sets used for two input variables and also for the three output variables; these are small, medium and large.

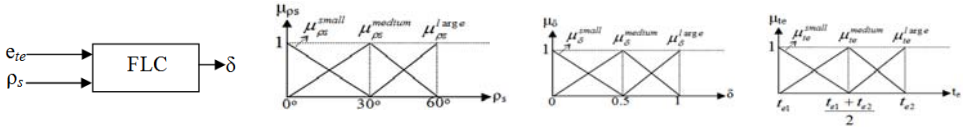


Fig. 4. Fuzzy-logic duty-ratio estimator, and membership functions

The hybrid flux estimator uses two models; a stator-voltage-equation-based model and also a rotor-voltage-equation-based model. Such an estimator utilizes the fact that at high speeds, accurate stator flux estimation can be obtained by using the stator voltage equation, but at low speeds accurate stator flux estimation can be obtained by using the rotor voltage equation. it is also possible to improve the estimation of the stator flux linkages with this method (Vas, 1989).

Designing Of The Simulink Model And Simulation Results

Both of control systems are realized in Matlab/Simulink. Fuzzy Logic Duty-Ratio Estimator and Hybrid Flux Observer based direct torque control Simulink schema of induction machine in Matlab/Simulink is shown in the Figure 5. Figure 6 and Figure 7 show us comparing torque, flux loop, and current respectively.

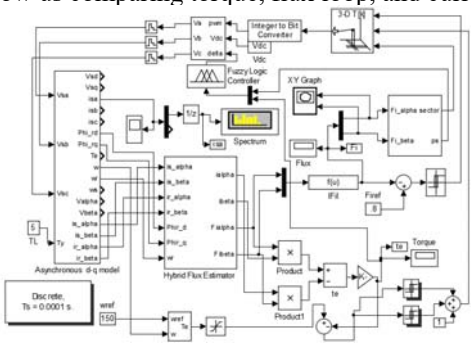
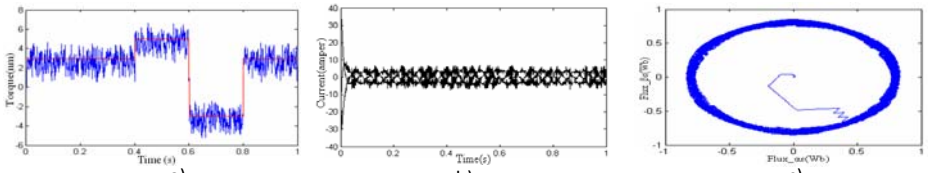
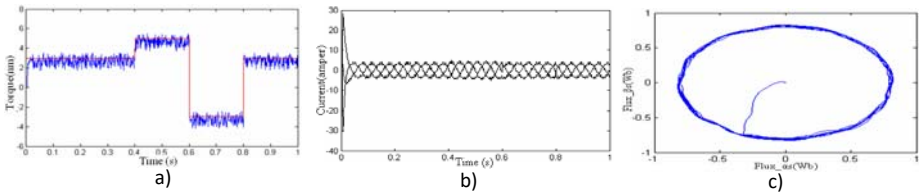


Fig. 5. Proposed DTC Matlab/Simulink Schema



a) b) c)

Fig.6 Conventional DTC a)Torque b)Current c)Flux Loop



a) b) c)

Fig.7 Proposed DTC a)Torque b)Current c)Flux Loop

Conclusion

Fuzzy Logic Duty-Ratio Estimator and Hybrid Flux Observer based direct torque control method is compared to conventional direct torque control. The DTC and the Fuzzy Logic Duty-Ratio Estimator and Hybrid Flux Observer based DTC method are simulated and the comparison of their performances is presented. The ripples in electromagnetic torque, stator flux and stator currents reduced by the duty-ratio-controlled DTC.

Acknowledgements

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USE OF MOLTEN SALT METHOD IN THE SYNTHESIS OF METAL HYDRIDE ELECTRODE MATERIALS

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Abstract: La-Ni based alloys are being used in the commercial secondary nickel metal hydride batteries. Economical synthesis of these alloys may cause large scale utilization of them especially in the electrical vehicles. The electro-deoxidation, which is accepted as the revolutionary technique in the extractive metallurgy, is very promising in the metal hydride alloy synthesis since it provides direct synthesis of the alloys from their oxide raw materials. In this study $La(Ni_{0.8}Co_{0.2})_5$ (AB_5 type) and $La_2(Ni_{0.8}Co_{0.2})_7$ (A_2B_7 type) alloys were synthesized in the molten $CaCl_2$ electrolyte at 850°C and the charge/discharge characteristics of the synthesized alloys were observed. Sintering caused the hygroscopic La_2O_3 to disappear and the non-hygroscopic $LaNiO_3$ to form. LaOCl was observed to form chemically upon contact of the sintered pellet with the melt. The X-ray diffraction peaks indicated that the sinter products reduced to $LaNi_5$ and La_2Ni_7 phases within 2 h and 6 h electro-deoxidation process, respectively. The sluggish reduction kinetics of LaOCl phase was observed to retard the appearance of La_2Ni_7 phase. The discharge capacities of $La(Ni_{0.8}Co_{0.2})_5$ and $La_2(Ni_{0.8}Co_{0.2})_7$ alloys were determined as 325 mA h g^{-1} and 332 mA h g^{-1}, respectively. The results obtained in this study showed that the electro-deoxidation technique is very promising in the synthesizing of the high performance hydrogen storage alloys.

