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BOOK OF PROCEEDINGS

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Supported by

The International Conference on Environmental Science and Technology

Edited by

Prof. Dr. Özer Çınar
Alma Ligata

Publisher: CNR GROUP Publishing

Published, 2015

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Welcome to ICOEST 2015

On behalf of the organizing committee, we are pleased to announce that the 1st International Conference on Environmental Science and Technology (ICOEST 2015) is held from September 9 to 13, 2015 in Sarajevo, Bosnia and Herzegovina. ICOEST 2015 provides an ideal academic platform for researchers to present the latest research findings and describe emerging technologies, and directions in Environmental Science and Technology. The conference seeks to contribute to presenting novel research results in all aspects of Environmental Science and Technology.

The conference aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Environmental Science and Technology. It also provides the premier interdisciplinary forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments, and applications in al lareas of Environmental Science and Technology. The conferencebrings together leading academic scientists, researchers and scholars in the domain of interest from around the world.

ICOEST 2015 is the oncoming event of the successful conference series focusing on Environmental Science and Technology. The scientific program focuses on current advances in the research, production and use of Environmental Engineering and Sciences with particular focus on their role in maintaining academic level in Science and Technology and elevating the science level such as: Water and waste water treatment, sludge handling and management, Solid waste and management, Surface water quality monitoring, Noise pollution and control, Air pollution and control, Ecology and ecosystem management, Environmental data analysis and modeling, Environmental education, Environmental planning, management and policies for cities and regions, Green energy and sustainability, Water resources and river basin management.

The conference's goals are to provide a scientific forum for all international prestige scholars around the world and enable the interactive exchange of state-of-the-art knowledge. The conference focuses on evidence-based benefits proven in environmental science and engineering experiments.

Best regards,

Prof. Dr. Özer ÇINAR
Chairman of Conference

TABLE OF CONTENTS

HandMadePaper Font

***Ebru Özbakır*[1]**

Abstract

The most important issue in recycling waste paper is to assess the level of use in developed countries. A piece of paper can be recycled six times. When we look at the advantages of recycling and new business opportunities as well as economic and job creation it is remarkable. It can provide water and energy savings. With this idea in mind I created this recycled font design project.

In this paper I would like to explain how important being sustainable in creative processes is, and what Graphic Designers should pay attention to, here I will explain my project with this view. And I created Eco-Font, which can use less ink, then normal Arial, Helvetica font.

Keywords: Eco-Design, Hand Made Paper, Sustainable Graphic Design, Typography.

1. INTRODUCTION

First step of this proposal is returning the waste paper to new paper, and in this set-up we shoot all of processes. Finally it became a 3-minute video. It displays processes of how evaluating the conversion of waste paper into new paper and material (font design).

After some modifying of these papers it becomes Experimental typography. In this digital part I am using a type and I have included a poster of the project. Type designs include numbers, small letters, big letters, some punctuation and special characters.

I would like to explain how important being sustainable in creative processes is, and what Graphic Designers should pay attention to, here I will explain my project with this view.

2. SOURCE OF POWER
Being Sustainable Graphic Designers

When we base Nature it's always in an endless circle. For this reason in lifecycle Recyclability is very important for human life. Environmental science can positively and directly impact people's lives. There's no doubt that the way we live is unsustainable. Before the industrial revolution, when furniture and household goods were produced locally by local resources. Since the Industrial Revolution, many propositions in the design field were raised with unsustainable design principles.

Within the context of an increasingly visual culture, last decade designers and consumers out there that claim to be environmentally conscious. The users' awareness of ecological issues and graphic designers find

[1]*Corresponding author: FMV Işık University, Fine Arts Faculty, Büyükdere Cad, No:194, 34398, Maslak/İstanbul, Turkey.* *info@ebruozbakir.com*

themselves that bears extraordinary potential to change the world. Most people are now trying to adhere to the most environmentally friendly source of power because without a healthy earth, humans cannot flourish.

In all life systems everything is possible – recycling, composting, exotic materials are used with environmentally friendly technology and made new products. Most of these materials, including glass, paper, plastic, metal, textiles and electronics are recyclable. And That Recyclable materials can be used in a new product. This second life object can be new or different type of product. Lifecycles from design through production for recyclability, reusability and recoverability of use less materials and less energy.

The Design field's perspective on ecology approach to design transition from "green" to "eco" to "sustainable" in theory and practice. In 1980s "Green" become the buzzword. The original term "green design" is rarely used today, instead, ecologically or environmentally sensitive or affirmative design, or more generally eco-design, has become the most widely accepted term.

In the next few years green designers began increasingly to refer to their work as "ecological design". "Ecological" to refer environment dates back to the beginning of the environmental movement in the late 1960s and '70s. The term came into prominence by the Ecological Design Association, formed by 1989, whose journal was called Eco-design. Eco-design has constantly borrowed ideas and terminology from ecology and environmentalism.

Sustainability is the capacity to endure in ecology. " Sustainable design (also called environmental design, environmentally sustainable design, environmentally conscious design, etc.) Is the philosophy of designing physical objects, the built environment, and services to comply with the principles of social, economic, and ecological sustainability." [1]

Sustainable graphic design integrates an environmentally friendly approach and throughout a life cycle that includes: raw material; transformation; manufacturing; transportation; use; and disposal. Sustainable Graphic Design considers the environmental impacts of design solution without harming natural cycles for future generations.

2.1. Sustainable Graphic Designer might consider:

- Discussing eco-options with clients earlier;
- Smaller, minimalist designs are more eco-friendly;
- Monochromatic or one-color design using and can be used Vegetable or soy ink,
- Using paper and materials made with recycled; if possible prepare tree-free paper such as Kenaf or Hemp,
- Spend time on pre-press, the end-product can be replaced by a digital (PDF), rather than Printed,
- Energy and materials should recyclability, reusability and recoverability of;
- Thinking the size affect the packaging, transportation costs, and fuel emissions, searching;
- What production methods require the least amount of transport, low impact distribution?

3. ENCOURAGES RECYCLING
Being Print Friendly in your home/office.

An environmentally responsible home/office not only save your money, but saves the earth too and doesn't require spending lots of money on fancy gadgets. There are some easy step you can save the environment, make a big difference with small things in your home/office.

"Printing inks and toner are the second largest uses of carbon black, which is primarily manufactured by the

incomplete combustion of oil." [2] More ink usage means more electricity, a longer print job while the discarded ink containers create plastic and metal waste. Inks that could have a lower impact on the environment but based on toxic heavy metals such as lead, arsenic, selenium, mercury, cadmium and hexavalent chromium. The ink in your product isn't toxic to your health-or the planets.

3.1. Recycled Presentation Folders

Recycled folders are made with at least 75% paper waste and When you're done with your recycled folders, putting them in a recycling bin and begin the process anew without the need for cutting down more trees.

3.2. Printer Tips: Being ecological

If you are going print in the web site, usually there are many unnecessary things on page, so you can use http://www.printfriendly.com/ [3] that make you only necessary things print.

First of all print only when it is necessary! Print in draft or black and white, ink-saver or toner-saver mode, Duplex (two-sided) printing.

Minimal ink coverage when working process. Petroleum-based inks contain high levels of VOCs (volatile organic compounds) and can cause health risks and air pollution but vegetable-based inks are naturally low in these chemicals and low impact on the environment. Soy and vegetable based inks are widely accepted as the environmentally friendly choice. Benefits of soy inks; Cost effective, highly recyclable, sustainability, but often get a bad reputation for drying slowly.

3.3. Paper Tips: Ecological Paper

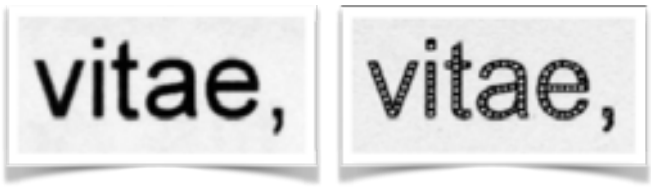
Paper is the one of the biggest industrial renewable and easy recyclable product. One paper can be recyclable six times. "Paper manufacturing alone is the third largest use of fossil fuels worldwide and the single largest industrial use of water per pound of finished product." [2]

Xerox Corporation scientists have invented "Erasable Paper", whose erases itself and prints images stay only a day on the paper, so that the paper can be used again and again. (For more information; http://www.xerox.com/innovation/news-stories/erasable-paper/enus.html) [4]

3.4. Font Tips: Eco-Font

There are also different options for saving ink. Changing the font effects inks. For example with a "normal" typeface such as "Garamond" has a very large x-height, so printed at the same nominal point size uses more ink than "Times". You could also easily save ink by setting the same font at a smaller point size or thinner at the same size works for saving ink more than normal size.

There are two different options for using ecological font for print out.
EcoFont: (http://www.ecofont.eu) [5]
In 2008 Dutch company Spranq published software name is EcoFont. This idea of eco typeface is a program you can download that leaving small holes in the letters so that when you print them, they use up less ink and saving toner.



Arial Eco Font

Figure 1. Example of Eco Font

With Ecofont, Arial 12pts shows ink and toner savings of 28%. Ecofont can use fonts: Arial, Calibri, Times New Roman, Verdana and Trebuchet MS.

Raymond Eco Font

Raymond Font is designed from Ryman Stationery and ad agency Grey London retailer Ryman Eco, a new "sustainable font". Raymond font has been carefully designed to look good while also saving you ink. Raymond Font uses 33% less ink than Arial, Times New Roman, Georgia and Verdana.

4. SUSTAINABLE GRAPHIC DESIGN

Reduce, Reuse, Recycle and Rethink

People need to understand themselves considerable role in the sustainable world. Near future is low-volume consumption of Earth's resources. Last decades, in many part of design process Sustainability becomes more than important. As designers in creative process should change their old narrow perspectives.

For graphic designers considerations traditional and digital graphic design domains include materials, ink, paper and the design itself. Printing industry usages unreasonable amount of ink and paper. Digital media such as emails, eBooks, and digital advertisement, printed materials are still an essential part of the graphic design process.

"In order to further understand how social activism in environmental sustainability in the field of graphic design exploded in the United States between the mid-to-late 1990s to today, it is crucial to define social activism, it's connection to sustainability, and how the field of design, particularly graphic design has been associated with social activism for over a century." [6]

Graphic design supports the noticing of complexity and relationships. The development of network theory supports a new focus on relationships within systems that is relevant for communication designers and environmental communicators. Communication and visual designers have an important role to play environmentally eco-friendly approach of their design. Most important of the 21st century considers nature resources as part of the design with less plastic, less oil, less waste. Print designers responsible choosing eco-friendly, ecological processes for greener planet.

"Forest Stewardship Council (FSC) certification is one of the most widely accepted and recognized environmental initiatives in the graphic arts community today. The FSC is an international non-profit organization that certifies pulp and paper companies who adhere to rigid forest stewardship standards." [7]

5. CONCLUSIONS

DESIGN FOR RECYCLABILITY (DFR)

Ecological Font Design

5.1. History of Typography - Contemporary Typography

From Antient times, typography is the visual component of the written idea by given a visual form.
"Typography is one of the most influential elements on the character and emotional quality of a design." [8]

Typography is the art and technique of arranging character of type. Designers making the words legible, with a some rules of various weights and styles to form a complete font family, carefully considered kerning pairs, multi-languge support with international characters, expressive alternate glyphs to add character and variety to type-setting. Good, bad and great design will make difference with designer's character of type; layout, grid, colour scheme, design theme and so on.

Character of type has basic concepts like a Size, Leading (vertical space between each line of type), Tracing (letter-spacing) and Kerning (adjusting the space between characters to create a harmonious pairing), Measure (width of a text block), Hierarcy and Scale (size, colour, spacing and weight make defined hierarchy).

5.2. Renewable Energy, Recycled Paper

Recycled paper processing mills uses less than half the energy required to make paper from wood pulp. Recycled paper use paper as their feedstock. The recovered paper is combined with water that acts like a blender to separate fibers in the paper sheets from each other. Shaped paper pulp hanged, dried and then flattened by applying pressure. After all process waste paper becoming new paper.

"The main sources of cellulosic fiber evolved as the ancient craft migrated from its birthplace in China to Korea and Japan, the Islamic world, and then to Europe and America." [9]

Over the centuries, paper has been made from a wide variety of materials such as cotton, wheat straw, sugar cane waste, flax, bamboo, wood, linen rags, and hemp. Regardless of the source, you need fiber to make paper. Today fiber comes mainly from two sources — wood and recycled paper products. [10]

Recycling is one the most important indicators of being a developed country. Today's most important recoiling field is using wasted papers. Raw material for the production of paper textile waste, cotton, fiber crops, rice straw, pine, fir, spruce such as with high-quality cellulose and waste paper are used. Paper can recycle only six times.

5.3. The project – HandMadePaper Font Design: How can I promote graphic project that protect and restore the environment?

The idea is recycled font design. My aim is for this project was to make a font family with re- cycling paper. In this project, my first step was turning waste paper into new paper pulp. With this renewable energy, new paper is forming. The Main paper (green one) was made and I waited a little for drying then I started drawing on top with different color (white) of recycle paper. All my font family were almost done like these. So the font family paper can be recycled again and again. So this Font Family, were themselves cycled in natural cycle. After all Paper recycling is the process of turning waste paper into new paper products. Then after all new handmade paper was scanned onto the computer, I cut out typography from paper and process starting with Photoshop. In Adobe Illustration I put some effects on for making eco-font with some emptiness on the type. Holes on the font and empty spaces on the face making used less ink when printing out paper with this font.

My aim is for this project was to make a font family with re- cycling paper, so this Font Family were themselves cycled in natural cycle. That's why the name of font family is 'Recyclable'. All the font family you can see here down this paper were created. You can download them here:

http://ebruozbakir.com/index.php/handmadepaperfont/ [11]

Figure 2. HandMadePaper Font DVD Cover

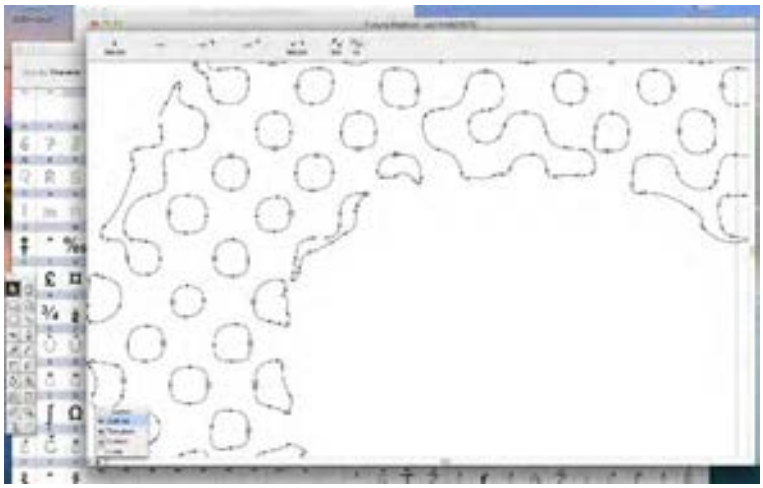


Figure 3. HandMadePaper Font close screenshot

Figure 4. HandMadePaper Font Family at Fontographer program

Figure 5. HandMadePaper Font Example of writing

6. CONTENT

ACKNOWLEDGMENT

My sincere thanks goes to Teacher Ayşenur Gül, who provided me an opportunity to join their team as intern, and who gave access to the laboratory and research facilities. Without they precious support it would not be possible to conduct this research.

I am also grateful to my dear friends Chioma Cureton and Onur Demircioğlu for all helpful for this project.

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BIOGRAPHY

She was born in Istanbul. She did double major and graduated from the Department of Visual Communication Design and Cinema-TV at the Faculty of Communication in Bahçeşehir University in 2006. She worked as a research assistant in the Department of Visual Communication Design at the Faculty of Communication in Maltepe University between 2008 and 2010. She did Master in the Department of Cinema-TV at the Faculty of Communication in İstanbul University. She also worked as a freelancer graphic designer while doing her academic career. Özbakır has been working as a research assistant in the Department of Visual Communication Design at the Faculty of Fine Arts in Işık University since 2010.

The Environmental and Climatic Functions of Green Roofs

***Neslihan Demircan*[1]**

Abstract

The dramatically increase in human populations and the migrations into the city centres cause the problem of unplanned urbanization. This problem specifically induces the destruction of green-fields and parks in metropolises. Thus the people living in these cities are indirectly forced to live in a depressed psychological mood between huge concrete-made buildings, without any involvement in natural life. Furthermore the unplanned urbanization causes a decrease in the sources above ground since it has environmental and climatic damages on Earth. The expensiveness of energy sources, difficulties on finding healthy food sources and decrease in productivity conveyed us to search on the solution of this unplanned urbanization problem. In this case, the green roofs which are also called living roofs, enables the users to plant on the roofs and intersect the metropolis with the natural life. Moreover the surfaces and roofs of buildings that are covered with plants may provide healthier city climates.

The aim behind planting on surfaces of the buildings is not only providing a visual sense of nature. There are lots of benefits of this application like: decreasing temperature differences between summer-winter and day-night, preventing the flood caused by sudden water flows after soakers, filtering the air from the toxic gases and dusts of cities, absorbing the noises around, providing a habitat for flora and fauna living around, covering the buildings with a natural beauty of plants, increasing the green field amount per person, combining the different and separated elements of Earth together...

In this research, beside the decorative effect; the environmental and climatic functions, the importance and necessity of green roofs will be examined by using the methods of literature review and the investigation of Turkish and international examples of this usage.

Key Words: City, climate, ecology, environment, green roof.

1. INTRODUCTION

Green environmental recreations that have lots of functions with the growing medium, vegetation and structural techniques and that can be placed on a building as flat or sloped are called green roofs.

The first existing example of green roofs are the Hanging Gardens of Babylon that were constructed by Emperor of Babylon II. Nebukadnezar for his wife Semiramis to reach the God and to quench the yearning of green and natural environment, which are called "roof gardens". In Ancient Greek civilizations, people grew plants on pots or vases and place them on the roofs just like roof gardens. In the beginning of the nineteenth century, the North European inventors found some ways to protect themselves against cold weather by covering the roof with soil, vegetation and sod-roofs to insulate the surface by green roofs [1].

Nowadays the green roof systems are more popular due to the increasing ecological, economical and social effects of global warming and they are called "living roofs", "ecological roofs" or "planting roof technology". Moreover, in Japan the train stations are covered by "sky gardens" that are also a type of green roof systems and these sky gardens provide a new perspective on architectural vision of green roofs.

One of the most important problems of the urban ecosystems that are ruined by fast developing technology and industry is the protection of natural ecosystem and vegetations around the city. To decrease the urban heat island effect and to provide a better and natural environment for the residents of the city, the best way is to maintain the green fields[2]. Because of that the surfaces of roofs, terraces, balconies and outer

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surfaces of whole buildings are vegetated since the green fields are decreased dramatically with urbanization processes.

The scientific investigations on the topic of green roof systems show that they are beneficial both on the scale of the building and the city. The technical, ecological and social benefits of green roof systems are accepted all around the world [3]. Throughout the centuries people are using the roof and terrace gardens for the purposes of esthetical beauty and ecological benefits. Roof and terrace gardens do not only provide a chance for city residents to reach the natural life in the centre of the city but also they provide a protection for city residents from the negative conditions of exterior environment.

It is possible to accept the roof gardens as green fields in both scales of buildings and cities. In the scale of a building, the roof with a garden is more durable than a traditional one and it provides a heat balance where the traditional does not have such a benefit. In the other scale (a city), creating green fields on top of buildings helps to arrange the effects of extreme temperatures, storm-management and water quality.

Roof gardens cannot have the same effect just as the forests or parks do but they can provide a nice and meditating place for the city residents, an ideal living field for birds and butterflies. Green roofs can act like a natural element of the environment and can diminish the quality of water and air of that area. Furthermore rather than repeated concrete blocks of buildings and asphalt-covered roofs, flowered vegetation and green grass on a field is a better place to look at every time[4].

Green roof system is thought to be a solution for the usage and maintenance of natural sources, global climate changes, consistent green fields against environmental problems. In this research, beside the decorative effect; the environmental and climatic functions, the importance and necessity of green roofs will be examined by using the methods of literature review and the investigation of Turkish and international examples of this usage.

1.1. The Types of Green Roof Systems

The modern roof gardens can be categorized as intensive and extensive roof gardens. This categorization is made due to the functions and benefits that occurs with different maintenance requirements, vegetation and the applied surface(4-8-9-10-11) (Table 1). There is also semi-intensive roof gardens that are combination of these two types [12]. Table 1 is drawn to show the differences and similarities between these three types of roof gardens.

Table 1. Comparable categorization of different green roof system types

CHARACTERISTICS	INTENSIVE GREEN ROOF	SEMI-INTENSIVE GREEN ROOF	EXTENSIVE GREEN ROOF
Purpose and use	Functional and aesthetic; increased living space, Park like garden	Functional and Designed green roof	Functional;storm-watermanagement,thermal insulation,fireproofing, ecological protection layer
Structural requirements/saturated weight	High (290-970 kg/m^2)	Varies (170-290kg/m^2)	Low (70-170kg/m^2)
Substrate type	Heavier weights	Heavy	Lightweight
Depth of material	More than 15 cm	Above and below 15cm	15 cm or less
Plant communities and diversty	Lawn or perennials, shrubs and trees. Greatest diversity	Grass-herbs, shrubs, Greater diversity	Environmentally-tolerant, moss, sedum, sukkulents, herbs and grasses, alpine types. Low diversity
Maintenance	Highest activities of fertilizing, irrigation and pruning	Varies	Minimum Level
Cost	Highest	Varies	Low
Irrigation	Irrigation usually necessary	Varies	Low water requirements
Slope	Relatively flat	Relatively flat	Slopes up to 30^0 and higher
Accessibility	Usually accessible	May be partialy accessible	Often inaccessible

1.1.1. Intensive green roof

Intensive green roof systems consist of deep medium level of substrates for dense vegetation and architectural additions like artificial ponds and waterfalls, banks, walkways [10-14]. In intensive roof constructions a great amount of soil is used, thus the weight on the roof is greater. Because of that this system is applied only for the statically available and new-designed buildings [13]. Intensive green roof systems are garnished with artificial plants, trees and bushes; and they are used in the roofs of garages and heavy buildings [12]. This system requires a flat roof and perfect insulation, irrigation, drainage and filters which makes it so expensive. The characteristics of this system are therefore causing a great weight on the roof, having expensive maintenance and design, and being durable for long time [14].

With the developments in the structural/constructional technology, the intensive green roof systems are between the weights of 390 and 730 kg/m^2, where the depth of the soil is between 20 and 60 cm. The maintenance of intensive green roof systems requires a great effort and long time[15]. Choosing the plants is an important step in this system and it is better to choose the plants that have similar requirements. If you want to plant different with an individual effort, individual irrigation and drainage systems, and individual periodical caring[15].

Intensive green roofs provide urban places for people to easily reach the natural life and for recreative activities. Thus this intensive green roofs are a chance for people to get away from the daily stresses and to meditate themselves both physical and mentally[10].