Keywords: La-Ni Alloys, Electro-deoxidation, Hydrogen Storage

Introduction

A novel technique called electro-deoxidation, which is also known as Fray-Farthing-Chen (FFC) Cambridge process (Chen, 2000, Mohandas, 2004), is reported as very promising for the economical synthesis of the alloys directly from their oxide mixtures (Zhu, 2007, Tan, 2010, Anik, 2014). Lanthanum-Nickel based alloys are generally synthesized by the melting and casting under the protective atmosphere (Srivastava, 1999, Hayakawa, 2005, An, 2013). Of course the individual elements (La and Ni) must be already extracted and refined for the melting and casting processes. The cast products need annealing for several hours to get the structural homogeneity (Huang, 2002). Obviously this production pathway for the La-Ni based hydrogen storage alloys is not very encouraging especially for the large scale applications like battery systems of the electrical vehicles. The electro-deoxidation method looks more cost-effective since it provides direct synthesis of the alloy with final stoichiometry from the raw materials (oxides). In this work AB_5 and A_2B_7 type intermetallic alloys were synthesized by the molten salt electro-deoxidation method and the electrochemical hydrogen storage was applied to the final alloy structures.

Materials and Methods

Commercially available La_2O_3, NiO and CoO powders were obtained from Alfa Aesar. Required amounts of the oxide powders were mixed homogeneously in anhydrous ethanol includes 3% (by weight) polyethylene glycol (PEG) with a planetary ball mill. The powder was then dried overnight at room temperature. Dried powder was cold pressed into pellets of 10 mm in diameter, under a pressure of 1.5 tonne cm^{-2}. The oxide pellets were then sintered at 1200°C for 3 h.

The electrochemical experiments were performed in a quartz cell which was located inside a homemade programmable electrical furnace. The upper end of the quartz cell was closed tightly with a quartz cover which has holes for the electrode leads, thermocouple, gas inlet and outlet. The quartz cell was continuously purged with Ar gas during the electro-deoxidation process.

100 gr $CaCl_2$ was mixed with 1 gr CaO and placed into graphite crucible. Before electro-deoxidation process $CaCl_2$-CaO powder mixture was dried under Ar gas. Drying was carried out by slow heating (about 1°C min^{-1}) to

150°C and holding at 150°C for 15 h and then slow heating to 300°C and holding at 300°C for 15 h and then finally slow heating to the target temperature of 850°C for the electro-deoxidation experiments.

In order to fully remove the water and the possible redox-active impurities, pre-electrolysis were carried out at 2.5 V and 850°C for 4 h. During the pre-electrolysis graphite crucible was used as anode and another graphite rod was used as cathode. For the electro-deoxidation experiments the graphite rod was removed from the cell and the prepared oxide pellet electrode was inserted into the quartz cell as a cathode. The electro-deoxidation was conducted at 3.2 V for various times at 850°C. The potential control was carried out by the programmable direct current source.

After the electro-deoxidation experiments the pellet electrodes were removed from the molten melt and they were located in the upper part of the quartz cell which was cooled down by keeping the Ar gas purging. The solidified salt on the pellet was washed out by tap water. After slight surface grinding the pellets were kept in 1 M HCl for few minutes. Finally the deoxidized pellet samples were dried at 100°C for 24 h under vacuum.

Working electrodes were prepared by mixing 0.1 g alloy powder with 0.3 g nickel powder and then cold pressing into pellets of 10 mm in diameter, under a pressure of 10 tonne cm^{-2}. Hg/HgO reference electrode was used in 6 M KOH solution. Tests were performed with GAMRY Model Reference 3000 potentiostat/galvanostat unit. The charge current density was 100 mA g^{-1} and the charging was carried out down to the severe gassing potential. The discharge current density was 25 mA g^{-1} and the discharge cut-off potential was -0.5 $V_{Hg/HgO}$.

The phase structure of the alloy powders was examined by the X–ray diffractometer (Bruker axs D8) using Cu Kα radiation. The powder morphologies were observed by ZEISS SUPRATM 50 VP Scanning Electron Microscope (SEM).

Results and Discussion

The alloy development stages of $La(Ni_{0.8}Co_{0.2})_5$ alloy during electro-deoxidation are shown in XRD patterns in Figure 1. Sintering of La_2O_3 + NiO + CoO mixture at 1200°C for 3 h yields formation $LaNiO_3$ phase in the expense of La_2O_3 as in the following reaction:

$$La_2O_3 + 2NiO + 1/2O_2 = 2LaNiO_3 \quad [1]$$

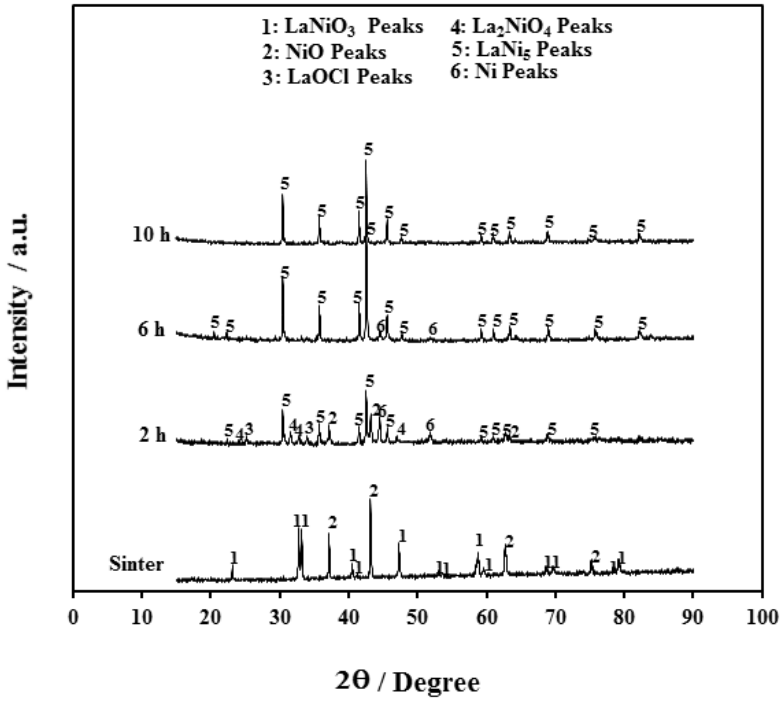

Figure 1. XRD patterns show the alloy development stages at various electro-deoxidation times for $La(Ni_{0.8}Co_{0.2})_5$ alloy.

After 2 h electro-deoxidation the sinter product $LaNiO_3$ phase disappears and La_2NiO_4 phase forms probably as a result of the following reduction reaction:

$$2LaNiO_3 + 2e^- = La_2NiO_4 + NiO + O^{2-} \quad [2]$$

The remaining reactions can be expected as in the followings:

$$La_2NiO_4 + 2Cl^- = 2LaOCl + NiO + O^{2-} \quad [3]$$

$$NiO + 2e^- = Ni + O^{2-} \quad [4]$$

$$La_2NiO_4 + 9Ni + 8e^- = 2LaNi_5 + 4O^{2-} \quad [5]$$

After 6 h electro-deoxidation La_2NiO_4 phase disappears due to the completion of Reactions 3 and 5, and the following reactions couple to the above reactions:

$$LaOCl + 3e^- = La + Cl^- + O^{2-} \quad [6]$$

$$La + 5Ni = LaNi_5 \quad [7]$$

10 h electro-deoxidation looks to enough to get stable alloy structure with 100% $LaNi_5$ phase. There is no any Co phase in Figure 1 since Co makes Co-La and Co-La-O phases with the exactly same stoichiometry of Ni-La and Ni-La-O phases. Therefore peak positions of Co phases are exactly same with those of Ni phases and it impossible to differentiate them in the XRD patterns.

Alloy development stages of $La_2(Ni_{0.8}Co_{0.2})_7$ alloy are depicted with the XRD patterns in Figure 2. Reactions 1-7 look also valid for the $La_2(Ni_{0.8}Co_{0.2})_7$ alloy development. In the final stage there is following extra reaction:

$$LaNi_5 + La + 2Ni = La_2Ni_7 \quad [8]$$

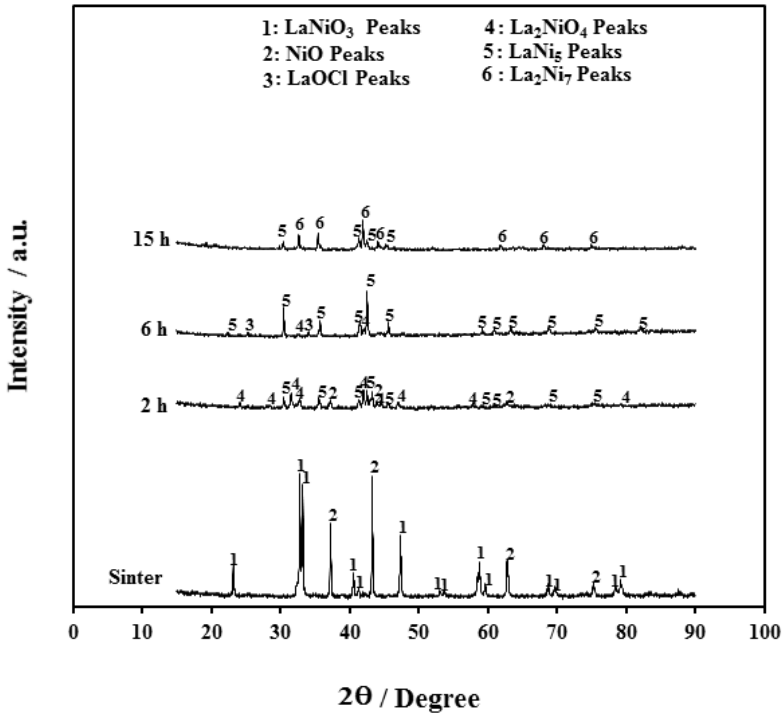

Figure 2. XRD patterns show the alloy development stages at various electro-deoxidation times for $La_2(Ni_{0.8}Co_{0.2})_7$ alloy.