1.1.2. Semi-intensive green roofs

It is a roof usage which is between intensive and extensive roof types. Deep layer of planting offers big opportunities for cultivation. Some kinds of shrubs, such as lavender plant, perennial herbaceous plants and various lawns can be planted while bushes and trees cannot be used[12]. The roof gardens are ecologically worthy landscapes.

1.1.3. Extensive green roofs

Extensive systems; which has labor, production and maintenance that costs to a minimum level in the vast areas with a minimum or no maintenance requirements are created on the shallow soils[8-10]. Lightweight and ultra-slim extensive green roofs of the buildings can be used without creating too much load area [12-13]. Light and slim extensive green roofs can be produced without extra weight. The property of natural drainage is only used for the roofs that are sloped up to 30 degrees and the slope is in between 1.0 - 1.5 % [10]. A typical layer of extensive roof consists of mineral based soil mix, crushed brick crumb, peat, organic substance and soil. The depth of a standard extensive roof substrates is from 5 to 15 cm and the weight is changing approximately 70kg/m^2 to 170kg/m^2 [15]. In the plantation of extensive roofs, plants are usually selected in stunned shrubs, mosses, lichens, single and perennial meadow plant and some cover crops which have sukulent* structure (Sedum* types). This species are usually resisted against wind, frost, drought and excessive water, requiring very little maintenance, high regeneration capabilities, low size, existing in shallow and less fertile soils and growing in the horizontal direction [8-10-11-16]. Light and slim extensive roofs are mostly designed for ecological benefits and aesthetic; not for the recreative needs [14].

2. MATERIAL

From past to present, people are using the roof and terrace gardens for both ecological and aesthetical purposes. The green roof systems do not only provide an area for recreative activities but also they quench the yearning for natural life and provide a protection against the negative effects of environmental conditions. In this part of the research the ecological, climatic and aesthetical (recreational) functions and benefits of the green roof systems will be examined.

2.1. The Functions of Green Roofs

It is a global reality for today that it is possible to observe the climatic changes and their effects, thus green roofs are more important on maintenance of ecological balance on Earth. Green roof systems are a solution up to a scale against the soakers, floods, extreme urban temperatures and atmospheric pollution [17]. Due to the data provided by Green Roof for Healthy Cities, the cities are covered with proof surfaces and a great amount of these surfaces are the roofs. In this case, green roof provide aesthetical and environmental benefits like vegetation, habitat for birds and butterflies, absorption of Carbon dioxide and other pollutants,

filter for ambient air, and production of oxygen (O2). Furthermore by evaporation, the ambient air is cooled down and this provides a better living place for the living organisms [18]. The other benefits of the green roofs are the aesthetical beauty, combining the urban and natural lives, providing an area for urban agriculture and noise insulation [19].

2.1.1. The Environmental and Climatic Functions of Green Roofs

Green roofs are a class of the bioengineering and biomimicry technologies. The interactive elements of the green roofs takes the properties of the vegetation at the surface of the roof and imitates it like a natural ecosystem [8].

Storm-water Management

The benefits of the green roofs can be categorized into three parts: Storm-water management, energy conservation and provision of urban habitats and these benefits are provided with these three characteristics of these systems: vegetation, growing medium and membranes. Plants cover the bottom surface and provide the water cycle with taking it from the surface, carrying and evaporating into the atmosphere. The growing medium is an important aspect in plant growth but it is more important for absorption the storm-water. Membranes keep their water-proof quality and prevent the roots of the plants to get into the surface wall [8].

In urban environments, the usage of materials like asphalt and concrete decreases the amount of water absorbed by the surfaces. Thus the green roofs is an ideal application to gather the storm-water and to manage it since by fulfilling the layers of the green roofs, it is prevented for storm-water to leave the roof directly. In green roofs, the storm-water is managed with the porous and absorbent characteristics of the system and also the water cycle provided by the plants helps this absorption process [20-21-22]. By provision of drainage channels into the edges of the roofs, the storm-water is gathered into that areas and an important amount of this water is used for the irrigation of green roof plants [12].

The Functions on Decreasing The Effects of Urban Heat Island

The dense urbanization process in cities is the reason for lots of environmental problems and the effect of urban heat island is one of these problems. This effect diminishes and gets more important with the decreasing green field percentage in cities. To provide consistent green fields in cities, the most beneficial and ecological application is to use the green roof systems. The green roofs do not only provide an aesthetical beauty, prevent air and noise pollution but also they have some thermal benefits on both environment and building. The solar radiation applied on the building is absorbed by the green roof and the energy is spent with transpiration and photosynthesis. Thus the surface temperature of the building decreases since less energy is applied on the surface [14-22].

Urban Heat Island effect is occurred in urban environments because there are lots of hard surfaces there and the wind-ways are prevented by the buildings. The main function of urban vegetation is to provide shadows for plants to grow inside and maintain the water cycle around. Thus by the water cycle, the thermal energy is conserved and a cooling effect is produced [17]. Green roofs positively affect the thermal performances of the buildings because the solar radiation and fluctuations in daily and annual temperatures are decreased by green roofs [23]. Moreover green roofs help to decrease the amount of energy spent for artificial cooling systems and to make the buildings comfortable in case of temperature. In nights or cloudy days, the green roofs store most of the solar energy and the temperature inside the building does not fluctuate a lot [12].

Habitat and Biodiversity Conservation

The green roofs provide biodiversity and habitat for a natural life and today in urban areas the biodiversity decreases dramatically and pushed outside of the cities. In that case, the green roofs is an important application to diminish the biodiversity in urban areas. The green roofs cannot have the same effect of natural ecosystems like rain forests or marshy areas but according to statistics green roofs provide a significant amount of biodiversity. Furthermore the urbanization process in city centres causes a non-living

environment around the city residents. The green roofs create the natural environment in city centres again, provide habitat for organisms like plants, birds, butterflies, insects and replace the non-living space with a living area [18].

In metropolises, the natural habitats are so limited, thus the roof gardens in buildings' scale both increase the amount of green fields in urban environment and provide habitats and biodiversity. Roof gardens reveals a natural life in a steryl urban environment. There are lots of species of birds, insects, ants, spiders, flies that chooses the roof gardens as habitats [24]. These gardens constructed on the buildings are better habitats for the winged organisms since it provides a habitat in a higher level than natural ones [18]. In addition, the coverage of plants and soil on the roof surfaces decreases the energy spent and negative impacts on local ecosystems [8].

The Functions on Preventing Air Pollution

One of the benefits of the green roof systems is the filtration of air from the toxic gases and dust particles. The plants can absorb the toxic gases in ambient air by the tissues with ion-absorbing characteristic [17]. Atmospheric dust is held until rain washes it into the greenroof soil substrate[10]. The roof garden produces oxygen and increases the quality of ambient air. The green roof plants uses carbon dioxide for photosynthesis and this decreases the negative effects of air pollution. The best choice is the high yield plants that produces the highest amount of biogases. In that case, it is at least an advantage for urban environment when the surfaces and roofs of the buildings are vegetated [25].

2.1.2. The Aesthetical, Recreative and Social Functions of Green Roofs

Roof gardens provide an active and passive recreation opportunity for the residents. With that opportunity, the urban environment is balanced with natural life and the stressful conditions of the urban life are changed to a relaxing and refreshing environment. Moreover by including relaxation, play and sport areas, the recreative requirements of city residents are provided [24].

With the construction of roof gardens, especially in tourism, office, education and health centres have different and special relaxing areas and this increases the yield of the work done in these centres. Moreover the roof gardens develop new social relationships and increase environmental aesthetical significance of those centres. The roof gardens help to increase the price and the number of selection of the centres. Furthermore green roofs and vertical gardens quench the lack of green fields in urban environments. Most of the city residents thinks that the walls of the buildings and roofs are an important chance for vegetation [16]. Another way of usage for the green roofs is the urban agriculture [25]. The food production by city residents provides lots of economical and educational benefits to them.

Green roofs absorb the sound waves around the building and do not let them enter the building thus these roofs prevent the noise pollution [14]. The plants around the buildings slow down the winds and absorb the sound waves. Therefore the roofs work as a layer for sound insulation [26].

3. CONCLUSION

From past to present the green roof systems are used and because of the increase of environmental and climatic problems, they have become a significant part of current studies. After these studies, it is concluded that green roofs provide the water cycle against the storm-water management problem caused by climatic changes and global warming; also they decrease the Urban Heat Island effect in city centres. Moreover these roofs filter the ambient air from the toxic gases and dusts; and they provide oxygen-carbon dioxide balance with photosynthesis and respiration processes. Furthermore green roofs are habitats for both flora and fauna that increase biodiversity in that area.

The green roofs provide vegetation inside the concrete surfaces of the urban environments which increases the green field per person and prevent the monotony to make people feel more comfortable, social and attracted with nature. These green roof systems provide landscapes and areas for recreation, vegetation and urban agriculture. In addition the vegetation and soil layer of these systems provide a thermal insulation and insulation for noise pollution.

Beside these benefits the application of green roofs in Turkey is in limited number. The reason why green roofs are not widespread is that the construction and maintenance are expensive and require long-time effort. In that case, it is a must for Turkey to pay attention on increasing the number of green roof systems and spreading them around the country. At first, the architects, engineers and planners should be informed and they should be attended on presentations of technological methods and materials of these systems.

Furthermore there should be deeper analysis on the technological methods and materials of green roof systems to decrease the cost of the system which can increase the amount of green roofs constructed. In Turkey, the local and private foundations should lead the presentation of green roofs around the country and they should provide some encouragements to local green roof users. Furthermore there should be education programs to inform the experts and users of these systems which will make the use of green roofs widespread.

ACKNOWLEDGEMENT

I would like to thank Mr. Orkun Altay GENÇ, with his helps during the research on proof reading the articles and providing language help.

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BIOGRAPHY

She was born is Erzurum in 1975. She has graduated from primary, secondary and high schools in Erzurum. In 1993, she has become a student in Faculty of Agriculture in Ataturk University. In 1997, she has graduated successfully from Landscape Architecture. She has started to work in that university as an assistant in 1998. She has completed the thesis entitled "An Investigation on The Criteria for Creating a Botanic Garden in Erzurum City Centre" as the thesis of post graduate degree in 2002. She has completed the doctorate with the thesis entitled "Investigation of Present and Suggested Urban Regeneration Projects with The Perspective of Landscape Architecture, Erzurum as An Example" in 2010. In 2011, she has become Assistant Associate Professor in Faculty of Architecture and Design in Ataturk University and up to 2015 she continues her job in that university. Neslihan Demircan is married and is a mother of two sons.

The Role of the Environment Action Programmes of European Union in the Development of EU Environmental Policy

***Abdurrahman Uluirmak*[1]**

Abstract

The European Union by its sui generis character of supranational structure having its own law and institutions as a power above national states, has aimed the integration target while developing environmental policies like other policy fields. 1970s were the awareness period of environmental degradation for the sake of economic development in the world. That period also became awakening years for the European Union from the perspective of environmental protection. EU Member States have become to take common actions in environmental issues like other many fields. The Second World War did not only damage human and economic capacity of the European Continent but also deteriorated the European environment. Not much later of the establishment of the European Economic Community, EU introduced many legal and administrative arrangements from preventive to protective.

Environment action programmes have been the basis for the European Union in order to develop its environmental policies. EU has introduced seven environment action programmes so far. Each of them covers a specific period of time. While the first programme was covering the period of 1973 – 1976, the final (seventh) programme covers the period of 2014 – 2020.

Keywords: Environment, Environment Action Programme, European Union.

1. INTRODUCTION

As a power above national states with own law and institutions of European Union (EU), with the nature of supranational, has pursued a goal of integration on forming environmental policies just as in other fields [1]. 1970s that a period of realizing of the destruction of environmental values worldwide in sake of economic development are "awakening" years in EU in terms of environmental protection. EU countries, as on many issues, have begun to move together on the environment. The main reasons of this are as follows:

- Adopting different environmental policies and standards by member states, lead to unfair competition, thus creating obstacles to the realization of the common market;
- Improving the living conditions and raising the quality of life in Member States on a common level;
- Understanding of the obligation to act together by interdependence of neighbouring countries and the spread of pollution from a country to another one with a transboundary character [2].

In parallel with global developments, EU prepared "Environment Action Programmes" in which shed light on the principles and priorities of environmental policy are determined so that will be a roadmap for the years ahead. Although there is no binding effect, Environment Action Programmes reveal main principles of the policy to be followed in union wide and are being guidance for prospective legislation [3].

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2. ENVIRONMENT ACTION PROGRAMMES

In the EU, six action programmes have been conducted so far. The duration of the Sixth Environment Action Programme was expired in July 2012 [4]. European Commission prepared the proposal of the Seventh Environment Programme, and Parliament and Council approved the Programme. Seventh Environment Programme which will be valid until December 31 2020 was published in the Official Journal the EU on 28 December 2013.

2.1. *First Environment Action Programme (1973-1976)*

Just after "United Nations Conference on Human Environment" which was held on June 5-16, 1972, Heads of State or Government of the EU member countries who came together in Paris on October 19-20, 1972 requested from relevant institutions to prepare "Environment Action Programmes" until July 31, 1973 by making a statement for the first time about environmental protection. The Programme that was prepared by Commission, namely "First Environment Action Programme" was adopted by Council on November 22, 1973 and has been put into force with the approval of the Member States [5].

First Environmental Action Programme revealed purposes and principles of the Environmental Policy of the Union and gave a long list of numerous measures should be taken at Community level. This programme searched out a solution on especially important and serious pollution problems.

Some of the targets set in the First Environmental Action Programme could be summarized as follows:

- Reducing and if possible, preventing the pressure on environment;
- Preserving ecological balance and biosphere;
- Avoiding use natural resources in such a way damage to ecological balance;
- Improving the working and living conditions;
- Further consideration on environment in urban and regional planning;
- Seeking common solutions on environmental problems with non-member states of Union and in particular international organizations [6].

It is understood that this programme that specifies general purpose of environmental policy as improving the life quality of individuals and their environment and living conditions, was determined in accordance with principles set in Stockholm Conference such as preventing the pollution at source, including the environmental concerns to all planning and decision-making processes, admitting the principle of "polluter pays", taking into consideration of the impact of union policy on developing countries and developing the international cooperation [7].

2.2 Second Environment Action Programme (1977-1981)

Second Environment Action Programme that was launched in 1977 is a continuation of the First Programme. In the section of purposes and principles of this programme, the purposes and principles of the First Programme was adopted and the view of which issues should be continued are reducing, preventing and if possible abolishing the pollution; disallowing use in such a way damage to ecological balance; further consideration on environment in urban and regional planning and cooperation with international organizations, was given place. Likewise in Second Programme, it was provided that the characteristic of environmental policy became inhibitor rather than troubleshooter by requesting on environmental policy the implementation of environmental impact assessment (EIA) [8].

First two environment action programmes of the European Union included targets for the purposes of providing immediate solutions to serious problems which were emerged as a result of pollution and can be described as restorative policies [9].

2.3. Third Environment Action Programme (1982-1986)

The third Environment Action Programme which was enacted in 1983 clarified its environmental approach and accelerated the development of that policy thinking. In this programme is based on a conservative approach and environmental resources has been recognized as the most important element of further economic and social development. Under this protective ideas and approaches, it is aimed to prevent the emergence of potential environmental problems. Therefore, it emphasized that it is an integral part of economic planning and operation of environmental needs. In this programme, in environmental policy, it is necessary to solve the problems with existing pollution prevention at the source. In addition, the requirement of rational use of natural resources as well as protection, indicating that the basic policy of conserving natural resources is emphasized [10].

In the introduction part of the programme, by considering the protection of the Mediterranean for the first time, it was stated that the protection of the Mediterranean would contribute to peace in the region as well as economic, social and cultural values.

2.4. Fourth Environment Action Programme (1987-1992)

In the fourth Environment Action Programme, covering the period 1987-1992, The Single European Act, which entered into force on 1 July 1987, the projected foreseeing the development and implementation of the Union's environmental policy it was emphasized that environmental protection is a requirement of the economic and social development. Among the topics reviewed are detailed in this programme.

- The development of policies on the environment and avoid any kind of pollution that endanger human health;
- Identification of appropriate strategies in the management of natural resources;
- Moving to international cooperation in environmental protection;
- Effective implementation of the EIA Directive dated 1985 and the development of appropriate tools, such as raising the awareness of the public, take place.

The fourth programme is of particular importance in terms of the coverage period provided for the creation of the European internal market. Because one of the barriers (technical barriers) in the internal market was about the environment. Therefore, in the fourth programme, it was emphasized that to produce high quality products and services and without creating pollution is required both the creation of the European internal market and to be competitive in international markets [11].

2.5. Fifth Environment Action Programme (1993-2000)

With the main theme "Towards Sustainability" and implemented during the period 1993-2000, the basic framework of the Fifth Environment Action Programme was determined by the idea of integration of the environment to economic and social development policies. It is also main idea of the United Nations Conference on Environment and Development which was held in Rio in 1992. Objectives of the Fifth Programme can be outlined as follows:

- The principle of sustainable development;
- Responsibility is shared by all sectors;
- Industrial, energy, transport, placing a special emphasis on agriculture and tourism sectors.

With the aim of the realization of the sectoral integration with the most important elements are prominent in Action Programme, the first four programmes discussed in this programme while maintaining the validity of legal instruments as the basis, so far these are the protection of the environment by emphasizing that they are not at the desired level of effective legal instruments economic instruments for environmental management as well as environmental impact assessments, management systems and product policies such as the implementation of new approaches is foreseen. For this purpose the traditional measure and control tool in the Union's environmental policies and the fifth programme, it is seen to be a shift to market-based economic instruments. such as carbon taxes and voluntary agreements (Eco-label) [12].

Basic environmental issues covered in this programme include:

- Climate change;
- Acidification and air quality;
- Nature conservation and biodiversity;
- Management of water resources;
- The urban environment;
- Coastal areas;
- Waste management.

In the Fifth Action Programme, local governments were considered important especially in terms of environmental protection authority. Citizens, non-governmental organizations, professional associations, private sector representatives were considered as actors of environmental policy [13].

In addition to these issues in the programme, issues on risks arising from industry and chemicals such as industrial accidents, nuclear safety, radiation protection and environmental emergencies goals and principles have been identified. The most important feature of this new strategy; All decisions relating to the Union's environmental and sustainable development, and implementation of action, ensuring the widest possible degree of citizen participation and the decisions of the transparency principle is expected to take place in an appropriate manner. For this purpose, it is seen that there has been special attention to shared responsibility in general among the Union/national or regional government/local or regional government/entrepreneurs/consumers [14]. In the fifth programme, the concept of sustainable development has also been raised for the first time.

2.6. *Sixth Environment Action Programme (2001-2010)*[15]

The slogan of Sixth Environment Action Programme, which was planned to span between years of 2001-2010 but concluded in July 2012, was defined as “Environment 2010: Our future, Our Choice”. At a first glance it seems to have a longer term rather than its predecessors, as it’s designed to cover a 10 years but lasted 12.5 years. The Programme emphasise that it doesn’t just target to preserve the environment for ourselves and future generations but also aims to improve citizens’ life standards. Targets were set in four different areas to meet demands for basic environmental priorities by this programme. Some of these targets were scheduled. These areas are as below:

1. Climate Change: To be a part of Kyoto Protocol in 2002 and to fulfil the commitments of decreasing the amount of greenhouse gases by %8 related to their 1990 levels between years of 2008-2012 according to 1998 Council Decisions. To reach this target, it is envisioned to take reducing measures in main sectors like energy, industry, transportation and fields like building heating systems, agriculture and waste management. In the evaluation of Sixth Programme which can be found in Commissions webpage for Draft of Seventh Programme, it is stated that this objective will be exceeded by 2012.

2. Nature and Biodiversity: Protection and restoration of natural systems functions, preserving biodiversity both in the Union and global level, protection of soil against erosion and pollution. Again, the evaluation of Sixth Programme stated that total ratio of Natura 2000 sites in comparison with total Union area were reached to %17, yet target for decreasing loss of biodiversity couldn't be reached by 2010 and "Soil Framework Directive" couldn't come into force.

3. Environment and Health: To achieve a quality of the environment which does not give rise to significant impacts on, or risks to, human health and environment. In the evaluation of the Programme, it was stated that "2004-2010 Environment and Health Action Plan" was helpful for raising public awareness for air, water pollution and chemicals; comprehensive legislation have been implemented about chemicals, pesticides and water; and there is a decrease in levels of SO2 (sulphur dioxide), NOx (nitrogen oxides) and amount of lead in air.

4. Natural Resources and Wastes: To ensure that the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment. Preventing wastes and increasing efficiency of resource consumption for economic development in the first place. In the evaluation of the programme, it was stated that the bond between waste policy and resource policy have been strengthened; waste management gained strength and policies for sustainable consumption and productivity are successful.

In the new Programme some strategic approaches defined to make a progress in these related fields. These are shortly:

- Showing an innovative approach in environment policy and seeking new ways for cooperation with the large segment of the society;
- Improving implementation of current environment legislations;
- Deepening the harmonization of environment policy with other policies;
- Developing further sustainable production methods and consumption habits;
- Providing qualified and accessible information to shape (and affect) citizens conception and behaviour about environment;
- Ensuring protection and improvement of environment in Member States' decisions in the field of land usage and management.

This new Programme represents the environment stage of Union's sustainable development strategy, and also emphasises that all parts of society must actively involve and take responsibility to develop innovative, applicable and sustainable solutions regarding to encountered environmental problems.

Another issue taken into account by Sixth Environment Action Programme was that Environment 2010 will include a time phase which new member states will join EU. As Central and Eastern European Countries with Malta and Greek Cypriot State becoming Member States, EU will gain an additional population of 170 million and enlarge its land area by %58. This situation brings up a special condition that, these new Member States will have unexploited natural structure and rich biodiversity in addition with new environmental problems which EU will need to overcome. In this regard, it is foreseen that this new programme shall have an important function to solve environment problems of new Member States which will join to the Union.

2.7. Seventh Environment Action Programme (2014-2020)[16]

The slogan of the 7th Environment Action Programme is "Living Well Within the Limits of Our Planet", and it aims 31 December 2020, adopted by the European Parliament and Council, and published in the Official Journal of the EU on 28 December 2013. It can be seen that, the economic crisis and the employment problem encountered in many EU Member States became very important in developing this programme.

It is stated that the programme is based on polluter pays principle, precautionary principle, preventive action principle and the principle of environmental pollution should be rectified at source.

The need for public institutions in all levels to work together with business world and social cooperatives, civil society and individual citizens in implementation of the programme is emphasized.

It is stated that the implementation the programme will be monitored by the Commission. It is envisaged that this monitoring will be before 2020, should be based on the Environment Status Report of European Environment Agency and sharing these information's with the public opinion.

The 7th Environment Action Programme has been prepared by taking into account the four issues listed below:

1. Although there are developments in some areas, the important environment problems still exist;
2. The Europe 2020 Smart Sustainable Inclusive Growth Strategy, which guides the development of Union's 2020 Policies, is ratified;
3. Many Member States are in economic crisis so that the need for the structural reforms will bring new opportunities for European Union transition to an inclusive green economy;
4. The Rio+20 emphasized the importance of global extent.

The 7th Environment Action Programme aims to contribute an environment policy where the Union's natural capital is protecting and enhancing, the health and welfare of the citizens is protecting and the resource-

efficient low-carbon economy is envisaged. With determining 9 priority objectives for EU and Member States to achieve, the Programme determines an inclusive framework for the 2020 environment policy. These 9 priority objectives are listed below.