The presence of Reaction 8 retards the gaining of the stable structure for $La_2(Ni_{0.8}Co_{0.2})_7$ alloy and it takes 15 h to complete electro-deoxidation process. There is also retained $LaNi_5$ phase in the alloy structure probably due to the inefficiency of Reaction 8 since it requires elemental diffusion of La and Ni. Segregation of these elements to the

pellet surface may destroy the homogeneity of the pellet and Reaction 8 cannot take place completely.

Scanning electron micrographs of the as-sintered oxide powders and fully deoxidized powders of both $La(Ni_{0.8}Co_{0.2})_5$ and $La_2(Ni_{0.8}Co_{0.2})_7$ alloys are provided in Figure 3. As-sintered powders have typical fine oxide powder appearance. At the end of the electro-deoxidation process, however, the large crystalline metallic powder morphology develops. The porous structure of the developed alloys are also apparent in Figure 3.

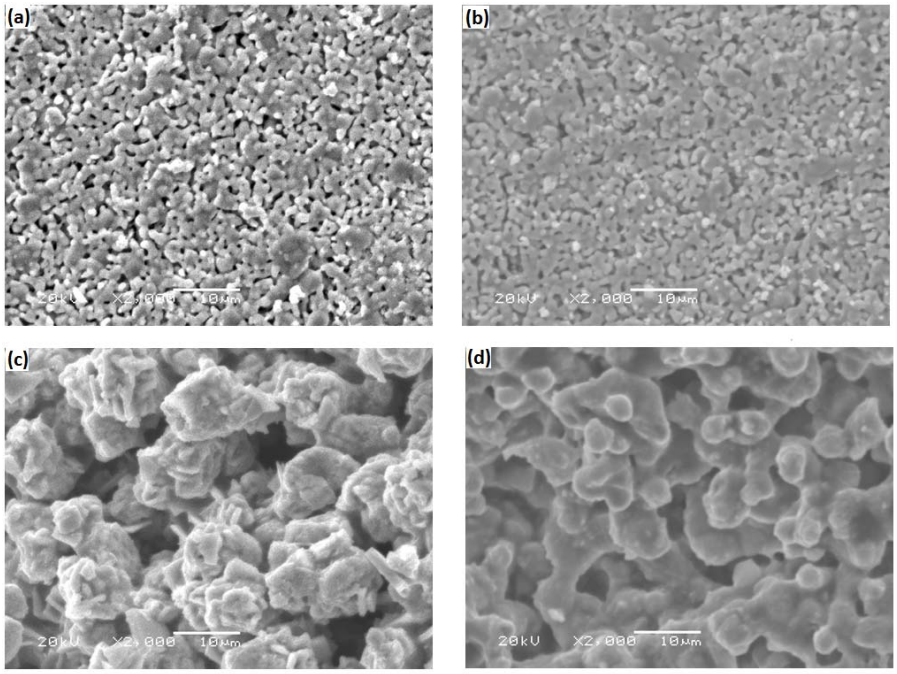

Figure 3. Powder morphology of sintered (a) $La(Ni_{0.8}Co_{0.2})_5$ and (b) $La_2(Ni_{0.8}Co_{0.2})_7$ alloys, and the fully deoxidized powder morphology of (c) $La(Ni_{0.8}Co_{0.2})_5$ and (d) $La_2(Ni_{0.8}Co_{0.2})_7$ alloys.

After synthesizing alloys with a final structure the discharge capacities as a function charge/discharge cycles are obtained as in Figure 4. The synthesized alloys need few cycles for activation to reach their maximum discharge capacities. The maximum discharge capacities of $La(Ni_{0.8}Co_{0.2})_5$ and $La_2(Ni_{0.8}Co_{0.2})_7$ alloys are 325 mA h g^{-1} and 332 mA h g^{-1}, respectively.

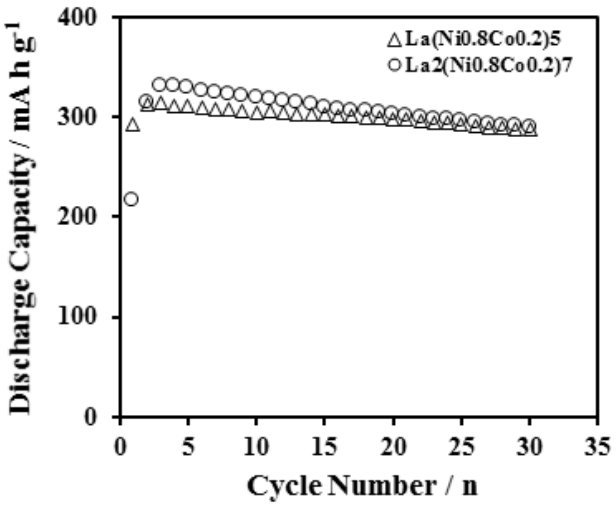

Figure 4. Discharge capacities of $La(Ni_{0.8}Co_{0.2})_5$ and $La_2(Ni_{0.8}Co_{0.2})_7$ alloys as a function of charge/discharge cycles.

This work clearly shows that electro-deoxidation may become very effective and probably more economical method in the synthesis of the energy storage materials.

Conclusion

$La(Ni_{0.8}Co_{0.2})_5$ (AB_5 type) and $La_2(Ni_{0.8}Co_{0.2})_7$ (A_2B_7 type) alloys were synthesized in the molten $CaCl_2$ salt at 850°C. Sintering caused the hygroscopic La_2O_3 to disappear and the non-hygroscopic $LaNiO_3$ to form. LaOCl was observed to form chemically upon contact of the sintered pellet with the melt. The X-ray diffraction peaks indicated that the sinter products reduced to $LaNi_5$ and La_2Ni_7 phases within 2 h and 6 h electro-deoxidation process, respectively. The sluggish reduction kinetics of LaOCl phase was observed to retard the appearance of La_2Ni_7 phase. The discharge capacities of $La(Ni_{0.8}Co_{0.2})_5$ and $La_2(Ni_{0.8}Co_{0.2})_7$ alloys were determined as 325 mA h g^{-1} and 332 mA h g^{-1}, respectively. The results indicated that the electro-deoxidation technique is very promising in the synthesizing of the high performance hydrogen storage alloys

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VARIATION OF DRIVING CONCENTRATION WITH DRIVER PERCEPTION THROUGH IN-CAR VIEW ROAD SCENE AS VISUAL STIMULANT

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Abstract: To make driver generate a right decision as evaluating scenes perceiving by his brain, several factors (objects with different shapes, movements, and illuminations) that effects on driving concentration are existed. In this study, continuously changing scenes that are seen by driver eyes through windshield are statistically investigated. Here I have initially extracted a set of features. Then I have found optimal feature subset using Linear discriminant analysis. And then I get a measure to indicate driver concentration using Jensen Shannon Inequality and Hellinger distance. It has been validated the measures via relationships between them. Consequently, a model is proposed for seeking how the scene influencing on driver concentration as an effective factor for comfortable driving. It suggests concentration risk rate of *fr* is less than all the other road models. However, concentration risk rate of *rsfs* is more than all the other road models.

Keywords: Vehicle environment perception, Jensen Shannon Divergence and Hellinger measure, feature selection, Linear discriminant analysis

Introduction

Motivation

There are many factors that influence on driver performance such as car interior design, suspension, technical specifications, road conditions, traffic density, changing climatic conditions, behavior of other vehicles, vehicle accessories in the placement. A very important factor that influences on driving comfort is also the scene through the windshield. In many studies conducted so far, one or a few factors have been taken into account. However, scene through windshield plays an important role in driver psychology, which has not been intensively investigated. As a matter of this fact in many trading areas I prefer background decoration with different colors considering customer mood. For instance, blue colors are used in a fishery shop; dresses with white, green or blue colors are preferred in hospital; relaxing wall paintings are chosen in resorts, and different decorations are used to increase working efficiency. Hence, depending on landscape in our environment I can sense specified perceptions in our brain. Therefore, I can come up with different ideas via this hypothesis for vehicle drivers who face with many visual landscapes on steering wheel. Different lights, colors, patterns and geometries of the landscape have positive or negative effect on driving performance. Drivers can be aggressive when they look through specified landscapes although some of scenes can improve his driving performance.

Problem Statement

There are limited studies on driving comfort of psychological impact of landscapes. Therefore, constantly changing landscapes under different light conditions should be classified to estimate impacts of resulting classification on driver visual performance. In order to identify impact of the scenes through windshield on driver concentration, different types of landscapes should also be examined. These visual conditions can be exemplified as light of the sun on the road, watching vehicles in crowded traffic, and driving on dark road.

Proposed Approach

In this study, 40 pictures taken within a car have been examined, which are specified as 10 fr, 10 mrht, 10 drht, and 10 rsfs. The pictures taken through the windshield include some inner part of the car that is not related to whole the scene. Therefore, this portion of the image is removed using a filter. Then Linear discriminant analysis algorithm is utilized to select some of effective features (C. Ding and H.C. Peng. 2003). I have developed pie charts to sketch minimum and maximum values of selected features. Analyzing the pie charts I have found that probabilistic

distribution of features fits an exponential kernel. By substituting correspondent probabilistic values in to an object function, scenes are classified. Using the resulting values of this classification, the concentration of driver on road is probabilistically investigated. In this way, a state of the art model is proposed to estimate driver concentration using respective scenes that driver look through windshield.

Related Work

In one study using spatial vibrotactile clues of landscapes, visual attention of drivers was investigated to get potential emergency response rate (Shankar, Venkataraman, Fred Mannering, and Woodrow Barfield, 1995). In another paper, authors worked on risk factors for traffic accidents with single vehicle in Hong Kong (Treat, John R, 1979). In this article, the effect of district, human, vehicle, safety, and environmental factors are examined (Ho, Cristy, Hong Z. Tan, and Charles Spence, 2005). As to another study, risk of injury of child bruises was strongly associated with traffic volume risk (Yau, Kelvin KW, 2004).. Injuries at region with highest traffic volumes were 14 times greater than less intensity region (Teran-Santos, J., A, 1999). In some of articles, reasons that cause accidents by diverting the attention of the drivers were investigated (Violanti, John M., and James R. Marshall, 1996). In these works, some of the reasons such as Sleep Apnea, Alzheimer disease, and using a cell phone increase the rate of traffic accidents by distracting drivers (Dubinsky, Richard M., Anthony C. Stein, and Kelly Lyons, 2000). In another paper, nearly half of truck drivers expressed a negative view about technological precautions for driver drowsiness (Ansari, S, 2000).