1. To protect, conserve and enhance the Union's natural capital

It is stated in the programme that, the natural capital includes ecosystems that provide essential goods and services, from fertile soil and multi-functional forests to productive land and seas, from good quality fresh water and clean air to pollination, food control and climate regulation and protection against natural disasters. It is also emphasized in the programme that, according to current considerations, the biological diversity of EU has decreased and many ecosystems have experienced serious damages. It is stated in the programme that, the water quality, marine environment, air quality, soil quality are not at the desired levels. So, the listed actions are envisaged in the programme by 2020:

- The decrease in biological diversity and the damage in ecosystems will be stopped and ecosystems will be protected and enhanced;
- The impacts of the pressures on clean, transboundary and coastal waters will be decreased to a great extent;
- The pressures on sea waters will be decreased;
- The impact of air pollution on ecosystems and biological diversity will be decreased;
- The Land at the Union level will be managed sustainably, the soil will be protected enough and the polluted areas will be cleaned;
- The nitrogen cycle will be managed more sustainable and resource-efficient;
- The forests will be protected.

2. To turn the Union into a resource-efficient, green and competitive low-carbon economy

It is seen as the most important objective that reflects the soul of 7th Environment Action Programme. A solution is sought by using the sources efficiently and effectively within the frame of the "competitive" and "innovation approaches, for the economic crisis in the Union and the unemployment problem in parallel with this. For this purpose, with referring to the Union's "2020 Resource-Efficient European Strategy"; by means of using all resources, separating the economic growth from resources and energy usage and its environmental impacts, decreasing the greenhouse gas emissions, strengthen the efficiency, innovation, competitiveness and promoting more energy security; transition of the economy is envisaged. So that, the issues listed below are emphasized:

- To improve environmental technologies where innovation that uses resources efficiently and effectively is required for a competitive economy in the context of rising resource prices and raw material supply constraints;
- Transformation to a low carbon and resource- efficient economy will bring new job opportunities. For example, the renewables sector alone is expected to generate more than 400 000 new jobs by 2020;
- The need for urgent improvements of efficiency in order to achieve Union's objectives of reducing greenhouse gas emissions 20 % below 1990 levels by 2020, enhancing renewable energy percentage to %20 and meeting the 20 % energy efficiency.;
- Since 80 % of environmental impacts arising from the product itself, originate in its design phase, the European Union policy should ensure that priority products placed on the EU market are 'eco-designed' with a view to optimizing resource and material efficiency, and taking into account the recyclability, recycled content and long product lifespan;
- Reach the target of applying green procurement percentage to at least 50 % of public tenders;
- The recyclable types of the wastes generated should gain to economy before going to the landfills. On average, 40 % of solid waste is prepared for re-use or recycled. More than 70 % of solid waste generated in some member countries is recycled, whereas in some member countries landfill 75 % of their municipal waste. In this way, resources will be used better, new markets will be opened, new employments will be created and the dependency on raw material importation will be reduced;
- Resource efficiency should be taken as one of priority subjects in the water sector. In spite of the impact of drought and water scarcity experienced in many regions in Europe, an estimated 20-40 % of Europe's available water is being wasted through leakages in the distribution system.

For this reason, the actions need to be taken under this heading by 2020 are listed below:

- The European Union will met its 2020 climate and energy targets and is working towards reducing by 2050 Greenhouse Gas emissions by 80–95 % compared to 1990 levels. With this, the European Union puts forward a target (2050) that is beyond the year 2020 which is the completion date of this programme;

- The total environmental impact of all major sectors of the EU economy will be significantly reduced and resource efficiency will be increased;
- The total environmental impact of production and consumption in the food and mobility sectors will be reduced;
- Waste will be safely managed as a resource;
- Water stress in the European Union will be prevented or significantly reduced.

3. To safeguard the Union's citizens from environment-related pressures and risks to health and well-being

It is stated in this objective of the programme that, European Union environment legislation has delivered significant benefits for the health and well-being of the public; however, water pollution, air pollution and chemicals still remain among the general public's top environmental concerns in the EU. It is also stated in this objective of the programme that, a substantial proportion of the Union's population remains exposed to levels of air pollution exceeding World Health Organization (WHO) standards; Access to adequate water quality still remain as a problem in many rural areas in EU; Horizontal chemicals legislation (REACH and CLP Regulations)[1] provides baseline protection for human health and the environment but there is still uncertainty about the full impacts on human health and the environment of the combined effects of different chemicals, nanomaterials, chemicals that interfere with the endocrine (hormone) system (endocrine disruptors) and chemicals in products; An estimated %40 of the EU urban population exposed to noise pollution levels exceeding World Health Organization (WHO) recommended levels.

To this end, the actions need to be taken under this heading by 2020 are listed below:

- Air quality in the Union will be significantly improved;
- Noise pollution in the Union will be significantly decreased;
- Citizens throughout the Union benefit from high standards for safe drinking and bathing water;
- Risks for the environment and health associated with the use of hazardous substances, including chemicals in products, will be minimized;
- Safety concerns related to nanomaterials are effectively addressed.

4. To maximize the benefits of Union environment legislation by improving implementation

In this objective of the 7th Environment Action Programme it is stated that, according to a research made in EU in 2011, the costs associated with failure to implement legislation is around EUR 50 billion and in 2009 alone there were 451 infringement cases related to Union environment legislation. Also it is stated that there are differences between member states related to the implementation of the legislation. Hence, it is emphasized that the enhancement of implementation of EU environment legislation in member states should be one of the important priorities in coming years. So, in order to maximize the benefits of EU legislation, it is envisaged to fulfil the matters listed below, by 2020.

- Accessing the explicit knowledge related to implementation of EU environment legislation by the EU citizens;
- Enhancing implementation of the determined environment legislation;
- Strengthening the respect to EU environment legislation in all management levels;
- Enhancing the support and the trust to EU environment legislation by the EU citizens.

5. To improve the knowledge and evidence base for Union environment policy

The visibility of EU environment policy is based on environmental monitoring, data, indicators and assessments related to the implementation of Union legislation including scientific research. Although many progresses have been made in this area, the need for the improvement of reliability in collection and quality of the environmental information and statistics is emphasized. Thus, these listed below are envisaged to fulfil by 2020.

- Policy makers and business man should have a better basis in order to enhance and implement environment and climate policies including measuring costs and benefits;
- Improvement of our understanding and ability in assessing and managing newly emerged environmental and climate risks;
- Strengthening the relation between environment and science.

6. To secure investment for environment and climate policy and address environmental externalities

[1] *REACH: Registration, Evaluation, Authorization and Restriction of Chemicals*

CLP: Classification, Labelling and Packaging

In order to achieve the goals of this target, both private and public sectors are needed. At the same time, it is stated that many countries are struggling to cope with the economic and financial crisis and needs economic reforms and the reduction of public debts to move towards a more resource efficient and low carbon economy. Attracting investment is difficult because of the absence of price signals.

The need for reflecting the environmental externalities to the prices and the implementation of the polluter pay principle is stated. In this regard, the issues that should be completed by 2020 are listed below:

- Achieving the environment and climate policy objectives in a cost-effective way and supporting by adequate finance;
- Increasing the private sector funding for environment and climate-related issues.

7. To improve environmental integration and policy coherence

Although integrating environmental protection concerns into other Union policies and activities has been an Amsterdam Treaty's requirement since 1997, it has not been sufficient to reverse all environmentally negative trends in EU wide. In order to achieve many goals in this programme, there is a need for integration of environmental and climate-related considerations into other policies. Effective implementation of the Strategic Environmental Assessment Directive and Environmental Impact Assessment Directives, integration of environmental protection requirements in plans, programmes and projects will be ensured. With this, both environmental impacts will be assessed and the natural capital will be protected and increased.

In order to achieve this goal by 2020, enhancing and implementing the sectoral policies at EU wide and member state level (energy, transport, industry, communication, agriculture, livestock and etc.) in accordance with the environment and climate goals and aims is the concrete target.

8. To enhance the sustainability of the Union's cities

The Union is densely populated and by 2020, 80 % of its population is likely to live in urban and peri-urban areas. Most cities will face a common set of core environmental problems, including low air quality, high levels of noise, water scarcity, floods and storms, contaminated sites and wastes. So there is need for European cities to put environmental sustainability at the core of their urban development strategies. This is in line with the commitment made at Rio + 20 to promote an integrated approach to planning, building and managing sustainable cities and urban settlements.

In order to achieve this objective, implementation of sustainable urban planning and design policies by most of the EU cities by 2020 is defined as a concrete goal.

9. To increase the Union's effectiveness in addressing regional and international environmental and climate-related challenges

In this objective of the programme, it is stated that the issues given in other objectives are already the globally or regionally accepted objectives, so with implementing this objective, the EU will be also implementing the global and regional objectives. Some of these are listed below:

- As accepted in Rio + 20, green economy is an important tool for the realization of sustainable development, and also plays an important role for the healthy environment;
- Reducing the greenhouse gas emissions %50 below 1990 levels by 2050;
- The global biodiversity targets laid down under the Convention on Biological Diversity (CBD) need to be met by 2020 as the basis for halting and if possible reversing the loss of biodiversity worldwide.

In order to achieve this goal, the listed issues in this programme are expected to be completed by 2020:

- Integration of Rio+20 decisions into EU's foreign policies and contribute to global efforts for the implementation of accepted commitments including provisions in Rio+20 Declaration;
- The EU subsidize to national, regional and international efforts in dealing with environment and climate problems and ensuring the sustainable development.

3. CONCLUSION

When each of the action programmes is examined, it is seen that they have brought new problems and discussion areas reflecting the specific conditions of their periods.

In the EU, within the framework of policies dedicated in each period of programme many legal arrangements have been put into force.

First two environment action programmes of the Union mostly cover the actions aiming immediate solutions of the serious problems arisen from the pollution. Restoration characteristic of this approach can also be seen in the third Programme in which preventive approach can also be seen. Fourth Programme by bringing wider perspective to the environmental protection, elaborated the environmental problems as the basic component of economic and social development. Fifth

Programme focused on the issue of the responsibility should be shared by all the sectors of society. Sixth Programme was likely the follow-up of the Fifth Programme.

Development of the European Union's environmental policies has been realized by the "Environment Action Programmes" which have been introduced in serial manner. After the enactment of each of the action programme, related legal texts have been put into force at EU level. Whereas first programmes have focused on restorative and preventive characteristics of policies like mitigating the pollution in drinking water resources and in the marine, phasing out lead in gasoline, and limiting the sulphur and nitrogen oxides emissions, following programmes have mainly addressed environmental protection issues in a broader perspective like river basin management, sustainable development, cleaner production, receiving media approach etc. Environmental policy of the EU has followed the path from prevention or mitigating pollution to the rational use of natural resources and conservation them without destruction.

It can be seen that, all action programmes including the last (seventh) programme have aimed at economic growth and welfare of the EU citizens. Anthropogenic environmental protection approach is still dominant in the programmes.

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Removal of Highly Polluted Wastewater by Electrocoagulation Process

F. İlter Türkdoğan [1], Gamze Dalgıç [2], Fatih İlhan

Abstract

Pharmaceutical industry is one of the industries which have many problems with the treatment of industrial wastewater. These problems arise from the variety of the products and the existing processes in the production of pharmaceuticals. As a result of the product range, the pharmaceutical wastewater is rich in organic matter and has intense color and high COD value. The pH, color and COD of the wastewater can differ depending on the applied process, the type and the amount of the product. At the same time, the biodegradability of the pharmaceutical wastewater is quite low. For this reason biological, chemical and physicochemical treatment technologies cannot always have high removal efficiencies. In the removal of COD, advanced oxidation processes are used frequently besides the traditional treatment methods. In this study, the removal of pollutants in the wastewater of a factory which produces paracetamol, a common analgesic and antipyretic drug, as a raw material was investigated by using electrocoagulation (EC) process. The parameters playing active roles (current, reaction time and electrode type) in the efficiency of the EC process was optimized. After the optimization of each parameter, removal efficiencies were calculated by the measurement of COD.

Keywords: paracetamol, pharmaceutical wastewater, electrocoagulation, reaction time, COD.

1. INTRODUCTION

The aim of the pharmaceutical industry is producing the drugs curing the humans and the animals. The most important common traits of these industries are the low product/raw material ratio and the variety of present processes used in drug production. These industries are also important in terms of pollution and the treatment of their waste is not so easy. Paracetamol (acetaminophen) (Figure 1), is an active pharmaceutical ingredient used a common analgesic and antipyretic drug. Paracetamol is absorbed rapidly in the gastrointestinal system when used orally. The drug reaches the maximum plasma concentrations in 30-60 minutes after being taken. Paracetamol disperses swiftly to all the tissues. The bonding to plasma proteins is weak. The plasma half-life is 1-4 hours. About 1-3% of paracetamol is thrown being unchanged by the urine. The main metabolites of paracetamol which are pharmaceutically unactive are glucuronide (55%) and sulphate (35%) [1].

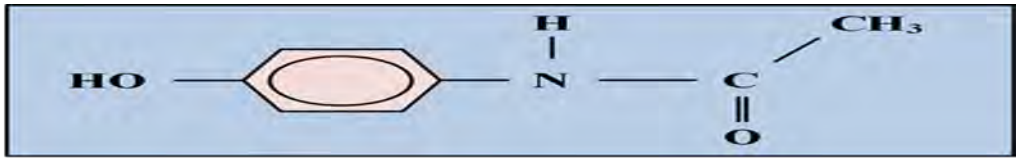

Figure 6. The molecular structure of paracetamol

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Paracetamol is a metabolite of a chemical named as phenacetine which had been used widespread in yesterdays. Phenacetine is not used nowadays because of the toxic effect and being metabolized to paracetamol [2]. Most of the pharmaceutical compounds cannot be destroyed by wastewater treatment or degraded biologically in the environment [3]. Effective techniques have been developed for their degradation to prevent their activity on the humans and the environment [4].

Electrocoagulation reactor, one of the developed techniques, consists of electrolytic cell having simply anode and cathode electrodes and DC Power Supply to which the anode and cathode electrodes are connected. This method takes part in the treatment plants for being used as direct or additional treatment which has been developed to overcome the disadvantages of the classical water and wastewater technologies.

Farhadi et al. [5] compared the efficiencies of electrocoagulation, photoelectrocoagulation, peroxielectrocoagulation and peroxi-photoelectrocoagulation processes in terms of chemical oxygen demand (COD) removal from pharmaceutical wastewater. COD removal efficiencies were found as peroxi-electrocoagulation > peroxi-photoelectrocoagulation > photoelectrocoagulation > electrocoagulation under the ideal process conditions. Hanafi et al. [6], studied the treatment of olive mill wastewater by electrocoagulation. The effects of the parameters such as electrolysis time, NaCl concentration and current density were investigated and it was found that the discoloration of the olive mill wastewater, the reduction of the chemical oxygen demand and the reduction of polyphenols overpassed 70%.

In this study, the treatability of the wastewater belonging to a factory producing paracetamol, having a complex structure, was determined using a lab-scale reactor by electrocoagulation method which is one of the advanced treatment technologies recently used and the optimization study was performed for various operating conditions.

2. MATERIALS AND METHODS

The wastewater was obtained from a pharmaceutical factory producing paracetamol. The main characteristics of paracetamol wastewater is given in Table 1.

Table 1. The main characteristics of paracetamol wastewater

Parameter	Value
pH	**9-9,5**
KOİ	**36000-76800 mg/L**
BOİ5	**15120-21500 mg/L**

The experiments were conducted in two reactors (plastic plate) having the volume of 400 mL and the dimensions of 5.5 cm x 5.5 cm x 12 cm. Iron and aluminum electrodes had been used during the study. The dimensions of the electrodes were 18 cm x 5 cm x 0.5 cm and the spacing between electrodes was 4.5 cm. The reaction times were determined as 15, 30, 45 and 60 minutes. The main reason of this determination is the need for long-term treatment as the complicated contents of the pharmaceutical wastewater despite the short reaction time of the electrocoagulation process. TT-Technic DC power supply MCH-305D-2 was used as the power supply source during the study. Various current densities as 4 – 8 – 12 – 16 - 20 (A/m2) were applied, the current values and the electrical potential values in the water are given in Table 2.

Table 2. Current density, current and electrical potential used in the study

Parameter / Run	Current Density (A/m2)	Current (A)	Electrical Potential (V)
1	**4**	**0.44**	**4.8**
2	**8**	**0.88**	**6.8**
3	**12**	**1.32**	**8.7**
4	**16**	**1.76**	**11.4**
5	**20**	**2.2**	**14**

The evaluations were made based on the COD removal by using different types of electrodes (iron and aluminum).

3. RESULTS AND DISCUSSION

Each reaction time was studied as different runs. The electrical current was cut at the end of the reaction time and the sample was put in a different cell for settling. Afterwards, sample was taken from the supernatant and the required analyses were performed over this sample.

3.1. Selection of the electrode type

Selecting the electrode providing the best efficiency was aimed by studying with two different electrodes (Al and Fe).

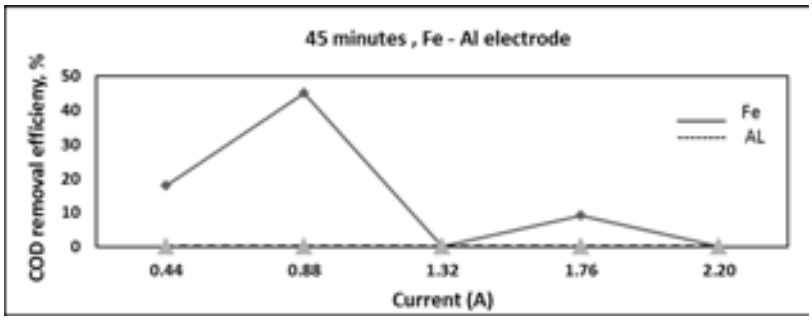

Figure 7. COD removal efficiencies of Al and Fe electrodes for different currents (reaction time 45 minutes)

As seen in Figure 2, the best removal efficiency was obtained from the Fe electrode for the current of 0.88 A and the reaction time of 45 minutes. For the Al electrode, the pollution load had increased instead of COD removal, in contrast with the Fe electrode. For this reason, Fe electrode was preferred for the next studies.

3.2. Selection of the current density

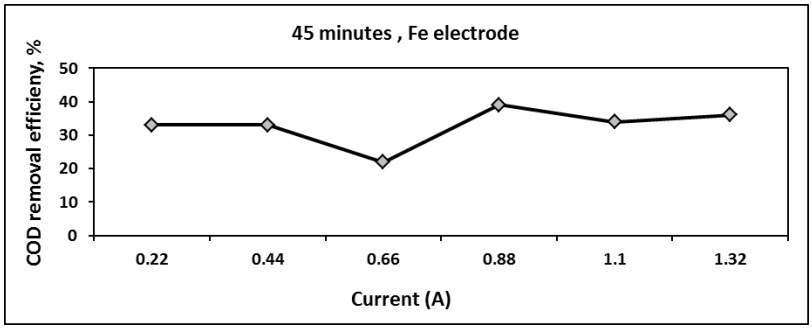

Figure 8. COD removal efficiencies of Fe electrode for different currents (reaction time 45 minutes)

As seen in Figure 3, the current of 1.76 A and the reaction time of 45 minutes formed the experimental conditions providing the best COD removal.

3.3. Selection of the reaction time

One of the other factors for the optimization of the treatment methods is the reaction time. Long-term treatment can be very costly even if it is effective. On the other side, short- term treatment cannot ensure effective efficiencies.

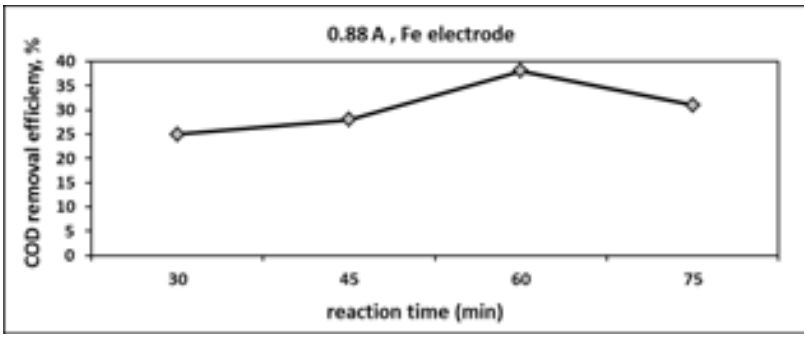

Figure 9. COD removal efficiencies of Fe electrode for different reaction times

4. CONCLUSIONS

It was concluded that the COD removal efficiency could be about 40% in the pre-study performed for the treatability of paracetamol wastewater having high and unstable pollution load by using EC process. The obtained data of the study indicated that EC process could be used as a pre-treatment or ultimate treatment method for this kind of wastewater.

ACKNOWLEDGMENTS

The authors would like to thank Research Project Coordinator of Yildiz Technical University for supporting this study financially under the number 2011-05-02-KAP03 and also the factory for providing the wastewater. We also express our great sorrow for the death of dear professor and one of the members of our project group, Ferruh Erturk, on 08.24.2011. He was a great scientist and at the same time he was a great person with humanity and warm kindness to all of us. The authors have declared no conflict of interest.

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The Effect of River Type Hydroelectric Power Plants on Aquatic Ecosystems: the Case Study of Göksu River-Eastern Mediterranean

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Abstract

The contribution of the hydropower energy potential to the reconstruction of the energy structure is very important in Turkey. In spite of numerous social and economic benefits experienced in the area in social and economic spheres due to the project, there is also a plurality of adverse impacts observed in the environment. In social and economic spheres, the land acquiring and resettlement of people are important issues. Large-scale irrigation causes salinization and leads to soil erosion; huge water reservoirs affect local climate and are a source of considerable amounts of pollution. The construction and operation of hydroelectric power plants is directly related to the flow of the river. Therefore, environmental flow is described as the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems. Environmental flow estimation is considered as a safe guard for an aquatic ecosystem in the water basins with regulated flow regime. Environmental flow not only the self purification flow to fulfill the water quality demand, but also the flow demand for the existing aquatic lives. Natural flow regime is critically important in sustaining the natural biodiversity and ecosystem integrity in river basins.

The maintenance of the flow regime was considered to be one of the objectives, while meeting the domestic, agricultural and hydropower demands was the second objective. Thus water management over the past century has largely been important issue, large-scale diversions of water out of natural systems. Growing populations and life style choices are putting greater pressure on the world's limited fresh water systems. Construction of dams and hydroelectric power plants development projects will likely continue. As a result, legal and policy frame works for protecting and restoring them also continue to develop, and various governmental agencies, community-based organizations, private-sector actors, and individuals are becoming involved with implementing and monitoring these flows.

This research estimates the environmental flow requirements in the Göksu River in Eastern Mediterranean and to understand the impact of hydroelectric power plant in maintaining the natural flow regime. The current operation policy can cause severe hydrological alteration in the natural flow regime so current status and calculated amount of flow are compared

Keywords: Dams, ecosystems, environmental flow, hydroelectric power.

1. INTRODUCTION

The environmental damage caused by hydropower schemes has become increasingly apparent over the last decade or so.

Changes to river flows are one of the key consequences of the construction of dams and/or hydroelectric power plants. Maximizing the electricity output of a hydropower plant according to demand can have serious

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consequences both for ecosystems and other users, as flow conditions downstream of the plants are altered. However, in many cases it is possible to adjust the operational regime of a dam to better meet a variety of needs. So called 'environmental flows' provide critical contributions to river health, economic development and poverty alleviation [1].

Total economic hydroelectric power potential of Turkey is 129.5 TWh/yr by the end of February 2007. 35.5% of this potential is in operation while 11.1% and 53.4% of this potential are under construction and in various design level, respectively [2].

Turkey is an energy-importing country. In order to be less dependent on other countries, Turkey needs to use its sustainable sources. From this point of view, hydropower is a very attractive choice, since it is economical, sustainable, and environmentally friendly and it is a publically familiar source of energy in Turkey [3].

Environmental flow is regulated in order to contribute to river basin planning. Environmental flows can include some restrictive and active management such as dams planning, reducing irrigation and water supply. This management can be applied in various situations such as low and high flow regime, particularly during dry periods. The EFA finds the optimal balance between ecosystem and the various utilizations such as water use and regulation of flow within a river, wetland or coastal zone. There are adverse effects of a time-varying flow regime over the ecosystem [4]. The influence of climate change, decreasing river flows, degradation of the river bed, flow regulations, agricultural and industrials activities and human use cause the change of deterioration of the natural conditions of the rivers. Aquatic organisms that are using river as habitat are affected by these negative effects. The EFA approach was developed to establish balance between ecological concerns in the context of the river ecosystems and sustainability and requirements of modern world. If the river flow has been greatly influenced by the human activity and natural, such as reservoirs, channels and urban diversion, erosion, these will limit the application of the hydrological methods. Because of the erosion, the shapes of the cross sections are changing continuously, especially in the lower reaches. The natural flow regime consists of flow magnitude, frequency, timing, duration and rate of change of flows. In order to protect the ecological functions it is important to maintain a semblance of the natural state of each component of the flow regime as each of these components contributes towards maintaining critical instream ecological functions [5]. The major problem in the management of rivers has not been protection and use balance over the water resources Management problems normally exacerbate during low-flow periods and with on-going water resources development resulting in gradual reduction of flow available for instream uses[6].

Instream flows are usually referred as environmental, minimum or maintenance flows that guarantee a sufficient level of protection for the aquatic environment in regulated rivers. Various types of environmental flow methodologies have been proposed in different region of the world to secure particular environmental needs. Flows that led to a enough level of protection for the aquatic environment in rivers are usually name as environmental, minimum or sustainable flows. During the last few decades numerous methodologies have been developed to establish environmental flows in regulated rivers. These methodologies can be grouped in four categories (Tharme 2003) described which could be differentiated into hydrological (Hydrological or historic flow methods[5]. They are based on the study of historical flow regime records, for instance, the Tennant (1976) method determines the environmental flow as a percentage of the mean annual flow.), hydraulic rating(These methods are based on the study of the hydraulic geometry of stream channels (cross-sections), habitat simulation and holistic methodologies. These methods have been used by many researchers and they highlighted that the one of the most common method is the Tennant method and modified Tenant method [7], 7Q10, Q95 [8, 9], wetted perimeter method which can use both hydrological and ecological data [10]. A comparison of the approaches for instream flow methods were explained in some detail [11]. Application of the hydrologic and hydraulically derived geometric parameters was evaluated to determine the minimum water requirements of ecological habitats [12]. All these methodologies, independently of the advantages and disadvantages they may have and their theoretical foundation, have a common characteristic that usually make them difficult to apply, which is the need of a large amount of data. Due to the small data requirement, hydraulic rating methods are widely applied. But the relationships are also concluded from natural rivers. It may fail to assess ecological base flow in regulated river using hydraulic rating methods. Long-term high-quality information on hydrological or hydraulic parameters, or habitat preference data, is rarely available. Hydraulic and habitat simulation methods demand intensive field work and sometimes long periods of time for their correct implementation [5, 13].

The objective of this study is to compare four commonly used hydrologically based instream flow assessment methods. Environmental flows is calculated in the hydroelectric power plant on the Göksu river to using five hydrologically based methods. The recorded average daily flow data at the downstream point, Göksu river for 18 years (1995-2013) was analyzed in two periods from 1995 to 2013 as pre-hydropower plant construction and 2010-2013 as post-hydropower construction to obtain the flow alteration at the measuring station due to hydropower development in the river.

2. STUDY AREA

The Göksu river is located in Eastern Mediterranean basin (Turkey). The basin covers the provinces of Antalya, Konya, Karaman and Mersin.

The river is 260 km long and discharges into the Mediterranean Sea 16 km south east of Silifke (in Mersin province). Akgöl Lake and Paradeniz Lagoon are within the delta of the Göksu. The location of the study area in the basin are shown in Figure 1.

The recorded average daily flow data of 18 years (1995-2013) at the downstream point of Göksu river was analyzed in two periods from 1995 to 2013 as pre-hydropower plant construction and 2010-2013 as post-hydropower construction to obtain the flow alteration at the measuring station due to hydropower development in the river.

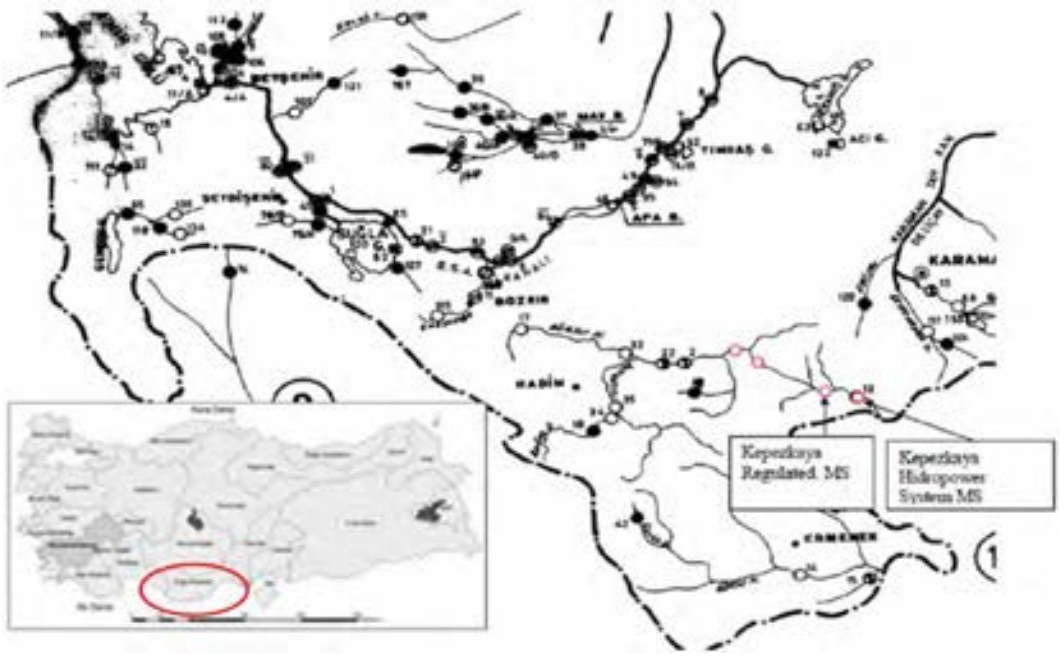

Figure 10. The location of study area

3. METHODS

Some methods, which are considered as hydrological and hydraulic methods, were examined to generate the environmental flow as explained above. These methods are 7Q10, Q95, the original Tennant method, modified Tennant method. These methods are summarized as the following.

3.1. 7Q10 Method

Daily river flows in the 7Q10 range are general indicators of prevalent drought conditions which normally cover large areas. The river flows that occurs over 7 consecutive days and has a 10-year recurrence interval period, or a 1 in 10 chance of occurring in any one year. 7Q10 values are also used by the U.S. for regulating water withdrawals and discharges into streams [9, 10, 14]. According to U.S. Fish and Wildlife Service the 7Q10 flow is a flow statistic used in identifying the volume for dilution to set permit limits for wastewater discharge so it does not cover the habitat alterations in rivers [14].

3.2. Q95 Method

The exceedance percentile Q95 can be interpreted as the flow discharge which can be expected to be exceeded 95% of the time. The index is sometimes described as one from Look-up table method that is using the flow duration curve of a river. Q95 index of natural low flow has been employed to define the environmental flow and the flow that is equaled or exceeded for 95% of the time. The Q95 index was determined solely by the hydrological data. However, the implementation of this method often requires the use of ecological information. Q95 index may be used to determine the dry periods such as the mean annual minimum flow [5, 11].

3.3. Original Tennant Method

It was developed by using historical data of 11 rivers in the states of Montana, Wyoming, and Nebraska in the USA to determine minimum flows to protect the aquatic life in rivers. Percentages of the mean annual flow are identified that provide different quality habitat for fish e.g. 10% for poor quality (survival), 30% for moderate habitat (satisfactory) and 60% for excellent habitat over two certain periods of the year for instance, October to March (6 mounts) as wet period and April to September (6 mounts) as dry period. This method can be used elsewhere, but there are some important issues about using this method in other areas. The method directly can be used for other areas if there are morphological similarities with other rivers. Otherwise application of this method directly is not recommended whereas the modification of this method is possible to simulate the aquatic life in other rivers [7,11].

3.4. Modified Tennant Methods

Modified Tennant method is different from original Tennant method that the selection of the periods may be different. The average flow of the river was determined by the means of 18-year data and 15% of the daily mean flow has been applied for wet period whereas 20% was for dry period [15].

4. RESULTS AND DISCUSSION

For the station some statistics such as minimum, maximum and standard deviation of the daily mean flows is given in Table 1.

Table 1. Some statistics for the station

Month	Min	Max	STD	Mean
O	2.55	29.5	1.78	8.14
N	1.14	145	12.04	13.45
D	1.14	247	29.60	27.72
J	6.16	124	16.70	23.44
F	9.02	163	19.50	32.50
M	10.5	340	31.15	52.74
A	9.56	226	38.20	62.30
M	7.78	124	17.35	29.80
J	2.75	33.8	3.40	11.90
J	2.13	22.7	1.57	8.40
A	1.2	14.8	1.14	7.44
S	1.08	13.4	1.19	7.25

Daily average flow of the river is well illustrated in Figure 2. According to daily average flows data, 30 percent of 20-year daily flow data has exceeded the average flow and 50 percent of 20-year daily flow data has exceeded the median flow.

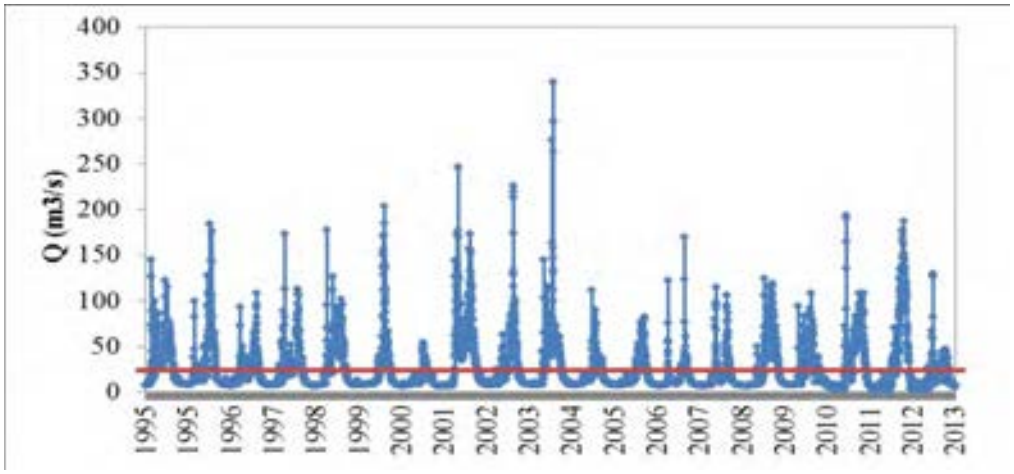

Figure 2. Flow time series

Figure 3 shows the flow duration curve of the river. The result of the Q95 method is derived from Figure 3 and calculated as to 7.22 m^3/s as the flow rate which is exceeded 95% of the time.

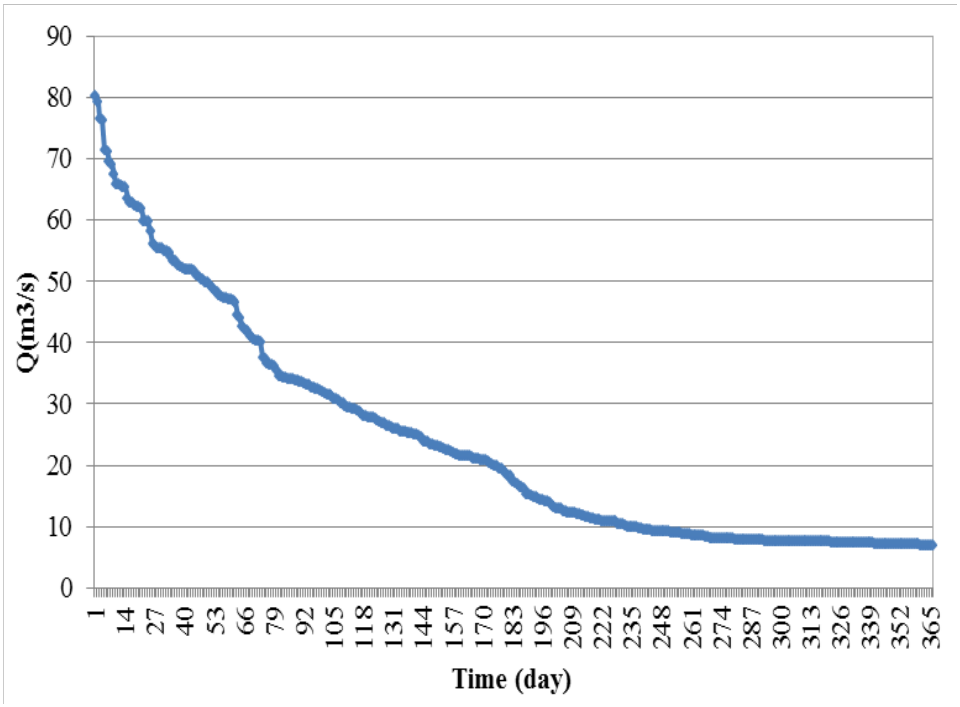

Figure 3. Flow Duration Curve

The monthly average flows are shown in Figure 4 Due to average and median flows are calculated for the estimating the environmental flow. In Figure 4 flow rate that plot above the average flow is accepted as wet period and below the average flow is dry period from which is indicated in the part of the modified Tennant method. Wet and dry periods, which set for each station, are provided in the Table 2.

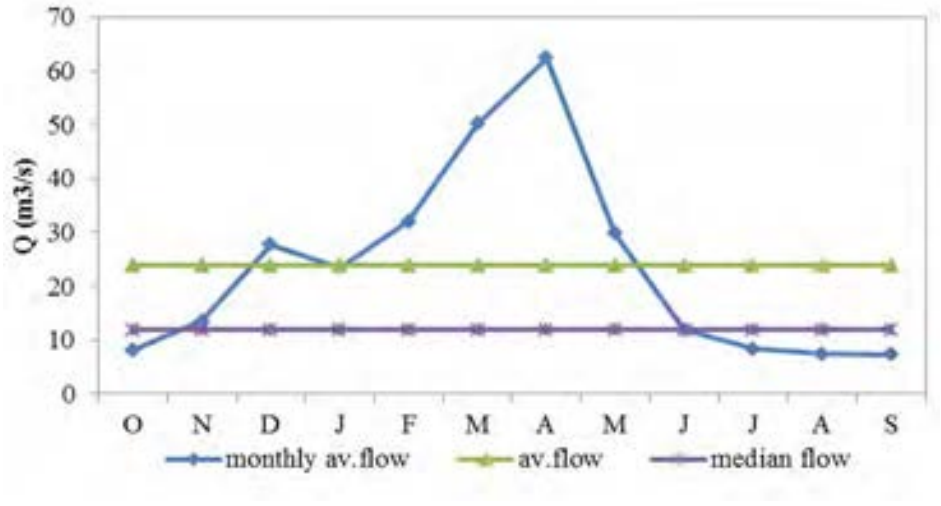

Figure 4. Monthly average flows

Table 2. Modified Tennant Method periods

Qaverage	From December to May (%15)	From June to November(%20)
Qmedian	From November to May (%15)	From June to October (%20)

The results of environmental flow with various methods are given in Table 3 where as the relationship between monthly incoming flows and release flows are given in Table 4 for the year of 2010-2013 periods. In order to compare them that must be in the same time period. For this, monthly incoming flows and release flows shown in Table 4 are the flows that exist in the river for the year of 2010-2013. Difference row of Table 4 shows the amount of water used for hydroelectric generation purposes.

Table 3. The results of environmental flow with various methods

	Flow rates by months (m^3/s)											
	O	N	D	J	F	M	A	M	J	J	A	S
Monthly Qav	8.14	13.45	27.72	23.44	32.5	52.74	62.32	29.8	11.9	8.4	7.44	7.25
Qav	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8
Qmed	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
7Q10	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)
Q_{95}	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)	7.22 (+)
Original Tennant Method	3.9 (+)	3.9 (+)	3.9 (+)	3.9 (+)	3.9 (+)	3.9 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)	4.23 (+)
Modified Tennant Method(by Qav)	1.88 (+)	1.88 (+)	5.64 (+)	5.64 (+)	5.64 (+)	5.64 (+)	5.64 (+)	5.64 (+)	1.88 (+)	1.88 (+)	1.88 (+)	1.88 (+)
Modified Tennant Method(byQmed)	1.72 (+)	5.12 (+)	5.12 (+)	5.12 (+)	5.12 (+)	5.12 (+)	5.12 (+)	5.12 (+)	1.72 (+)	1.72 (+)	1.72 (+)	1.72 (+)

(+) This amount of water is below baseflow, so, can be supplied by Monthly Qaverage

As it can be seen in Table 3, (+) indicates sufficient amount of water can be provided as environmental flow. When this situation is taken into consideration, all methods shows that environmental water flow exist in all months of the year. However for dry period, Modified Tennant methods have low values which cannot be assumed as environmental flow. Moreover the values which were calculated by Tennant methods were observed to be lower than the baseflow (7.25 m3/s). In this case the flow amounts which remain lower than the base flow (which used to be evaluated as life water) are not suggested as environmental flow.

In the method which was suggested by Tennant in 1976 [7], water year was divided into two, as wet and dry periods. In modified Tennant method, if many factors such as hydrological and climatic properties of basin and river are taken into consideration it will not be meaningful to apply the original Tennant method directly to all rivers. When the flows that are supposed to exist in river system and the average flows in original Tennant method are checked, water deficiency is not observed in whichever months. In modified Tennant method according to average and median flow water deficiency is not observed. Environmental flow is calculated as 7.22 m3/s using Q95 method. This value almost equals to baseflow. So, water deficiency can be observed especially in 2 months (Aug, Sep). Water should not be taken from river system in months that of water deficiency.

Table 4. Relationship between incoming flow and release flow (2010-2013)

	Flow rates by months (m^3/s)											
	O	N	D	J	F	M	A	M	J	J	A	S
Monthly Qav	6.73	7.16	31.6	21.56	28.32	57.66	79.41	47.33	12.52	7.47	6.2	5.83
Release flow	2.5	2.63	17.61	3.25	4.05	21.93	43.76	15.87	2.61	2.43	2.85	2.43
Difference (Monthly Qav-Release flow)	4.23	4.53	13.99	18.31	24.27	35.73	35.65	31.46	9.91	5.04	3.35	3.4

When current status and calculated amount of flows are compared to one and other, the Tennant Methods are not suitable for the river because of calculated values much lower than those of average and median flow value. In current conditions, released flow values are low for some months. Although, the released flows are seemed to be appropriate comparing to some methods used in this investigation, it might be suggested to increase release flow up to some value towards the average monthly flows of the river.

5. CONCLUSION

Hydropower potential is an attractive solution for energy need because of being a clean way of energy generation. Hydropower plants are the large-scale water management program aiming to increase the domestic electricity production and develop vast irrigation schemes for agriculture. There are 25 hydrological basins in Turkey, Turkey has great advantages from the view point of hydropower potential without storage and hydroelectric energy which is a clean and renewable energy source rise in importance day by day due to its domestic energy resource feature to meet Turkey's electricity energy need.

Many reasons such as limited water sources throughout the world or the decrease in usable water amount requires more attention for the management of the water sources. The necessity to maintain the sustainability of water in long term against increasing water demand placed integrated water source management to forefront.

In this case environmental flow evaluation studies constitute the base of integrated water sources management. The environmental flow evaluation studies aim to minimize the pressure and effects on a river while maintaining the balance between using and preserving thus ensuring the effective usage of water. Environmental flow evaluation may vary from country to country and even in different basins within the country. Therefore environmental flow evaluation should be made specific to each river in the basin.

ACKNOWLEDGMENT

Presentation of this research has been financially supported by the Scientific Research Project Fund (BAP) of Selcuk University, Konya-Turkey.

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A Thermal Change for a Heat Exchanger Cooling System of PCM

***Numan Yüksel*[1]**

Abstract

A current study is presented in which a real-size room at daytime is cooled by a heat charge and discharge in a latent-heat-storage unit of phase changed materials. The unit is designed as a shell-and-tube heat exchanger. The tubes are vertical and filled with a phase-change material. The PCM melts and the room air is cooled down to a comfortable level, which lasts as long as the PCM is melting. While the ambient temperature changes from 35◦C to 45◦C, the comfortable time and variations are analytically calculated. Some cases are considered: an insulated room, a room heated by the ambient. By using the averaged values defined for the phase changed materials, the obtained analytical calculations and solutions are carried out with the available data in the literature. It is shown that the present theoretical study results related to the cooling using ambient temperature and the different parameter will have an effect on the time of cooling.

Keywords: Phase Change, Energy Storage, Cooling Time and Heat Exchanger.

1. INTRODUCTION

Many studies about the energy problems and solutions have been reported. The problems can be solved by using thermal energy storage. Several theoretical and experimental investigations were devoted to modelling the thermal performance of the storage units and phase changed materials (PCM) [1-6], the different phase change materials, investigation of new geometries, and new concepts/ for energy storage technology. In these studies, the effects of various working parameters, the storage time, the efficiency of system and phase changed materials were investigated.

Thermal storage units are used for domestic, waste, vehicle heating or cooling in systems characterized by different temperatures in the daytime and cool nights. During the day the PCM absorbs heat in it and melts, and then it releases its latent heat to the ambient while at night/different times. So, a PCM-based unit in air conditioner decreases considerable energy consumption and solves an energy problem in its operation.