Contribution

The factors effecting on traffic accidents have been investigated in most of the recent studies. However there are a few researches that are focusing effects of environmental landscape on driver. In this way, performing a risk analysis I are seeking how to affect windshield landscape on performance of driver. In this study Linear discriminant analysis based feature reduction method is exploited. Then Jensen Shannon and Hellinger Distance with exponential kernel are utilized to get object function. Additionally, classifications are probabilistically visualized on a pie chart.

Outline of the Paper

Theories and infrastructure information of the study are given in Section II. Experimental results are explained in Section III. Finally the results obtained are discussed in Section IV.

Materials and Methods

There are many visual factors that influence on driver concentration such as monotonous free road (fr), road scene under frontal full sunlight (rsfs), dark road with heavy traffic (drht), and monotonous road with heavy traffic (mrht). For example, sunlight bothering driver's eyes can impair driving comfort and safety. In this study, under stochastic driving conditions, driver concentration effect for changing landscape has been modeled, and introduced a state of the art approach. Hence, investigating pictures with 10 fr, 10 mrht, 10 drht, and 10 rsfs are taken inside a vehicle.

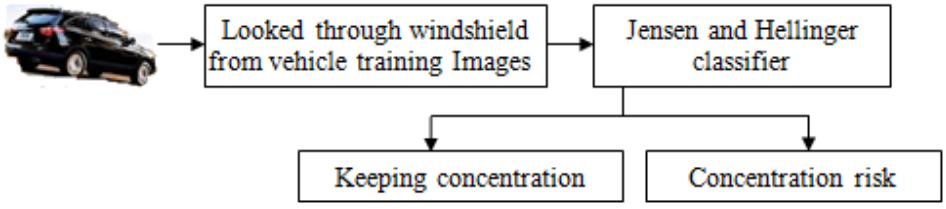


Figure 1. Proposed system

These 40 pictures are preferred as training pictures. The proposed system is shown in Figure 1.
Steps to be followed for the proposed system are

Step 1: 40 pictures are acquired through the windshield. In the pictures, some inner part of the car that is not related to whole the scene is removed using a filter.
Step 2: 10 of them are selected using Linear discriminant analysis.
Step 3: Pie charts are obtained considering minimum and maximum ranges of selected features for pictures with 10fr, 10mrht, 10drht, and 10rsfs as seen in Figure 2. These pie chart limit values are subjected to 3 stages for each feature separately as depicted in Figure 2.