Units of similar and different structure have been investigated in the literature. Farid and Kanzawa [7] theoretically investigated a shell-and-tube heat exchanger unit based on thermal storage. The air of system was flowing in the shell across the tubes filled with PCM. The performance of the unit improves by using different PCMs in the same unit. However, Lacroix [8] investigated numerically and experimentally the PCM stored in the shell and the heat-transfer fluid circulated inside the vertical tubes in a shell-and-tube unit. Turnpenny et al. [9,10] studied a unit utilized as a ventilation cooling system in buildings and used a heat pipe embedded in a phase-change material. Mozhevelov et al. [11] studied thin vertical storage units installed parallel to walls in a room. In daytime heat was free-convected from the room air, while at night heat was released from the unit into the ambient by both free and forced convection. Mozhevelov [12] also investigated simulations of a portable storage unit with cooling elements of various shapes in a shell: vertical plates, horizontal plates, horizontal square tubes in in-line and staggered configurations, and vertical square tubes in an in-line configuration. Arye and Guedj [13] experimented with a shell-and-tube unit, in which the tubes

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were vertical and filled with paraffin wax. The room air convected by fans through the shell. While the ambient temperature at daytime was 30 ◦C to 35◦C and at night, 18 ◦C to 19◦C. Mosaffaa et al [14] presented a comparative study for solidification of the PCM in cylindrical shell and rectangular storages having the same volume and heat transfer surface area. Vakilaltojjar and Saman [15] investigated the effect of slab thickness on a rectangular storage unit performance by using a semi-analytical method for phase change for air conditioning applications. Akgun et al. [16] experimentally carried out PCM melting and solidification in a shell and tube heat exchanger. Hosseini et al [17] studied experimentally and numerically thermal behavior and heat transfer characteristics of Paraffin RT50 as a phase change material (PCM) during constrained melting and solidification processes inside a shell and tube heat exchanger. Hosseini et al [18] investigated the effect of inlet temperature of the heat transfer fluid on melting process in a shell and tube heat exchanger numerically and experimentally. Agyenim et al. [19-22] investigated melting and solidification on a paraffin in a shell and tube heat exchanger for various operating conditions and geometric parameters. Erek et al [23] carried out experimental and numerical investigation of thermal energy storage with a finned tube. In this type of heat exchanger, PCM fills the annular shell space around the finned tube while the heat transfer fluid flows within the tube.

Due to the relatively low thermal conductivity of PCMs, many studies have been performed to improve the heat transfer in a storage unit. Zhang and Faghri [24] investigated the heat transfer enhancement in a latent storage system using a finned tube. Sciacovelli et al [25] analysed the melting process in a single vertical shell-and-tube latent heat thermal energy storage, unit and directed at understanding the effect of nanoparticle enhancement of the system.

It can be seen from the studies above, to understand the effect of ambient and the problems faced with sizing the thermal energy storage system, a simplified heat exchanger can be a good contribution and practical both in design and also in operation. Therefore, a shell-and-tube heat exchanger based on the PCMs is presented in this paper. This uses basic mathematical calculations to estimate total time of charging and discharging processes under constant or mean entrance conditions. Furthermore, the calculations are carried out for a latent-heat-storage unit utilized for temperature moderation of an enclosed space. In the examined case, a real-size room is cooled down to a comfortable level, which continues as long as the PCM is melting. The design of the unit and its mode of operation temperature determine the thermal change of PCM and the rate of air cooling in the room.

2. HEAT EXCHANGER SYSTEM DESIGN

In this study, a shell and tube heat exchanger unit selected in order to investigate the change of storage time for a latent heat storage system. Fig. 1 illustrates a picture and a schematic diagram of the unit, which consist of airflow through tubes, and the heat exchanger section based on PCM. Because most engineering systems use cylindrical tubes and heat loss from the shell and tube system is minimal. The shell-and-tube heat exchanger as a portable cooler is operated in crossflow. The tubes are vertical and the room air is fan-driven through the shell. PCM in vertical tubes is unmixed, airflow in shell is mixed. The external dimensions of the heat exchanger section are 1.35 m length (L), 0.21 m width (W) and 0.80 m height (H) [26].

The fans are positioned vertically and the overall length of the fans is 1.55 m. Also a fan which is 0.20 m length has been located centrally and height and width are the same as in the heat exchanger. In the fans, the velocity u_∞ of air outside the tube array is changed from 1.2 m/s to 2 m/s [26].

The dimensions of tubes are diameter (d) of 0.01 m; height (H) of 0.80 m. They are vertical, thin, and circular and are made of aluminum [26]. The square in-line configuration of the tubes is $S_p = S_n = 1.5 \times d$, as shown in Fig.2, where Sn is the tube pitch normal to flow and S_p is the tube pitch parallel to flow. The location of the tubes in the exchanger are indicated in Fig. 2, detailing as $S_p = S_n = 1.5 \times d$.

The external size of the exchanger determines by reducing 25%, 50% and 75%, except for the current size of a conventional air conditioner cooler.

The dimensions of a real room has selected as the following: height 2.5 m, length 4.0 m, and width 4.0 m [27]. The initial temperatures of air in the room is $T_{r,i}$ =35 ◦C, 37 ◦C, 40 ◦C and 45 ◦C. The room temperature at any instant is uniform (the room air is mixed). Radiation inside the room is ignored.

For simplification of calculations, all the thermophysical properties are assumed independent of temperature. The PCM is homogeneous and isotropic as both a liquid and a solid. The phase change material is a paraffin wax (RT-25 by Rubitherm). The thermophysical properties of the PCM are as follows: melting temperature Tm, 23◦C; specific enthalpy of melting h_m, 206 kJ/kg; liquid density ρ_l, 750 kg/m^3; solid density ρ_s, 800 kg/m^3; thermal conductivity k, 0.2 W/m K; specific heat capacity c_p, 2500 J/kg K [26].

In calculations, a real-size room is cooled at daytime by a unit in which the PCM melts at 23◦C, while the ambient temperature is changed from 35◦C to 45◦C. Then, the paraffin solidified at night, and thermal comfort is preserved in the room. The calculations are conducted analytically.

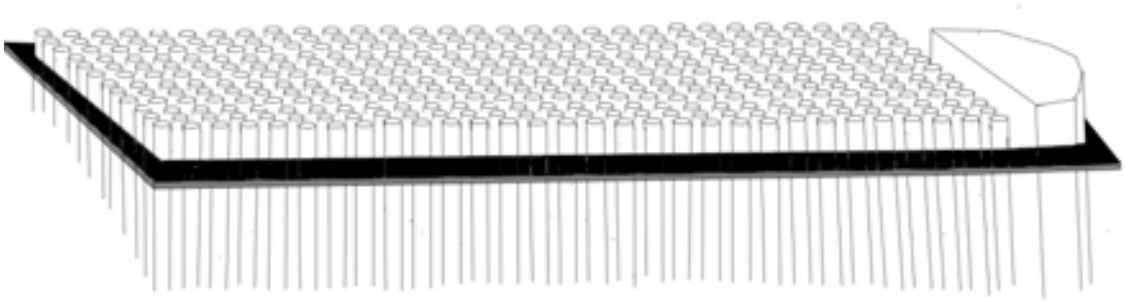


Figure 1.Tthe structure of the heat exchanger system

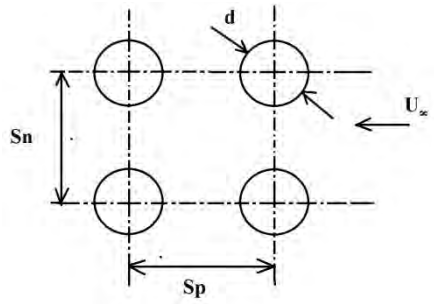


Figure 2. Square in-line configuration of tubes in the heat exchanger

where N Total number of tubes. N_n and N_p is number of tubes in a row normal to flow and number of tubes in a row parallel to flow. The width and length of the configuration is as follows :

$$W = N_n.S_n = N_n.(1.5 \times d) \quad (1)$$

$$L = N_p.S_p = N_p.(1.5 \times d) \quad (2)$$

The total number of tubes in the exchanger is $N = N_n.\ N_p = 14 \times 90 = 1260$. The liquefied PCM mass in tubes fills each tube up to its top. The mass can be expressed [26]:

$$M_{PCM} = N.V_{tube}.\rho_l = N.\left(\frac{\pi.d^2}{4}.H\right).\rho_l \quad (3)$$

For the crossflow of air, the convection heat transfer coefficient outside the tubes (h_o) is calculated by the Grimson correlation [27]:

$$\frac{h_o.d}{k_a} = C.\left(\frac{U_{max}.d}{\nu_a}.H\right)^n.Pr^{1/3} \quad (4)$$

Where C, n are constants of relation. For an square in-line configuration, C = 0.278 and n = 0.620 according to the pitch-to-diameter ratio $S_n/d = S_p/d = 1.5$. The properties have been evaluated as air at atmospheric pressure and room temperature of 27◦C (300 K). The air density ρ_a= 1.177 kg/m^3, specific-heat capacity $c_{p,a}$ = 1006 J/kg K, thermal conductivity k_a =0.026 W/m K, kinematic viscosity ν_a= 15.7x10^{-6} m^2/s, and Prandtl number Pr = 0.708. In an square in-line arrangement, the air velocity at the minimum frontal area U_{max} is expressed [26]:

$$U_{max} = U_\infty.\left(\frac{S_n}{S_n - d}\right) \quad (5)$$

For $S_n/d = 1.5$, substituting above values in the equation changes the velocity versus U_∞. Thus, the air heat capacity rate is

$$C_a = \dot{m}_a . c_{p,a} \quad (6)$$

where the mass flow rate of air across the free cross-sectional area A_c is [26]:

$$\dot{m}_a = U_\infty . \rho_a . A_c \quad (7)$$

Where the area A_c for flow of air from the fans into the tube array is $A_c = W.H$. The area changes also according to reducing 25%, 50% and 75%. Mass of air in the room can be given [26]:

$$M_a = V_{room} . \rho_a \quad (8)$$

The shell dimensions of shell-and-tube heat exchanger are changed as rate of percent. Because of the thinness of the tube wall, the inside and outside surfaces are accepted as the same. The surface heat-transfer area of the tubes A can be given as [26]:

$$A = N.\pi.d.H \quad (9)$$

3. METHODS

The analysis of the PCM based heat exchanger unit is investigated for two conditions. In conditions, the exchanger operates for an insulated room and a room heated by the ambient. Each condition is to be analyzed in a way: An ideal performance of the exchanger. The wall temperature of all tubes is preserved at the constant temperature of melting Tm. This is an extreme condition. In the actual performance of the exchanger, the temperature of a tube wall varies with the melt fraction accumulated in the tube.

Both performances are compared with respect to the temperature achievable in the room, the range of operation of the ambient temperature and the design of the exchanger.

The melting of the PCM advances gradually from the first row to the last one. The wall temperature has risen above the melting point, while the tubes downstream are full of solid PCM and their wall is preserved at the melting temperature.

3.1. Room perfectly insulated

The entire document should be in Times New Roman. Type 3 fonts must not be used. Other font types may be used if needed for special purposes. For ideal performance**, t**he melting-point temperature is preserved throughout the whole operation at the wall of all the tubes in the exchanger: $T_w = T_m$. The lowest temperature achievable in the room could be $T_{r,min} = T_m$. In such a case, the heat absorbed from the room by the exchanger and the PCM mass to be melted would have to be [26]:

$$Q_a = \left(M.c_p\right)_a . \left(T_{r,o} - T_m\right) \quad (10)$$

$$\Delta Q_{PCM} = Q_a = (\Delta M.\Delta h)_{PCM} \quad (11)$$

At such a specific melt fraction most of the tubes remain fully solid and at a temperature T_m. The time required to reach any comfortable temperature is assessed from the heat balance over the air [26]:

$$-\left(M.c_p\right)_a \frac{dT}{dt} = \left(\dot{m}.c_p\right)_a (T_r - T_m) \quad (12)$$

$$\Delta t = -\left(\frac{M}{\dot{m}}\right)_a \ln \frac{(T_r - T_m)}{(T_{r,o} - T_m)} \quad (13)$$

3.2. Room heated by the environment

Heat is transferred from the surroundings to the room through the walls and ceiling. The floor is adiabatic. An overall heat-transfer coefficient (U_r) is assigned to both the walls and the ceiling and 1.2 W/m^{2}K. The

ambient room temperature during the whole operation of the exchanger cooling is changed from 35◦C to 45 ◦C. For ideal performance, the heat balance over the room is [26]:

$$\left(\mathrm{M}.\,\mathrm{c_p}\right)_a \frac{\mathrm{dT}}{\mathrm{dt}} = (\mathrm{A}.\,\mathrm{U})_r(\mathrm{T}_\infty - \mathrm{T_r}) - \left(\dot{\mathrm{m}}.\,\mathrm{c_p}\right)_a(\mathrm{T_r} - \mathrm{T_m}) \tag{15}$$

where the inlet temperature of air to the exchanger is the room temperature, $T_{in} = T_r$ and its outlet temperature is $T_{out} = T_m$ in the very long heat exchanger. At steady state, the temperature could be given as [26]:

$$(\mathrm{A}.\,U)_r(T_\infty - T_r)_{ss} = \left(\dot{\mathrm{m}}.\,c_p\right)_a(T_r - T_m)_{ss} \tag{16}$$

$$T_{r,ss} = \frac{\left[(\mathrm{A}.U)_r/\left(\dot{\mathrm{m}}.c_p\right)_a\right].T_\infty + T_m}{1 + (\mathrm{A}.U)_r/\left(\dot{\mathrm{m}}.c_p\right)_a} \tag{17}$$

$$\mathrm{NTU} = \frac{(\mathrm{A.h_o})}{\mathrm{C_a}} \tag{18}$$

where Ar = 4 × (4 × 2.5) + 4 × 4 = 56 m^2. At this temperature the rate of heat gains through the walls and ceiling amounts to [26]:

$$q_{amb} = (\mathrm{A}.\,U)_r\left(T_\infty - T_{r,ss}\right) = \left(\dot{\mathrm{m}}.\,c_p\right)_a(T_r - T_m)_{ss} \tag{19}$$

The duration of the exchanger operation in this mode can be estimated from the heat capacity of the PCM mass [26]:

$$\Delta\mathrm{t} = \frac{\mathrm{Q_{PCM}}}{\mathrm{q_{amb}}} = \frac{(\mathrm{M}.\Delta\mathrm{h})_{\mathrm{PCM}}}{\mathrm{q_{amb}}} \tag{20}$$

In this calculation the time duration of the operation is determined, considering the initial ambient temperature of the room and the dimension change of the exchanger. All the figures given above relate to an ideal operation in which the tubes are maintained at the melting temperature. For actual performance, the full analysis of an actual performance is presented in literature.

However, if the equations described in the section are adopted to the insulated room and room heated by the environment, it would be obtained the evolution of the room temperature with time and the cooling time in operation. The room temperature versus time is plotted in Fig. 3, 4 and 5. As estimated above, while the different room temperature investigates from 35 ◦C to 45◦C, the temperature decreases from 35 ◦C to 23 ◦C (or 25◦C). Thus, the ideal and actual performances are the same.

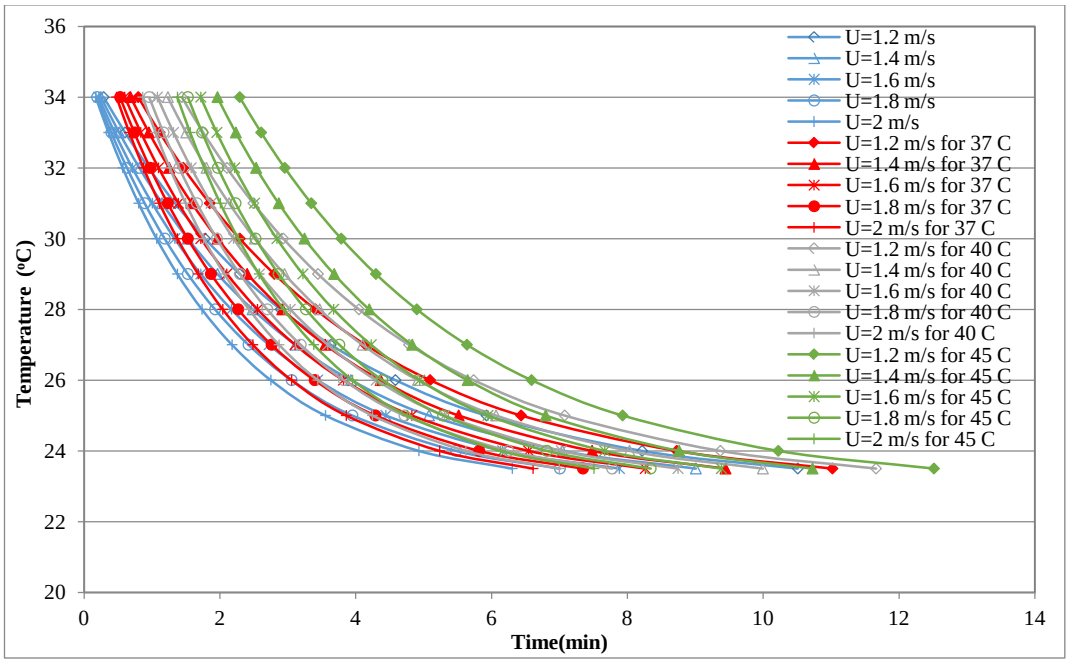
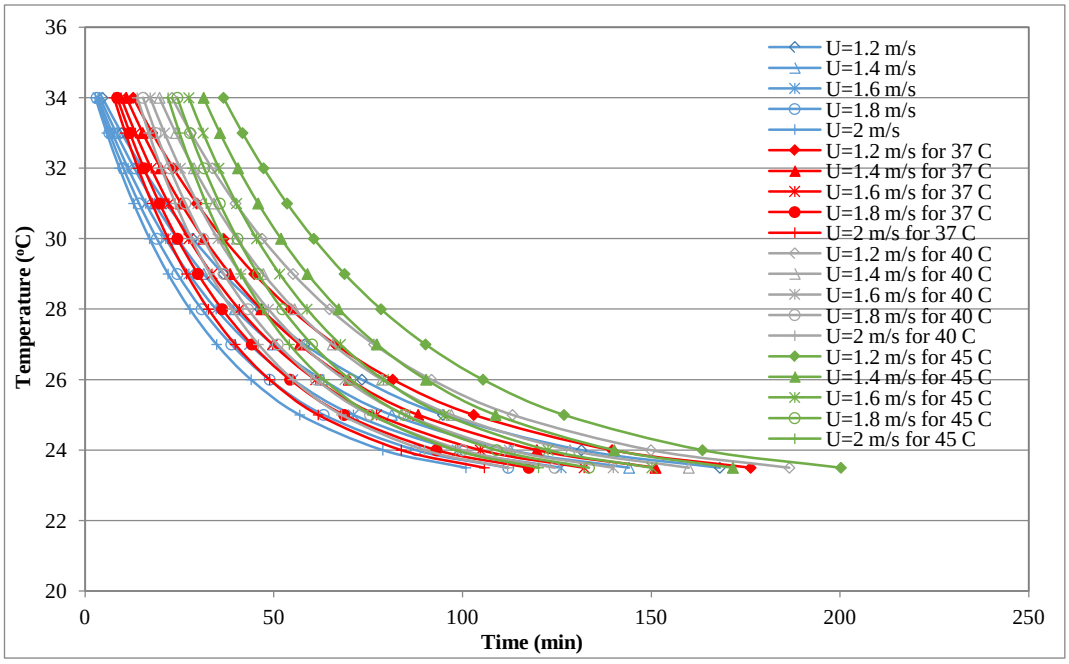
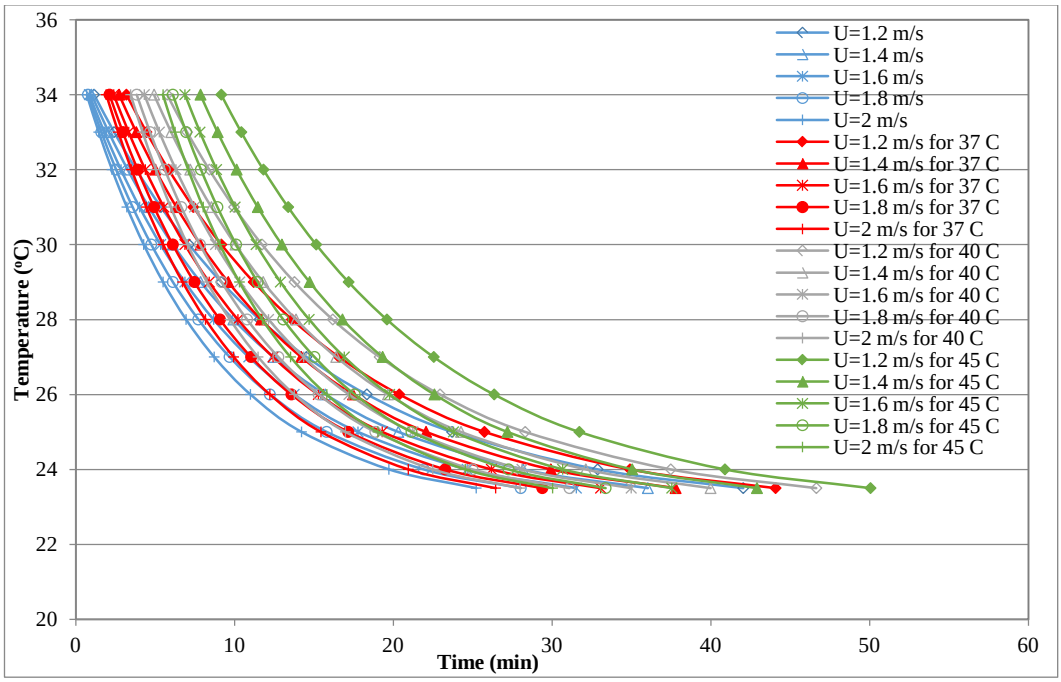


Figure 3. Cooling of an insulated room for different velocity and different ambient temperature: room temperature versus time for current exchanger dimensions



(a)



(b)

Figure 4. Cooling of an insulated room for different velocity and different ambient temperature: (a) room temperature versus time for current exchanger dimensions of 25 %; (b) room temperature versus time for exchanger dimensions of 50 %

Figure 6 shows the cooling time for the different ambient room temperatures reaching 23◦C. In the room by the environment, these times remain at same level for different ambient room temperatures.