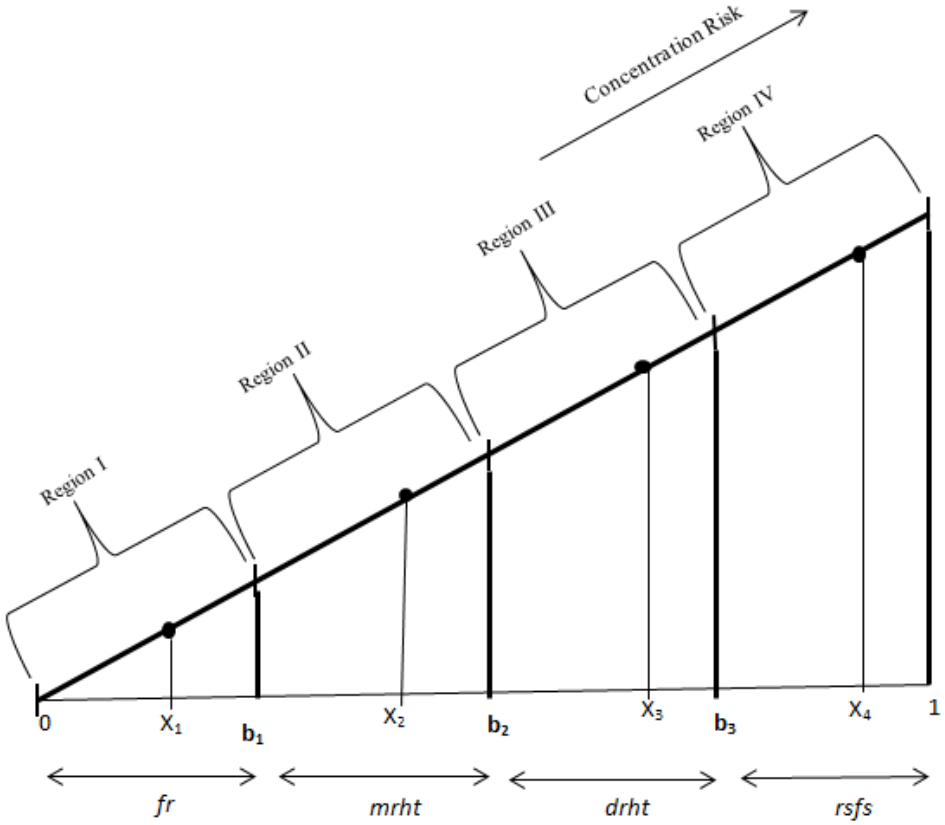


Figure 2. Dial limit values of features in the fr, mrht, drht and rsfs pictures

In Fig. 2, $ffr_i = \{ffr_1, ffr_2, \ldots., ffr_{10}\}$ is feature *i* values of image for *fr*. $frsfs_i = \{frsfs_1, frsfs_2., frsfs_{10}\}$ is feature i values of image for *rsfs*. $fmrht_i = \{fmrht_1, fmrht_2, \ldots., fmrht_{10}\}$ is feature *i* values of image for *mrht*. $fdrht_i = \{fdrht_1, fdrht_2,, fdrht_{10}\}$ is feature *i* values of image for *drht*. ffr_{min} is the smallest feature values of 10 *frv*. ffr_{max} is the biggest feature values of 10 *frv*. $frsfs_{max}$ is the biggest feature values of 10 *rsfs*. $fmrht_{max}$ is the biggest feature values of 10 *mrht*. $fdrht_{max}$ is the biggest feature values of 10 *drht*. Road (R_j) is 10 *fr*, 10 *mrht*, 10 *drht*, and 10 *rsfs*. In Fig. 2, region I is *fr*, Region II is *mrht*, Region III is *drht*, Region IV is *rsfs* . As Stage II is normalized to Stage III, ranges of features can be expressed as

$$x_i = (fR_j - a).1/frsfs_{max} \qquad b_i = (fR_{jmax} - a).1/frsfs_{max} \tag{1}$$

where b_i is the status of maximum feature value normalized to 1, which is obtained from 40 training pictures *fr*, *mrht*, *drht*, and *rsfs*; x_i refers to feature values obtained from pictures. As pie chart values are examined, it is seen that x_i and b_i values are in compliance with exponential distribution. Accordingly, exponential kernel is obtained by

$$P(c|a_{ij}) = 100b_i^{x_i} \tag{2}$$

where $P(c|a_{ij})$ is probabilistic value of the images, *fr*, *mrht*, *drht* and *rsfs*.
Step 4: In Stage II, minimum value of *fr* images is subtracted from each of limit rates so that initial value of these values shall be 0. They are normalized in Stage III by means of Eq. (1), and probabilistic ranges are estimated.
Step 5: After training image is normalized to 1, these values indicate exponential distribution rather linear one. This situation can be seen from b_i and x_i rates on the pie chart.
Step 6: Probabilistic values of *fr*, *mrht*, *drht* or *rsfs* are found by means of Eq. (2) for exponential kernel.
Step 7: These probabilistic values are used by Eqs. (2) and (3) for each feature associated with concentration rate.

Step 8: The values obtained by Step 7 are substituted by Eqs. (4) and (5) which are weights according to Jensen divergence and Hellinger measure. Therefore weight values for each feature can be found.
Step 9: These weight values are added and multiplied with the value of each feature separately by means of Eq. (6). As a result of this calculation, a probabilistic measure is obtained. The range of this measure is in between 0 and 1 since the rates obtained by Eq. (9) are estimated in a probabilistic way. Thus, closing to 1 means the increase of "Concentration Risk" as seen in Fig. 2, Stage III.

Jensen-Shannon Divergence and Hellinger

Jensen Divergence (Js) and Hellinger (He) measure are given in Eqs. (3) and (4) for 10 *fr*, 10 *mrht*, 10 *drht* and 10 *rsfs* images taken through windshield of vehicle. $P(c|a_{ij})$, in Eq. (2), can be calculated by Bayesian Network probabilistic approach. However, probabilistic distributions of features show conformity with the Exponential Kernel. Initial values of $P(c|a_{ij})$ are obtained from this kernel. $KL(C|a_{ij})$ is the average mutual information between the events c and a_{ij} with the expectation taken with respect to a posteriori probability distribution of (C Lee, Chang-Hwan, Fernando Gutierrez, and Dejing Dou 2011). I can define Kullback- Leibler divergence with naïve Bayesian as

$$KL(C|a_{ij}) = \sum_c P(c|a_{ij}) \, log(\frac{P(c|a_{ij})}{P(c)}) \tag{3}$$

Progressing Eq. (3) I can find the new measures, which are Jensen Shannon and Hellinger. When Jensen divergence and Hellinger measure in Eq. (4), (5) are put in their place, average weights with respect to Js and He are estimated namely by Eq. (6). Weights calculation Js and He are shown in Eq. (7) as

$$Js(C|a_{ij}) = \sum_c P(c|a_{ij}) \, log(\frac{P(c|a_{ij})}{P(c)} \quad + \quad (1 - P(c|a_{ij})) \, log(\frac{(1-P(c|a_{ij}))}{(1-P(c))}) \tag{4}$$

$$He(C|a_{ij}) = \sum_c (\sqrt{P(c|a_{ij})} \quad - \sqrt{(P(c)} \;)^2 \tag{5}$$

$$W_{Jsavg,Heavg}(i) = \sum_{j/i} \frac{(a_{ij})}{N} Js(C|a_{ij}), He(C|a_{ij}) \tag{6}$$

$$W_{Js,He}(i) = \frac{W_{Jsavg,Heavg}(i)}{z \sum_{j/i} P(a_{ij}) \log P(a_{ij})} \tag{7}$$

where $W_{Jsavg,Heavg}(i)$ is average weight calculation of the feature i for Js and He. $W_{Js,He}(i)$ is weight of the feature i for Js and He.