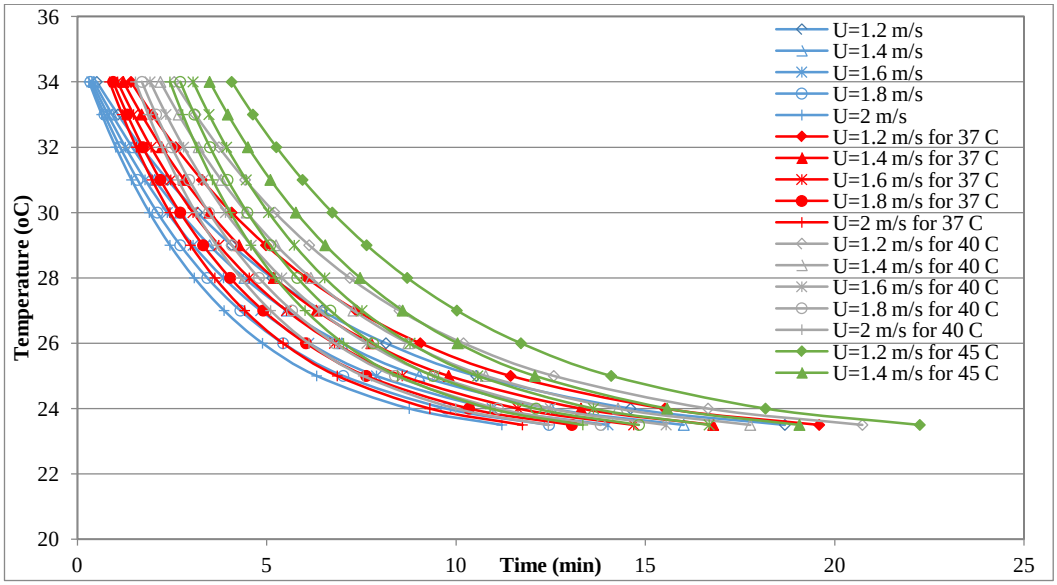


Figure 5. Cooling of an insulated room for different velocity and different ambient temperature: room temperature versus time for exchanger dimensions of 75 %

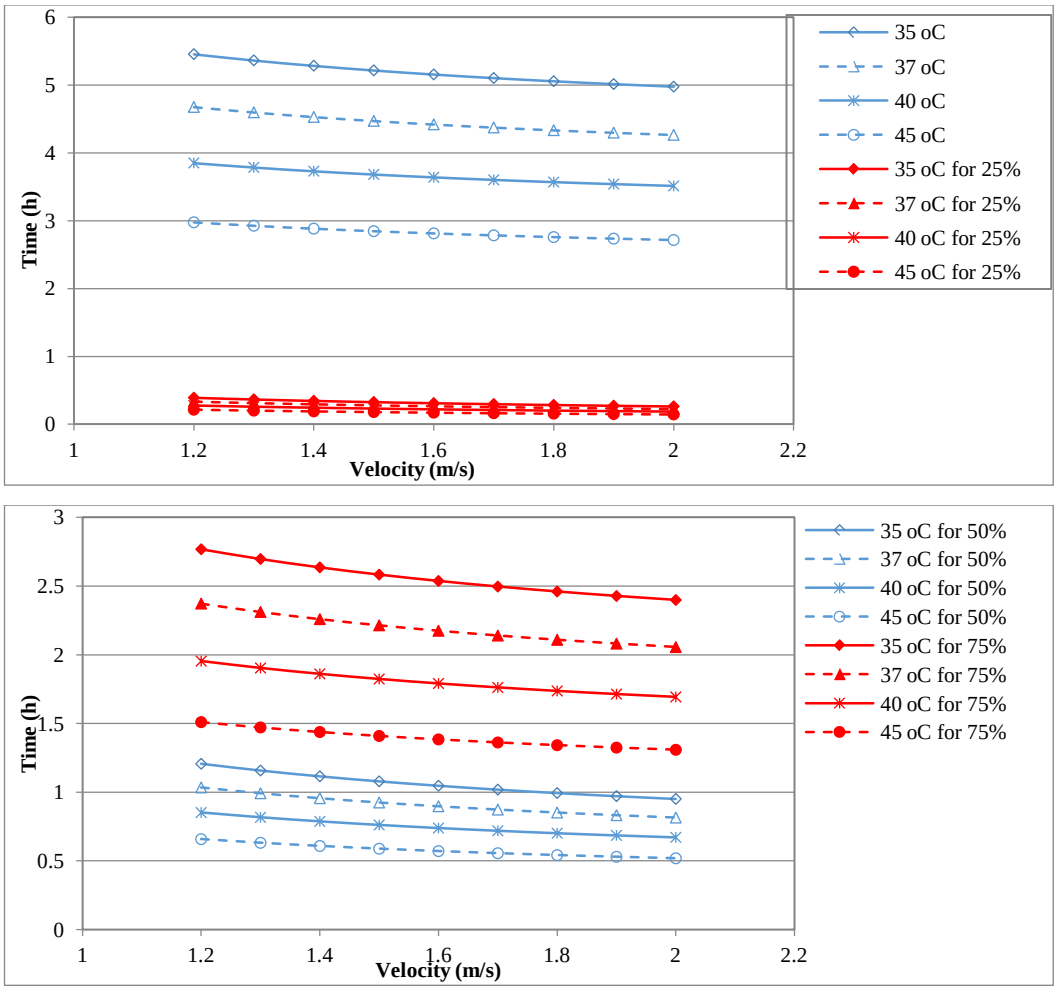


Figure 6. The cooling time of a room heated by the environment for different velocity and different ambient room temperatures: time versus velocity for exchanger dimensions of current, 25 %, 50 % and 75 %

4. CONCLUSIONS

In all the calculations presented herein a few simplifying assumptions were involved. The density of liquid PCM was used for both liquid and solid. The room temperature was assumed uniform, as if the air were perfectly mixed. Air properties were considered constant. Radiation in the room was ignored. These simplifications affect the closeness of the results to a real situation, but enable the comparison of solutions. The analytical solution is the simplest, while the real solution is a heavily time-consuming procedure. Two cases were analyzed: cooling of an insulated room and a room heated by the ambient. Different cases were solved analytically, for an "ideal" performance. In all cases the analytical results were close to the literature [26] results and could have been used for estimates of the room temperature.

The analytical calculations related to exactly the different dimensions. The solution was also based on different ambient room temperatures. The results obtained by this method could have been the most accurate. However, in the present study the analytical method provides the cooling times of the PCM process.

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BIOGRAPHY

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Genetic-Based PI Controller for Cooling Independent PV Systems

Göksu Görel[1], Ertuğrul Çam[2], Murat Lüy[3], Zafer Civelek[4]

Abstract

Photovoltaic (PV) systems are green and sustainable energy. This systems are becoming increasingly common every area. Providing cheaper day by day is the most important factor of PV systems. As known, PV systems are generally clean energy and without damage to the environment. PV sources is only solar energy. Therefore, this systems temperature is increasing in time. This result causes to a decrease in energy efficiency. In a large PV systems on the interconnected grid, this is an important factor for cost of energy. As a result, the temperature of the panel must constantly be balanced.

In this study, surface temperature on a photovoltaic cell is kept via a cooling systems (CS). Genetic Optimization based PI controller is designed for CS. Therefore, efficiency of PV systems is aimed to be increased. Firstly, PV systems can be modelled from a voltage equation at the simple equivalent circuit. Later, variable air temperature is used for an input of PV cell. For kept constant this temperature, some water flows on the PV panel with using PMDC motor. A Genetic-Based PI Controller is designed for keeping constant panel's temperature. MATLAB-Simulink are used for simulation and modelling.

Keywords: GA-PI Control, Cooling, Genetic Algorithm, Photovoltaic Systems.

1. INTRODUCTION

Recently, increasing energy demand and the high cost of energy of different energy sources revealed efficient use of energy resources is imperative. The main one of these resources are renewable energy sources and the continuity of renewable energy sources to the energy problem is the most logical alternative. Especially in Figure 1 showing the off-grid systems to remote or island settlements located in the system to operate independently from the network should be established. Photovoltaic energy systems are the top of them. In such places the resulting increase in energy consumption from renewable sources with the existing photovoltaic (PV) energy systems become more efficient as a solution. Photovoltaic Panels (FVP) environmental conditions are an influential role in the performance of the power system. Temperature value of PV panels is the right fit and to have sufficient strength values to be designed with an ideal is a requirement for PV panels. However, climatic conditions, air temperature and environmental conditions such as shadowing effects it is not always possible. [3] Solar Cells producing firm Standard Environmental Conditions is testing under the PV cells. (Spectrum AM 1.5, radiation 1000 W / m^2, cell temperature 20 °C) [4] Many researchers under ideal environmental conditions are not suitable for increasing the performance of PV panels as projects. Low radiation and temperature under the maximum power point tracking (MPPT) is the most important method to obtain high yields. [5] The source of the error is one of the MPPT methods and observation method was optimized by fuzzy logic. High temperature during the hot season to reach a high of PV modules reduce power values are obtained. [6] The high temperature at the source by placing the panels

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around the cooling fan was made to reduce the temperature of the air. Another method of keeping the temperature at an optimum level of water to be made to the panel surface and the cooling mechanism. In this article, the temperature on the surface of the water balance were studied using the FV. Substrate temperature water to be increased with the PI controller is designed for the flow to perform a simulation of PV solar cell.

2. PV EQUIVALENT CIRCUIT PANEL STRUCTURE AND MODELLING

Circuit model is required ranging from 1960 to the present modeling was carried out. Public static equivalent circuit models of solar cells connected in parallel or in series on the PV cells to be connected to variable light intensity and temperature changes will be carried out to respond to a dynamic model should have such a model with a dynamic realize importance of protecting the long-term is a subject by researchers. FV at a simplified equivalent circuit of the solar cell is shown in Figure 1. PV solar cell in Figure 1, a current source (I_{FV}) is represented by. [7] With the current source of the incident photons of light obtained by the action of electrical current is shown as current sources. I_D, the PV solar cell formed in the reverse saturation current, R_s resistance is an important part of this article forming operation, heat losses at the point represents PN. Output voltage circuit of Figure 2 to be obtained by Equation (1) are also shown.

$$V_{pil}=\frac{A*k*T_{pil}}{e}\ln\left(\frac{I_{FV}+I_0-I_{pil}}{I_0}\right)-R_s*I_{pil} \quad (1)$$

Where the symbols are defined as follows;

I_{pil} : Cell output current (A)
I_0 : Reverse saturation current of diode (A)
I_{FV} : Photocurrent, function of irradiation level and junction temperature (A)
V_{pil} : Cell output voltage (V)
R_S : Series resistance of cell (Ω)
e : Electron charge (C)
K : Boltzmann constant (J/ºK)
T_{pil} : Reference cell operating temperature (ºK)

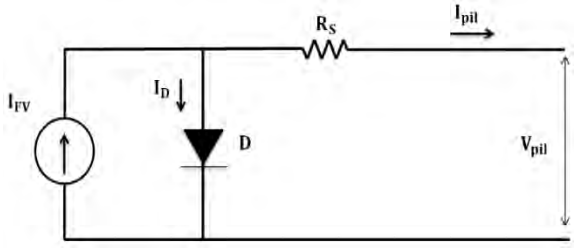

Figure 1. Solar cells have been reduced to the simplest equivalent circuit

3. WATER TRANSMISSION SYSTEM MODELING

Photovoltaic panels at an ideal working temperature of the surface temperature in a system designed to bring Permanent Magnet DC Motor (PMDC Motor) is used. PMDC motors, with a low temperature causes the water to flow over the panel surface. [10] Photovoltaic panels due to the increase in surface temperature also increases engine speed. Depending on the speed of PMDC motors increasing water flow rate through the flow PV surface temperature is stabilized.

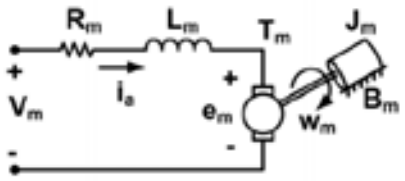

Figure 2. PMDC motor equivalent circuit

PMDC motors, DC motors supplied from the voltage source type is one of the magnetic coupling of the electrical energy into mechanical energy using the method of the rotating rotor. PMDC motor equivalent circuit is shown in Figure 2.

Table 1. PMDC motors used in the system inputs

N=	2.6
R_a=	1.4Ω
L_a=	0.0805H
K_t=	0.095Nm/A
K_m=	0.095v/rad
F_m= B_m=	0.000431V.s/rad
J_m=	0.0007432 kgm^2
V=	36V

PMDC motors used in modelling the system parameters are shown in Table 1. Direct current motor winding, the inductance connected in series, with the voltage source resistance is expressed in contrast to the induced voltage. According to the equivalent circuit of electrical circuit theory of differential equations of equation (2) as in shown.

$$V_m(k) = R_m I_a(k) + L_m \frac{d\, I_a(k)}{dt} + E_m(k) \quad (2)$$

Where:

1. $E_m(k) = K_E\, \omega_m(k)$
2. $i_1 =$ constant; so $K_E = K_T$

Total motor torque must be zero. This condition equation (3) are expressed.

$$T_e(k) - J\frac{d\, \omega_m(k)}{dt} - B\omega_m(k) - T_L(k) = 0 \quad (3)$$

Electromagnetic torque, is proportional to the current flowing in the armature windings and the equation (4) are expressed with.

$$T_e = K_T\, i_a \quad (4)$$

The armature current and angular velocity in the form of the state space equation for the differential equation (5) is shown. [11]

$$\frac{d}{dt}\begin{bmatrix} i_a \\ \omega_m \end{bmatrix} = \begin{bmatrix} -\frac{R_m}{L_m} & -\frac{K_t}{L_m} \\ \frac{K_t}{J} & -\frac{B}{J} \end{bmatrix} \begin{bmatrix} i_a \\ \omega_m \end{bmatrix} + \begin{bmatrix} \frac{1}{L_m} & 0 \\ 0 & -\frac{1}{J} \end{bmatrix} \begin{bmatrix} V_m \\ T_1 \end{bmatrix} \quad (5)$$

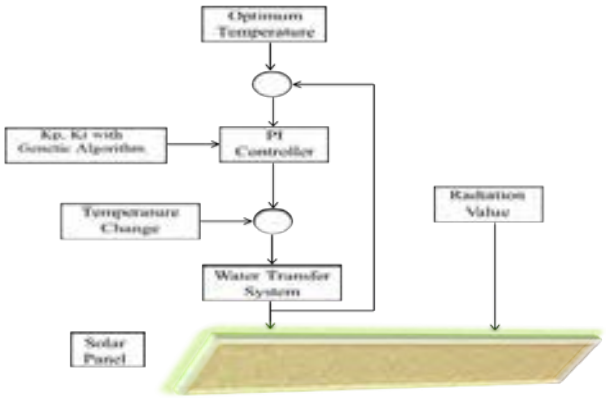

Figure 3. Water Transfer System Applied to Solar Panels

4. GENETIC ALGORITHM

Genetic algorithms (GA) is based on the regulations natural choice and inherent propagation in real life situations. The nature of the species that carry out their lives, and could not enables the kind of coherence that

can adapt to difficult conditions is a natural choice to be eliminated. Bring about a new generation of mating selected individuals of this species, so natural reproduction is carried out. In this period of individual genes, forming new genes to unite with any other individual genes.

Genetic algorithms, the optimal point exploration procedure combining the two cases in of life. This event is intricate and multi-dimensional exploration is a search method that is based on the principle of better survival in space and searches for optimal solutions at the same time a point of the search space. A genetic algorithm, resembling our own genetic code of our DNA construction is based on many of the genes from chromosome encoded generated.[12] GA are represented by character or number sequences involves a generation of individuals.

Basic flow diagram of genetic algorithm is given as follows. First limit of the search space, the level of fitness function to identify compatibility of individuals for the solution is determined. In addition to optimized parameters are defined. Then, the generated first generation at random. After a compatibility test for each individual in the generation, based on to the program's approximation test is move to a new generation of process or program termination. Although different operators in different applications used for generating a new generation operator 3 standard is mainly used together.[13-14] These are:

- Reproduction
- Crossover
- Mutation

It can be expressed.

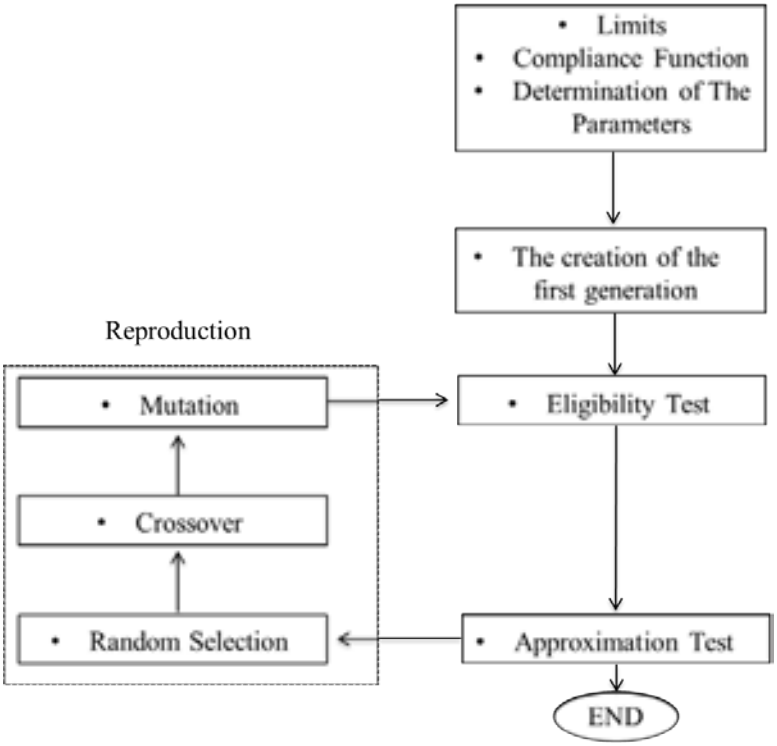

Figure 4. The main genetic algorithm loop

5. RESULTS

Today photovoltaic power systems are systems as high as the initial installation cost. These costs, increasing the efficiency of the operation of the system during the installation, the cost of their time can be shortened to tolerate. Efficiency of solar cells by reducing losses increased mainly speaks. The most important of FV determined the surface temperature of the battery can be kept constant at the ideal temperature. In this article studies of the surface temperature of PV system can be obtained by balancing the amount of increase or decrease panel temperature.

Operating speed of the cooling system for the different irradiation conditions were obtained. Photovoltaic solar panels depending on the temperature and radiation level voltage generated from the panel will undergo

changes in direct proportion. Simulation program was run for 1 seconds. Panel cooling system is controlled and uncontrolled exchange is shown in Figure 6. As shown in Figure 6 GA-PI controlled system the minimum the influence of the impact of ambient temperature. As shown in the Figure 7, when the GA-PI 1000 iteration controller is included in the system by minimizing the effect of temperature as 20 °C.

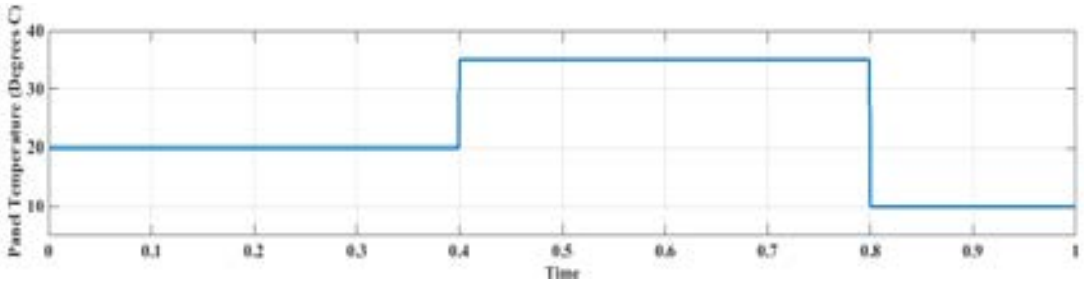

Figure 5. Panel Temperature

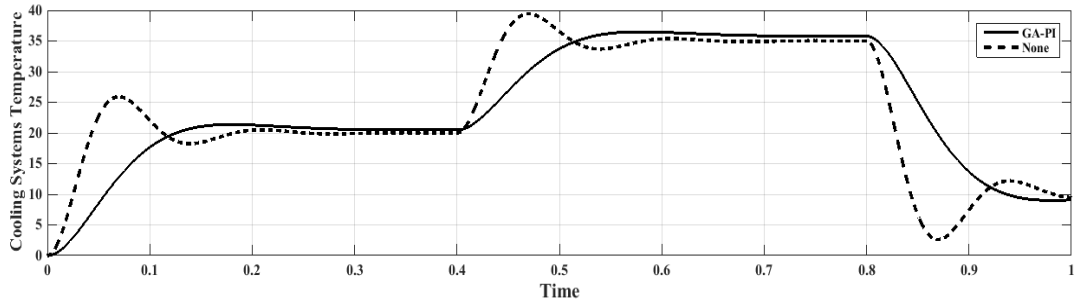

Figure 6. The results of GA-PI 800 iterations

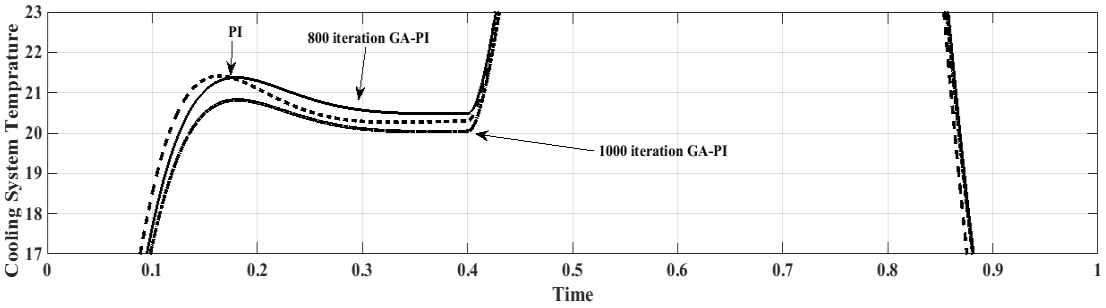

Figure 7. The results of GA-PI 800 and 1000 iterations

6. CONCLUSIONS

This article Matlab / Simulink environment through simulation studies carried out in the optimum photovoltaic panels worth of work in order to keep the surface temperature of cooling system controlled using a GA-PI was carried out. PV panels, due to the increase in surface temperature of the panel water released on the surface of the speed controlled. According to the results, the optimized controller with genetic algorithm that showed better results. The result of this iteration, a benefit of 1 degree. From about 1 degree difference, which is equivalent to the energy authors he had put forward earlier work around 2W.[15]

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DRYING OF DEWATERED SLUDGE BY USING A NEW PARABOLIC THROUGH TYPE SOLAR CONCENTRATOR

M. Emin Argun[1], Mustafa İnal[2], Zabit Özcan[3], Serdar Koyuncu[4]

Abstract

Drying beds are generally used throughout the world to dry wastewater treatment sludge. to increase solid matter of sludge and to reduce sludge mass and volume. Consequently the cost of storage, handling and transport are reduced. Therefore, this process is an important step for wastewater sludge management which has a beneficial use of free solar energy. Direct solar radiation and wind are used to increase solid matter of sludge and to decrease pathogen bacteria. However, with this methods, a large area of drying bed and a wide range of time need. We aimed in this study to decrease required area and time by concentrating solar energy with parabolic through collector. Results showed that the amount of dry solids (DS) was increased in a short time by comparison with classical methods and coliform bacteria decreased rapidly at the same time.

Keywords: Watewater sludge, solar drying, parabolic through collector, dry matter

7. INTRODUCTION

Sludge management is one of the most difficult and expensive step of waste water treatment process which its costs reaches to about 50% of the overall costs. Sludge thickening, digesting, dewatering and drying steps lead to this cost. Sludge drying with a large area and long time requirement has also importance of sludge treatment. Sludge management should be protective for both environmental and public health and also be cost effective. For public health protection, it is not only intended to be volumetric reduction but also pathogen control. [1]

According to EU average values 60 g of dry solids have produced in waste water treatment plant by a person per day [2]. By using this method, Turkish wastewater treatment plants is estimated to produce municipal sludge more than 1,970,000 tons DS/year, in 2020. Conventional aerobic or anaerobic processes are known to be digestion for sludge stabilizing but their effect is low in pathogen control. Alkaline treatment with increase of pH, mechanical processing like centrifugation, belt or filter pressing and thermal treatment are the other alternatives to decrease moisture and volume of sludge. However, alkaline and mechanical treatments can only be reach to 20-25 % dry solids (DS) content. Thermal treatment is most effective method for DS increasing up to 95 %. Unfortunately, this method requires higher capital and operational costs [3,4]. Therefore, authorities

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have preferred drying beds to further increase of DS instead of expensive thermal method. Solar drying processes have been promising alternative to conventional thermal process with its low investment and operational costs. General application are drying beds and greenhouse type of solar drying.