On the other hand, Topsøe (F. Topsøe 2000). mentioned about a close relationship between Hellinger distance and Jensen divergence. Therefore the relationship between Jensen-Shannon and Hellinger can be expressed by

$$\frac{1}{2} He\left(P(c|a_{ij}), (P(c)\right) \leq Js\left(P(c|a_{ij}), (P(c)\right) \leq 2 \ln(2) \, He\left(P(c|a_{ij}), (P(c)\right) \tag{8}$$

Decision Making

After calculating weights for each selected feature of images, these weights are put in their places as

$$d_{Jsavg,Heavg} = \frac{argmax \;\; P(c) \prod_{a_{ij} \in d} P(a_{ij}|c)^{W_{Js,He}(i)}}{Si} \tag{9}$$

where a_{ij} is the *j*-th value in *i*-th feature, N is the total number of records, c is the target feature, d_{Js} is test data for Jensen, d_{He} is test data for Hellinger, z is normalization constant, and *Si* is number of sample images for each scene type, that is, *Si*=10 for 10 *fr*, 10 *mrht*, 10 *drht*, and 10 *rsfs*.

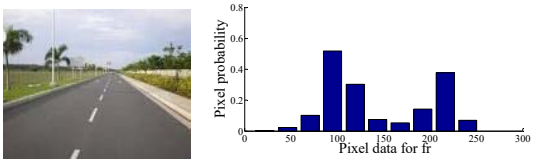
$$Concentration \;\; Risk = \frac{d_{Jsavg} + d_{Heavg}}{2} \tag{10}$$

The concentration risk can be estimated using the average of d_{Jsavg} and d_{Heavg} as seen in Eq. (9).

Results and Discussion

Some of samples out of 40 pictures are given in Figure 3.

Figure 3. Sample images through windshield for *fr, mrht, drht, rsfs*



(a) (b)

Figure 4. (a) Image (fr1)(b) Probabilistic distribution of image in (a)

Probabilistic density distributions of the image fr2, in and Figure 4 are shown at right side of same images. All the Equations between (9-10) the values of d_{Js} and d_{He} are obtained in Figure 5.

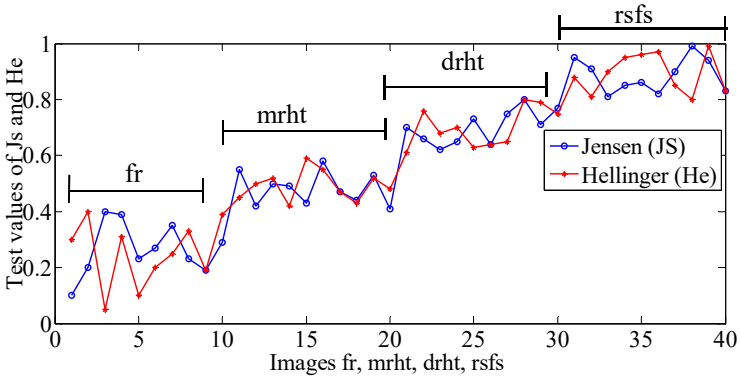


Figure 5. $d_{js\,,\,dHe}$ values for images fr, mrht, drht and rsfs

Reviewing Figure 5, the $d_{js,he}$ values of fr images are in the range between 0-0.4; the $d_{js,he}$ values of mrht images are in the range between 0.4-0.6; the $d_{js,he}$ values of drht images are in the range between 0.6-0.8, and the $d_{js,he}$ values of rsfs images are in the range between 0.8-1 are found. Table 1 is obtained by Figure 5.

Table 1: D_{Jsort}, D_{Heort} and Concentrarion Risk (*Conr)* Rates of *fr, mrht, drht and rsfs for* 40 İmages

	fr	**mrht**	**drht**	**rsfs**
d_{Jsort}	0.251	0.534	0.701	0.894
d_{Heort}	0.265	0.482	0.703	0.886
$Concentration\ Risk\ (Conr)$	0.258	0.508	0.702	0.89

According to *Conr* row in Table 1, I can conclude that

$$Conr_{fr} < Conr_{mrht} < Conr_{drht} < Conr_{rsfs}$$

It suggests concentration risk rate of *fr* is less than all the other road models. However, concentration risk rate of *rsfs* is more than all the other road models.

Conclusion

In this work, 40 training images taken through windshield of the vehicle are examined. Object function for the images *fr, mrht, drht*, and *rsfs* is obtained by Jensen Shannon Divergence and Bhattacharya Distance. The results are found as concentration risk via proposed decision-making algorithm. Consequently, I estimate the impact of landscape through the windshield on driver concentration. It suggests concentration risk rate of *fr* is less than all the other road models. However, concentration risk rate of *rsfs* is more than all the other road models. As a next step of this study all the frames along the road could be combined. Hence, this information would be a complementary clue for the studies on driver behavior.

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