The most common sludge disposal methods are sanitary landfilling, which requires sludge to be dewatered to minimum 35 % of DS [5], usage in cement factory for energy obtain, fertilizer for agriculture which should not excess some limiting heavy metal values. [6]

Solar sludge drying has acquired significant interest over the last years, and both pilot- and full-scale facilities have been reported [1, 7-9]. In this study, parabolic through type solar concentrator is used as new method to increase DS of sludge in a short time and to decrease required area.

8. MATERIALS and METHODS

8.1. Materials and Studying Area

Konya is located in central Turkey and the population of Konya is about 1.5 millions in metropolitan area. Konya City is considered as the 7th largest city of Turkey. The average annual precipitation is about 320-350 mm. Long-term average sunshine duration for the Konya city 2,898 h/year, and the annual total solar radiation is between 1600 and 1750 kWh/m^2. Solar radiation values and monthly sunshine duration for Konya city were given in Figure 1.

Konya wastewater treatment plant has produced about 120-140 tons sludge/day with 25-28 % DS content. Dewatered sludge has been lay out on about 300.000 m^2 drying beds. Sludge has reached about 60-70 % DS content in drying beds during 180-240 days. It was calculated that produced dewatered sludge/m^3 waste water was 0.72 kg/m^3.day and dewatered sludge/equivalent person was 0,13 kg/EP.day.

The sludge production of Turkey is estimated as 4560 tons DS/day and 1,664,400 tons DS/year for the year of 2015.

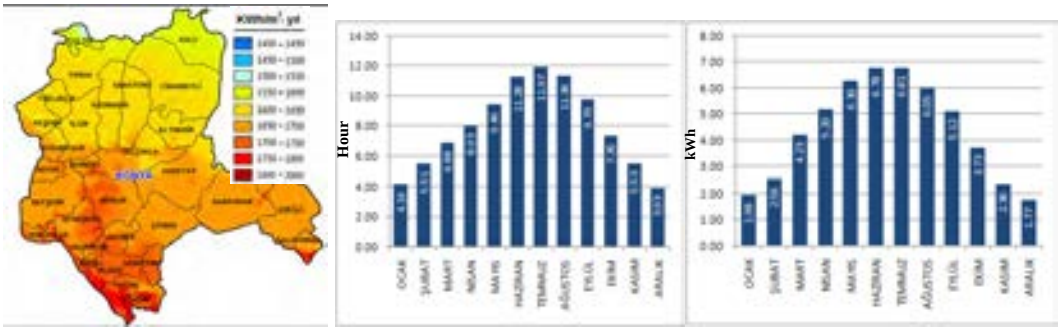

Figure 1. Solar radiation values and sunshine duration for Konya city [10]

8.2. Methods

Solar drying unit consist of parabolic through concentrator, a pipe at the focus of concentrator with feeding cap, mixing equipment and air ventilation holes. A PV module of 100 W was used to alter the DC motor to one axis sun trucking (Figure 2). The motion of the sludge was provided with a screw which was placed in the drying pipe.

During the experiments, changes in the dry solids, mg NH_3-N/g sludge, faecal coliform and climatic conditions were measured. Meteorological data were measured with Oregon scientific WMR 200 weather station. Variations of temperatures of sludge at the inlet,

ventilation holes and outlet were also measured with laser thermometer. Dry solids of sludge were hourly analyzed according to the Standard Methods [11]. The most probable number method were used to determine faecal coliform counts.

Figure 2. Parabolic through solar drying system and its components using for experimental study

9. RESULTS and DISCUSSION

Solar radiation for a sunny day of experiment in July was between 840-1025 W/m^2 and DS increased from 30 % to 55% during 300 min experiment (Fig. 3). The temperature value in empty drying pipe reached up to 130^{o}C due to solar focus effect, while sludge present there was maximum 97^{o}C. These values are significantly higher than the temperature which a greenhouse type dryer could reach. The sludge volume reduced from 2000 mL to 700 mL in 120 min on 01 June 2015. Volume reduction was 63 % while weight reduction was about 43 % (Table 1). The drying rate was calculated as 174 g H_2O/(hour.m^2). It was also observed that the retained sludge in the drying pipe reached to 96 % DS during a couple of days. The moisture content was estimated to decrease the target value of 10 % in 12 hour (about 2 sunny days). This period was significantly lower than 7–12 days reported by Mathioudakis et al. [1], 26 days reported by Salihoğlu and Pinarli [8], 64–83 days reported in Bux et al. [12] and 13 days reported by Akgül [13].

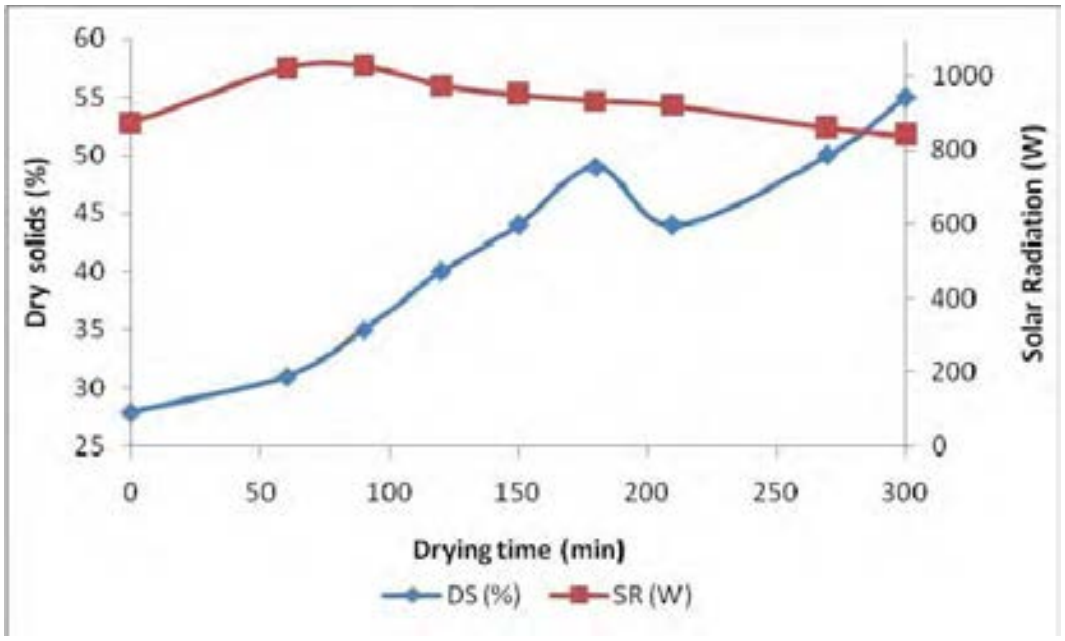

Figure 3. Experimental study on 02.Jul. 15

The characteristics of the final dry-product are presented in Table 1. Fecal coliforms was decreased by 771 orders of magnitude during solar drying. Increasing temperature up to 100°C may lead to partial sludge disinfection and decreased coliforms from $5.4x10^6$ CFU/g DS to $7x10^3$ CFU/g DS. This value means that coliform reduction was 99,9 % and 2.89 log.

Some ammonia nitrogen content was observed to be evaporated as a result of high temperature and decreased from 3.5 mg N/g sludge to 2,3 mg N/g sludge during 300 min drying time. According to Turkish regulations coliform reduction should be at least 99% and 2 log. DS content should be 35 % for landfilling and 90 % for agricultural application. Metal concentration and some organic micro pollutants of drying sludge should also be met the limits. It was concluded these result that, the sludge which has been dried in this study may be used for landfilling, but may even be used for agriculture with developing this system.

It was observed that DS content decreased sometimes due to without required ventilation. Therefore, the sludge surface saturated with vapor and evaporation partially took place from ventilation windows. However, some vapor condensed at the upper surface of pipe and condensed moisture regained by sludge with mixing.

Table 1. Sludge characteristics before and after drying

	Influent	Effluent
Sludge Temp. (°C)	30	65
Dry Solids (DS; %)	30	55
NH_3 (mg N/g)	3,5	2,3
Faecal coliform (MPN)	$5,4.10^6$	$7,0.10^3$
Sludge volume (mL)	2000	700
Sludge weight (g)	2500	1136

10. CONCLUSIONS

The maximum temperature was obtained as 130°C with parabolic through type solar concentrator. The dry matter (DS) content of the dried sludge increased from 25 to 55 % during only 300 min and the corresponding volume reduction was up 63 %. Fecal coliform content were reduced by 99,9 %.

The sludge dewatering rate in this study, was determined equal to 174 g H_2O/m^2.h. Sludge drying rate was more effective according to open sludge drying beds and greenhouse type dryer. Produced sludge met the requirements for the landfilling regulations.

ACKNOWLEDGMENT

The authors thank Selcuk University Research Fund (SU-BAP) for its financial support to symposium attendance (Project no: 15701746). The authors also thank to TUBITAK and Konya Directorate of Water and Sewage Administration (KOSKİ) for the support of industry oriented undergraduate thesis.

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Current Status and Problems Of The Protected Areas in Turkey

Serkan Özer[1], Neslihan Demircan[2]

Abstract

The history of nature protection in the world dates back to very old times. The first known protection is the Indian Emperor Asoka's enactment in 252 B.C. The first protection status was granted to Yellowstone in the USA in 1872 by declaring it to be national park. In Turkey, the first protection attempt was the declaration of Yozgat Pinetum to be national park in 1958. Afterwards, several points in Turkey were taken under protection in different statues. Today, protected areas in Turkey are classified by Turkish Ministry of Forestry and Affairs into protection categories such as conservation forests, urban forests, honey forest, gene conservation forests, seed stands, seed gardens, wildlife protection and development areas and wetlands. In addition, the areas protected by the Ministry of Environment and Urbanization are the special environmental protection areas and other protected areas. It has been determined in the study that there are 3495 areas which are protected with legal status in Turkey, and the total size of these areas has reached 7.516.180,86 ha. The protected areas cover the 9,23 % of the country's total area. This figure shows that the status in Turkey has reached a perfect level according to the criteria set by the IUCN telling that at least 4% of a country's total area must be under protection. However, it has been determined in this study that although the size of the protected areas is not problematic, these areas have administrative, legal, economic, etc. problems.

Keywords: Protected areas, protect status, problems, IUCN, Turkey.

1. HISTORICAL DEVELOPMENT OF THE PROTECTED AREAS IN THE WORLD

The first known protection in the world started with the order of the Indian King Asoka for the protection of animals, fish and forests in 252 B.C. Then King William from Britain prepared plans for the protection of certain areas and elements; and fruit trees were protected in Rome in 2000. This process continued with Germany by enacting laws on forestation of agricultural areas and pastures in 1343 [1-3].

However, the real developments on protection started in 1900s after the Industrial Revolution. Because the damage given to the nature had increased in those years. As a result of the work in those years to ensure the comfort of the life of human beings, irreversible damages were given to the fauna and flora, and the number of the species began to decline [4]. Human beings had great benefits and victories in the fight with the nature; however, also faced great disasters in the following period. As a result of these processes, the work on protecting the nature increased, and various protection concepts were introduced in different countries [4-6].

The first protection concept in official sense in the world is the concept of "*National Park*". In 1872, the American Congress proclaimed the "Yellowstone Park", which is 8670 km^2 as the first National Park of the World [7].Then the first work on protecting Natural Monuments was also started in the USA. In 1906, the "Antiquities Act" was approved by the Congress to regulate the historical works [8]. These protection works spread to other countries in the following years and numerous protection areas were formed all over the world. These protection works spread to other countries in the following years and numerous protection areas were formed all over the world. As a result of these works, the size of the protected areas increased in the world and these protected areas cover 13 % of the world's total area in 2010 [9-10].

IUCN (2011) describes the Protected Area as "Geographical areas defined to be protected together with ecosystems and cultural values in the long term, and managed with relevant laws or other valid means".

With this study, the latest status of the officially protected areas in Turkey will be examined and the rate of these areas to the surface area of the country will be investigated. In addition, the areas in Turkey will be examined in regards to the criteria set by IUCN as 4%; and the relevant problems will be revealed.

2. HISTORICAL DEVELOPMENT OF THE PROTECTED AREAS IN TURKEY

The first law after the Republic of Turkey was established was enacted on 08.02.1937 with the number 3116 and was called the "Forestry Law". With the law, hunting and collecting any kinds of plants and herbal products was subjected to obtaining permission, and the protection of the forests was given to the State as a responsibility [3]. However, the Forestry Law was amended many times in the forthcoming years; and in 1956, the following statement was added to the 4th Paragraph, 2nd Item of the law: "Forests are classified under three classes in terms of quality and characteristics as; Protection Forests, National Parks and Production Parks" [11].

After the Forestry Law in 1956, "Yozgat Çamlığı" area was declared as the first national park of Turkey in 1958. In later times, many areas were declared as protection areas under various statues [12-13]. The areas which were previously protected by various ministries in Turkey are protected by 2 ministries nowadays. These ministries are, the Ministry of Forestry and Affairs, and the Ministry of Environment and Urbanization. The authorities of these ministries were interviewed and data on the protected areas were obtained as of June 2015 [14-16]. These data were used in evaluating the changes, the sizes and the number of the protected areas.

3. THE AREAS PROTECTED BY THE MINISTRY OF FORESTRY AND AFFAIRS

Some of the areas protected by the Ministry of Forestry and Affairs are protected under the Directorate of Protection of the Nature and National Parks, and some are protected under the General Directorate of Forestry. In Turkey, the areas protected in the Ministry of Forestry and Water Affairs under the Directorate of Protection of the Nature and National Parks in official status are the national parks, nature parks, nature monuments, nature protection areas, developing the wild life areas, protecting the wild life areas, and wetlands. The areas protected with official status in the General Directorate of Forestry in the Ministry are the protection forests, city forests, honey forests, gene protection forests, seed stands and seed orchards [17-20].

Figure 1. The Map of All Protected Areas in Turkey [21].

3.1. The Areas Protected by the Directorate of Protecting the Nature and National Parks

The concept of protection first entered the Constitution of the Republic of Turkey with the Forestry Law, and was improved with the National Parks Law on August 9, 1983, with the number 2873. The definitions and current status of the areas protected in Turkey are as follows. The following datas were taken from Protected by the Directorate of Protecting the Nature and National Parks [14].

National Parks: These parks are parts of the nature that have rare natural and cultural sources in terms of science and aesthetics. These areas have protected areas for leisure and tourism. The National Park in Gallipoli in Çanakkale, which is one of the most important national parks in Turkey, was declared as a national park in 28.6.2014 with the decree number 29044 and with the title "The Law on the Establishment of Dardanelles Wars Gallipoli Historic Area Management". This area was later transferred to the Ministry of Culture and Tourism, and therefore the number of the national parks decreased to 39. However, the area located within the borders of Ankara and Haymana, which was the area where the Sakarya War took place, was declared as the "Sakarya War Historical National Park" on 8.02.2015, and the number of the national parks increased to 40 again (Figure 2). There are **40** national parks in Turkey and the total area of these parks is: **828.614,32 ha**.

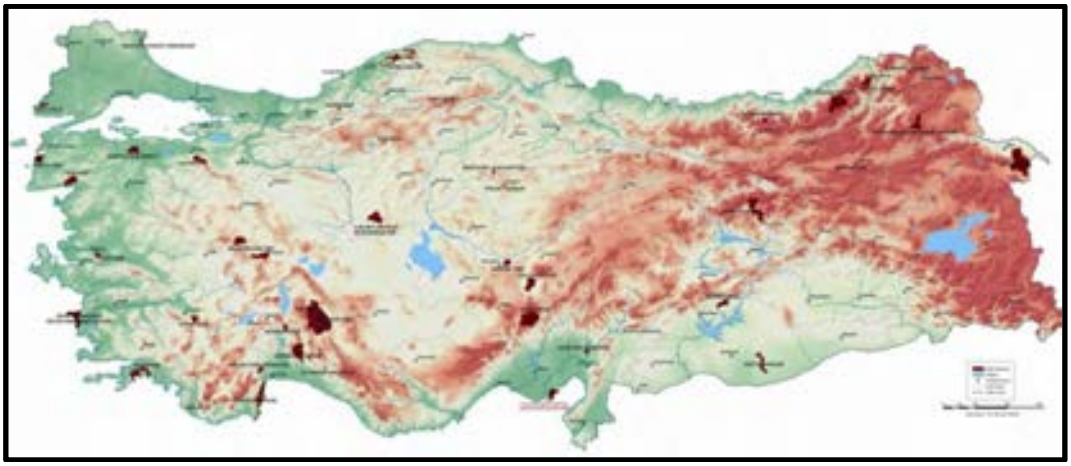

Figure 2. Location of National Parks in Turkey [22].

Nature Parks: These areas have flora and wild life characteristics and are suitable for the leisure and enjoyment of people with an integrity of scenery. While the number of the nature parks in Turkey was 201 in 2014, this number reached **203** with the addition of Rize Isırlık and Gümüşhane Karşıkaya. The total area reached: **97.157,51 ha**..

Nature Monuments: These are the areas that have the characteristics of nature and natural events with a scientific value. They are protected under the principles of national parks. The number of the nature monuments has not changed as of 2013 and is **112**. The total area is **6.683,72 ha**..

Protecting The Nature Areas: Rare ecosystems that are important in terms of science and education, which are about to become extinct or endangered, are considered under this title. They include prominent samples and species formed by the natural events, which must be protected to be used for scientific and educational purposes. The number of these areas stayed the same since 1998, and today, the number is **31** with a surface area of **64.242,95 ha**..

Developing The Wild Life Areas: These are the areas protected and processed the hunt and wild animals and wild life, located the wild animals and taken precautions about processing their habitat and sometimes allowed the hunting. These areas are protected with the Law 4915, Land Hunting. The area in Ankara where *Aegypius Monachus* lives was declared as the Developing the Wild Life Area in 2014, and there have never been another area added ever since. As of 2015, the number is **81**, and the area is **1.192.264 ha**.

Protecting The Wild Life Areas: These are the areas having wild life values together with animal and plant species that must be protected and maintained. These areas are the ones which were protected with the Law 4915, Land Hunting. Protecting the Wild Life Areas were included in the Developing the Wild Life Areas due to come problems. However, the Gebekirse Lake in İzmir, Selçuk, stayed under the same status with the decree of the court. The Gebekirse Lake has a surface area of **545 ha**..

Wetlands: Natural or artificial, temporary or permanent, stable or flowing, fresh, salty or sour having depths no more than 6 meters in the tidal wave times, and areas that are important for waterfowls and other life forms, and swamps, reed beds, turbaries, and other wetlands that have from the borderline of these areas until the landlines ecologically are called Ramsar Areas under the Convention on Wetlands of International Importance [23-24].

The Ramsar Areas under The Convention on Wetlands of International Importance: These areas are accepted as the areas having at least one of the criteria set by the Convention on Wetlands of International Importance. There are **14** Ramsar Areas in Turkey, and the total area is **184.487 ha**..

Wetlands with National Importance: The Ministry of Forestry and Irrigation Affairs has started to protect these wetlands with national importance in 2015. As of 2015, there are **20** areas that are protected and the total area is **288.427 ha**..

3.2. Areas Protected by The Ministry of Forestry General Directorate: With the Law 6831 which was enacted in August 1956, there are 5 protection status contributing to the on-site protection of the nature. These are; Gene Protection Forests, Seed Stands, Seed Orchards, Protection Forests, City Forests, and Honey Forests. The main purpose of the protection status is not to protect the nature, but to ensure that the sources of the forests are used in a sustainable manner. The following datas were taken from the Ministry of Forestry General Directorate [15].

Gene Protection Forests These are the natural areas and stands that are selected and managed for the purpose of protecting the genetic variety of a species in-situ. There are **186** Gene Protection Forests in Turkey 17 of which was declared in 2015, and the total area is **36.331,58 ha**..

Seed Stands: These are the areas where there are trees of superior quality in terms of character under current conditions in a certain geographical region having specific management and administration. There are **227** Seed Stands in Turkey 23 of which were declared in 2015, and the total area is **33.480,62 ha**..

***Seed Orchards*:** These are the areas that are ecologically suitable for seed production. Seeds are produced in shorter terms, more easily and cheaper due to intensive care precautions in these areas. They are protected from unwanted pollen sources (isolated). The genetic gain is more in these areas because of the fertilization methods among selected seeds when compared with the seed stands. There are **73** Seed Orchards 12 of which were declared in 2015 and the total area is **583,65 ha**..

Protection Forests: These areas have importance in terms of defense of the country, settlements, agricultural areas, and industrial areas, and are allocated for these purposes. There are **44** Protection Forests in Turkey 2 of which have been declared in 2015, and the total area is **33.480,62 ha**..

Honey Forests: These areas are protected for the purpose of encouraging the beekeeping. They are controlled in terms of afforestation, erosion and rehabilitation. These areas are formed by planting proper pants with honey without any intervention. The migrator bees are made comfortable in these areas. There are **65** protected areas in Turkey 17 of which have been declared in 2015, and the total area is **75.298,6 ha**..

City Forests: These areas are allocated for health, sports, aesthetics, cultural and social activities, for contributing to the beauty of the country, for covering the sports and leisure needs of the society, touristic activities, for introducing technical forestry activities and flora and fauna; organizing scouting, trekking, cycling, riding activities to popularize the forests to children and young people, for country restaurants, country coffeehouses, cultural houses, local exhibitions, amphitheaters, various mini sports activities, and other recreational structures and plants in cities and counties. There are **60** forests for these purposes 3 of which have been declared in 2015 and the total area is **8953,73 ha**..

3.3. Areas Protected by* Directorate of Protecting The Cultural and Natural Assest (*The Ministry of Environment and Urbanization): The Law for Protecting the Cultural and Natural Sit were enacted in 1983 with the number 2863, and was amended in 1987 with the number 3386, and includes the protected areas and relevant regulations. In addition, the Special Environmental Protection Areas were also protected by the

General Directorate of Protecting the Cultural and Natural Assets. The following datas were taken from Directorate of Protecting the Cultural and Natural Assest [16].

The Sit Areas: The environment or a rural scenery around a city which is the work of human beings or the nature are considered as a Natural Protection Area [23]. ***Natural Sit Areas:*** These are the rare areas which were formed in geological periods or in prehistoric times that need to be protected because of their properties and beauties underground or above the ground, or under the , having one or more of the topographical, hydrological, biological, aesthetical-perceptional, cultural-historical characteristics, and which need to be protected for being the representative of important natural areas and protecting the natural genetic materials. These are classified in three levels. 1. Level, 2. Level and 3. Level Natural Sit Areas [12]. There are **2430** Natural Sit Areas in 2015 and the total area is **1.773.200 ha**..

Special Environmental Protection Areas: These areas are the areas with historical, natural, ecological and cultural integrity and importance for the country in the world scale. The first legal regulation was enacted in 05.07.1986 in the Official Gazette and amended with the regulation on 12.06.1988 with the number 88/13019 under the name "Determining and Declaring Certain Areas as the Special Environmental Protection Areas" released by the Council of Ministers. There are 16 areas protected by the Special Environmental Protection Areas Management. The total surface area of these **16** areas is **2.459.116,06 ha**..
Protected areas in Turkey by Directorate of Protecting the Cultural and Natural Assets are the largest protected areas both in surface area (2.459.116,06) and number (2430), followed by Special Environment Protection areas protected by the same institution. The smallest protected area is Wild Life Area (545 ha and only 1) protected by the Directırate ıf Protection of the nature and natural parks (Figure 3).

4. CONCLUSION

The protection work which dates back to thousands of years ago in the world became official in Turkey with the declaration of "Yozgat Çamlığı" Area as a National Park [12]. After "Yozgat Çamlığı" Area National Park, many areas were declared as national parks. Many areas were declared as national parks in the scope of the Constitution and international laws. Protected areas in Turkey by Directorate of Protecting the Cultural and Natural Assets are the largest protected areas both in surface area (2.459.116,06) and number (2430), followed by Special Environment Protection areas protected by the same institution. The smallest protected area is Wild Life Area (545 ha and only 1) protected by the Directorate of Protection of the nature and natural parks (Figure 3).

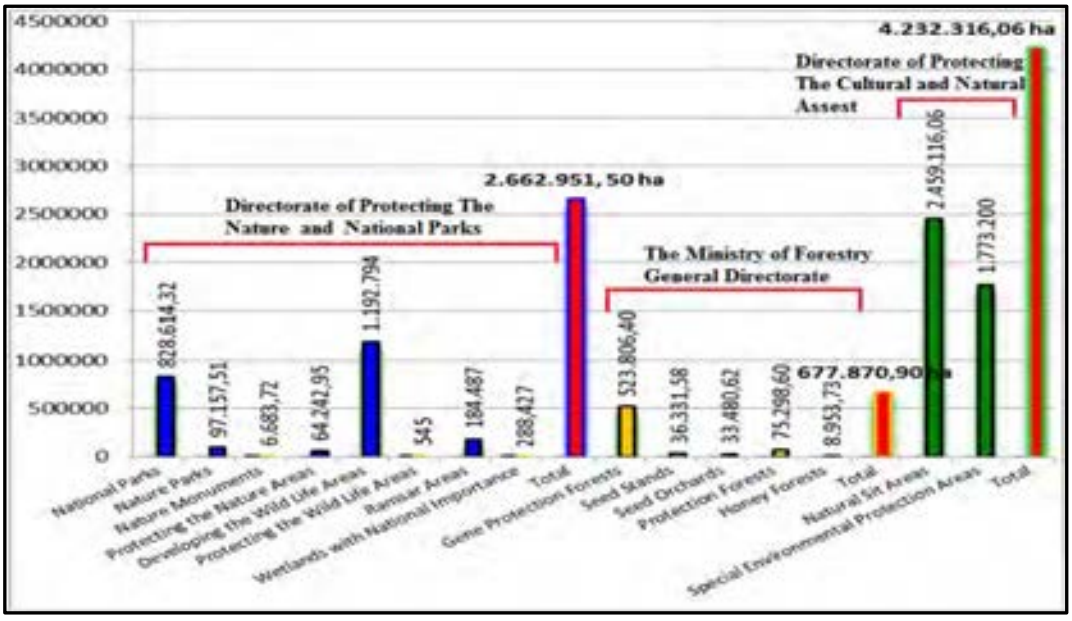

Figure 3. Protection Types and Sizes of Areas in Turkey

The number of the protected areas by 2 ministries and three separate directorates has reached to **3495** and the surface area has reached to **7.516.180,86** ha. The latest status of the protection areas in Turkey as of 2015 is given in Table 1. This area covers 9,23% of the total area of the country. This ratio is about two-fold the value set by IUCN in Bali, Indonesia, telling that countries should have at least 4% of their surface areas as protected areas [3]. It is observed that the current status is very good in terms of surface area.

Table 1. *The Types and Surface Areas of the Protection Areas in the Turkey*

Protecting Institution	**Protection Type**	**Number of Protection Areas**	**Size of Area (ha)**	**Ratio to Country's surface Area**
Ministry of Forestry and Water Affairs Directorate of Protection of the Nature and National Parks	National Parks	40	828.614,32	% 1
	Nature Parks	203	97.157,51	% 0,11
	Nature Monuments	112	6.683,72	% 0,01
	Protecting the Nature Areas	31	64.242,95	% 0,08
	Developing the Wild Life Areas	81	1.192.794	% 1,5
	Protecting the Wild Life Areas	1	545	$\%7^{-6}$
	Ramsar Areas	14	184.487	%0,23
	Wetlands with National Importance	20	288.427	%0,35
Total		**502**	**2.662.951,5**	**%3,27**
General Directorate of Forestry	Gene Protection Forests	44	523.806,4	% 0,64
	Seed Stands	186	36.331,58	% 0,05
	Seed Orchards	227	33.480,62	% 0,04
	Protection Forests	65	75.298,6	% 0,09
	Honey Forests	60	8.953,73	%0,01
Total		**582**	**677.870,9**	**0,83**
Ministry of Environment and Urbanization Directorate of Protecting the Cultural and Natural Assets	Natural Sit Areas	16	2.459.116,06	% 3,02
	Special Environmental Protection Areas	2430	1.773.200	%2,18
Total		**2446**	**4.232.316,06**	**%5,20**
Overall Total		**3530**	**7.573.138,46**	
Total of Overlopping Areas			**56.957,6**	**%0,07**
Total of Protected Area			**7.516.180,86**	**%9,23**

Although the situation is very good in terms of the surface area, these areas lack many important points in terms of quality. The major problems of the protected areas are as follows: The delay in the bidding periods of the Long-Term Development and Application Plans, lack of staff -especially qualified ones-, insufficient infrastructure, insufficient financial resources, problems in legal affairs and in their applications. In addition, the same areas being under the responsibility of different institutions and the lacking coordination among these institutions appear to be among the major problems. Moreover, the insufficient introduction of the protected areas, and the importance not being realized by the people of the area lead to more problems with the people living in the vicinity. As well as increasing the number and the size of the protected areas, it is also important to solve the abovementioned problems to ensure that the protected areas in Turkey achieve to the status they deserve.

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Researching Influence of Climatic Environmental Parameters on Performance of Large Caliber Ammunition during Storage

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Abstract

Influences of environment on ammunition and weapon performance are the subject of continuous research to be able to estimate lifetime of ammunition and establishing quality control. Researching about causes of failure and cancellation of mechanism on some part of ammunition as warhead, cartridge with propellant, primer, fuses and pyrotechnics components are intensively continue to implement.

Temperature and humidity of environment are the main parameters that influence on performance of ammunition during storage. Available date about climatic environmental influence during storage of ammunition and detection of factors that influence on the lifetime of ammunition are relatively scant.

Measurements of temperature and relatively humidity are taken at three geographical locations with different atmospheric parameters on specific warehouses during all four seasons. Temperature and humidity changes are measured outside and inside of warehouse. At the same time, temperature and humidity changes are measured inside of ammunition box and inside of tight fiber container with ammunition. Measurement results are very interesting and require continuous measurements for a longer period. There is necessity to make a model for heat and mass transfer in a complex package of ammunition, which is consisted of inner and outer packaging.

Keywords: ammunition, lifetime, shelf-life, storage, temperature, humidity.

1. INTRODUCTION

Due to the increased number of completed combat mission, ammunition shelf-life becomes very important question for countries in mild climate areas. Lifetime of ammunition is very often limited with propellant aging and condition of storage ammunition.

Ammunition shelf-life or propellants is consisted of two components [1]:

- Safety shelf-life and
- Functional or ballistic shelf-life.

Safety shelf-life of ammunition is often called chemically safe shelf-life and it is a period when the propellant is safely storage without any risk for environment. Safety shelf-life is limited with intensity of chemical

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reactions by aging, like degradation of nitrogen ester and reaction of these degradation products with stabilizer in the propellant. Functional life or ballistic shelf-life is a period when propellant or ammunition can be safely used and during which inner ballistic parameters are unchangeable. Main factors of propellant that limit functional life are decreased molecular weight of nitrocellulose, as a result of diffusion and incompatibility of the aging process. It is normal that ballistic shelf-life of ammunition usage is shorter than safety shelf-life ammunition usage. Shelf-life is interval during which propellant can be stored without danger, operated and used.

Influence of natural environment on ammunition and weapon performance are the subject of continuous study, with the aim to estimate shelf-life of ammunition and establish supervision and control of ammunition quality.

During ammunition storage, temperature fluctuations are very dangerous during day and night with the presence of high humidity. Effects of high temperatures can be physical, chemical effects or combined influence of these two effects. It is important to emphasis that during high temperature and high humidity, negative effects are more significant than when it is lower temperature [2].

To achieve optimal conditions for storage of explosive materials, it is desirable to keep temperature and relatively humidity within certain limits. Ideal conditions are that relative humidity at ammunition warehouse is between 50% and 60%, and temperature inside of warehouse is in interval from 5˚C to 25˚C [3]. Higher relative humidity can cause ammunition damage, and lower humidity can cause static electricity. Higher air temperature can intensify degradation reaction of certain components inside of explosive matters.

In the case when ammunition is longer exposed not only to increased temperature, also to solar radiation, it causes degradation of explosive charge in projectile, if temperature arise above 63˚C.There is possibility that explosion exude through screw joint of fuse and projectile body, and that represents extremely dangerous condition in the launching phase because of the possible projectile explosion in the barrel of weapon.

Pyrotechnic materials are heterogeneous mixture of different materials and very sensitive on higher temperatures during storage. Adhesives of these mixtures are very sensitive on high temperatures and melting, which can cause failure of these systems. Combination of increased temperature and humidity, significantly reduces shelf-life of pyrotechnic materials.

Materials like rubber and different types of plastic are rapidly aging with the increase of environmental temperature, especially if they are directly exposed to the sun and ultraviolet radiation. These materials then become hard and brittle, and rough handling or firing can cause failure of that subsystem.

Impact of humidity in the warehouse can be very complex and significantly depends on air temperature. Humidity at high temperature is significantly higher than at low temperatures:

- When moisture migrates in the chain combustion system, it can lead to the failure of overall system in the phase of launching;
- Single base propellant for guns is very sensitive on humidity impact;
- Direct contact of moisture with metal surfaces that are not enough surface protected causes corrosion (Figure 1 and Figure 2). Effect of corrosion increases in the case of explosive material degradation and reaction with the remains of acid. Humidity can influence on ammunition components and cause uncontrolled chemical reactions, very often with unwanted consequences;
- Because of moisture, ammunition can become unstable and very dangerous. Ammunition is usually stored in buildings that are partly covered with ground. Inside of warehouse is usually high humidity, resulting in occurrence of corrosion and rapid degradation of chemical compounds,
- Reducing relative humidity at warehouses, ammunition shelf-life can be extended;
- Moisture in the air causes presence of corrosion on steel surfaces. When relative humidity is below 45-50%, then steel objects can be stored without any problem. When relative humidity is above 60 %, then the process of corrosion begins on metal objects and if water vapor is present in the air, then the corrosion process is intense (Figure 3);
- Pyrotechnic materials that consist aluminum and magnesium powder, in contact with the moisture can cause oxidation of steel surfaces and difficulties in the process of ignition. Interaction of aluminum powder and increased humidity can cause presence of hydrogen inside of pyrotechnic composition and very serious safety problems.

Diurnal temperature cycling (day-night) can cause that dew point temperature is equal air temperature, and extraction of water from humid air. Extracted water from air migrates inside of ammunition packing or

pervades through seals and joints in ammunition. Because of that, it is very important to design package and components of ammunition that ensure good sealing and waterproof. More complex type of ammunition as part of the package have also indicators of humidity level. Completing ammunition and package, or opening the package with ammunition during inspection and supervision should be done when the level of humidity is low and temperature of the air is also low.

Figure 11. Influence of surface corrosion on AP ammunition 76 mm 345B

Figure 12. Corrosion caused by moisture on pyrotechnical materials in ammunition [5]

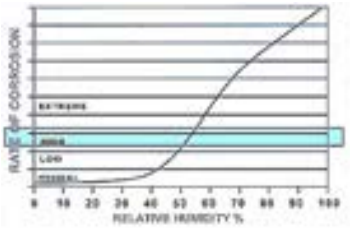

Figure 13. Typical Rate of Corrosion for Ferrous Metals [4]

Higher air temperature during storage of ammunition causes rapid aging of energetic material. Increasing temperature inside of warehouse for 10˚C will generally accelerate chemical reactions for 2 to 3 times [5]. If it is improperly packed, moisture can enter into energetic material and cause degradation by increased rate degradation. Contemporary studies about natural environmental influence on ammunition have shown that it is no longer enough to read temperature once per day, but continuous control of ammunition is necessary (operation in Iraq, Afghanistan, Djibouti etc.). Significant deviations of actual temperature with time were observed, compared to the measurement of a long term mean temperature by time for given warehouse location [6]. Besides that, very important factor is a measurement of temperature and humidity within each package of ammunition. This results with precise data necessary for estimation of remaining ammunition shelf-life.

Researching that are made in Iraq [7] with the aim to determine natural environment impact on shelf-life of ammunition pyrotechnic components (flare), influence of ammunition transport and realistic conditions of storage, made it possible to determine critical data for storage temperature and humidity. Researching comparative functional performance of flares that were exposed to the influence of extreme natural environmental conditions, compared to the flares that were not exposed to these conditions, has shown significant differences.

Increase of humidity and temperature, causes growth of mold on certain ammunition components. With the decrease of relative humidity, process of creating mold can be stopped and in the future growth of mold can be stopped completely.

Large number of explosive materials is sensitive on humidity and because of that, control of humidity has to be done in storage of ammunition and bulk explosive materials. Many components of complicated armed system before integration in projectiles are kept in special containers, in which are certain amount of adsorption substances, type silica, that have ability to absorb humidity. But, ammunition is a complex system and at the same time under the influence of increased temperature and humidity, several different processes are happening. All these processes directly influence on shelf-life of ammunition.

Last 25 years of intensive engagement of armed forces USA and NATO countries in Iraq and Afghanistan are followed by intensive transport of ammunition and its storage under temperatures that have achieved in desert about 60˚C or 70˚C, causing rapid degradation of energy materials in ammunition [8].

Shelf-life of such ammunition is not so long as it was specified by manufacturer. Now, question of ammunition maintain has become essential. Need for periodical control and inspection of ammunition is not only from the point of security, reliability and functional performance, but also from the point of operational status during the war of low intensity.

Chemical effects at increased temperatures are reflected on composition of explosive materials and materials as rubber and plastic. In explosive material, chemical effects due to the increased temperature influence are reflecting in degradation and decreasing ballistic performance or causing chemical degradation of materials and gas occurrence that can cause cracks in propellant charge. According to American concept for estimation shelf-life of propellant for gun, degradation degree of guns propellant during longer exposure to increased

temperature, is twice higher per every increase of ammunition temperature, for every 10˚C rise in temperature above 30˚C (Figure 4) [2].

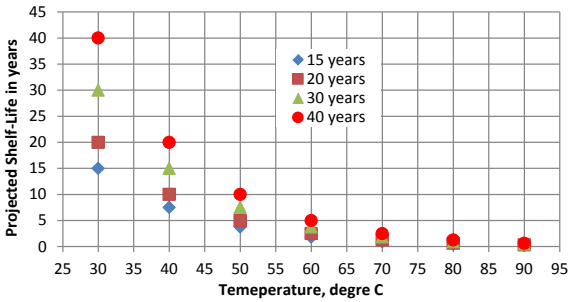

Figure 4. Projected shelf-life gun propellants with increasing temperature above 30˚C (American criteria)

Depending on chemical composition and shape, most of the gun propellants have shelf-life from 15 to 25 years on 30˚C.In mid climatic conditions, its shelf-life can be longer, but during storage under increased temperatures, it is necessary to do earlier control and propellant testing. When designed shelf-life expires, propellants must be tested to establish the remaining amount of stabilizer and to estimate if shelf-life of propellant can be extended.

Decreasing stabilizer content in propellant in the case of delivering external heat or long-lasting process of fuel decomposition can cause self-ignition of propellant in ammunition during storage and explosion of warehouse. It is undesired not only from the safety point, but also from economic, operative and logistic reasons [5].

During ammunition storage, NOx separates from propellant and binds with moisture in the air. A result of that reaction is nitric acid. Material used for propellant charge bags, at propellant charge ammunition can cause deterioration of textile quality (Figure 6) and threaten ammunition function (safety and functional reliability) [9].

Physical effects at increased temperatures cause stress state between certain components at explosive materials. Different materials have different expansion rate and under sudden change of temperature, as a result there are very high stress states on contact surfaces (Figure 5). During large diurnal temperature cycles, it can cause early failure of seals.

It is necessary to continually measure temperature and relative humidity in warehouse. Humidity control inside of container of more complex system is done often in accordance with instructions for certain weapon systems, usually per week. It is necessary to know that with increase of temperature for every 10˚C, increases amount of water in the air for double, but relative humidity decreases by half. When temperature decrease for every 10˚C, relative humidity increases for 50%, until it reaches 100 %. After that, further decrease of temperature causes extraction of water in the air.

Degradation of ammunition does not happen overnight, but when it reaches certain years of age. When ammunition reaches more than 20 years, its reliability rapidly degrades. It can be assumed that 7-8% of ammunition will be lost annually, after reaching age limit of 20 years [10].

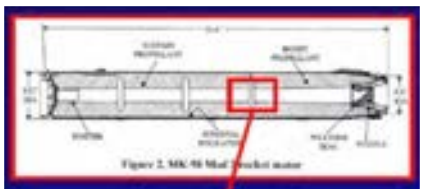

Figure 5. Presence of cracks in rocket charge propellant because of inner stress (Source: paper P. Huisveld, AVT-RTO-089, 2002 Aalborg) [12]

Figure 6. Influence of moisture on bag for propellant charge ammunition 155mm [8]

According to Indian army sources, manufacturer of fuse, in its technical specification, notifies that „minimum shelf-life of fuse for ammunition 155 mm would be 10 years, without deterioration, when it is stored under controlled conditions at temperature 21± 2°C and relative humidity of air that is not higher than 60%, but in the case of storing on open space, minimum shelf-life is six months“ [11].

2. RESEARCHING

Researching about temperature and humidity changes are done in ammunition storage on three location that are geographical and climatic very different in period of time that includes four seasons. The aim of research process is to identify natural environmental parameters that can threaten safety and decrease shelf-life of ammunition [13].

Data is continuously collected by sensors for temperature and humidity measurement on all three locations, or on five objects. Three objects for ammunition storage are Earth Covered Magazine-ECM and other two objects are Above Ground Magazine-AGM. On every location, sensor for temperature and humidity measurement was mounted, resistant to external conditions. Inside of every object, one device with sensors for temperature and humidity measurement was mounted, characterized as safe to work with it in storage of ammunition and explosives. One sensor was mounted inside of wooden box with ammunition that was in fiber container, and second sensor was mounted inside of fiber container (impregnated, waterproof, card boarded) together with ammunition to control state in which is ammunition.

Measurement of temperature and relative humidity at warehouses is done by data logger system Tinytag Plus TGIS-1580 Intrinsically Safe Dual Channel Temperature/Relative Humidity (-40 to +85°C/0 to 100% RH), that allows continuous control of temperature and relative humidity inside of dangerous zones for storage.

2.1. Climatic environmental parameters at ammunition storage locations

Researching about Climatic environmental parameters are carried on locations A, B and C, on different geographical positions. Ammunition storage A is located along a valley surrounded by mountains and along the creek, running through valley. Two magazines are being considered, object ECM-A and object AGM-A. Ammunition storage on location B are located on one plateau, where object ECM-B-1 is located on small basin, and object ECM-B-2 is located in the level with plateau. Magazine AGM-C on location C is located on hill-side, oriented toward the coast.

Measurement results show that there are no significant differences in climatic environmental parameters on ammunition storage locations A and B, but there is perceptible difference in parameters on location C comparing with two other locations (Figure 7 and Figure 8).

On all three ammunition storage locations, maximum environmental temperature during particular period of measuring time does not across 35˚C. Results of relative humidity on all three ammunition storage locations are disturbing, specially on locations A and B. Generally, most of the time during year, ambient relative humidity at ammunition storage locations A, B and C are in the range of 60% to 100%.

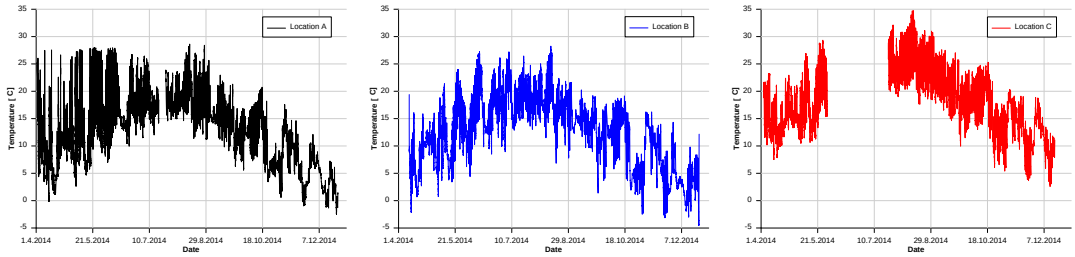

Figure 7. Temperature change at ammunition storage locations A, B and C

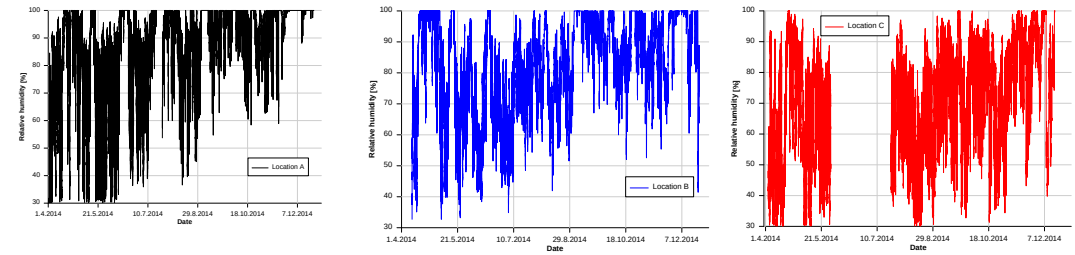

Figure 8. Relative humidity change at ammunition storage locations A, B i C

2.2. Influence of Climatic environmental parameters on the inside of ammunition magazine

Because all five objects that are located on three locations are being considered, where three objects are type ECM and two objects type AGM, there are large differences in the structure between ammunition magazines ECM and AGM. Because of that, environmental influence on temperature and relative humidity parameters inside of the objects will be particularly considered for every type of the ammunition magazine.

Analysis of measurement results for temperature inside of the ammunition magazines ECM-A, ECM-B-1 and ECM-B-2 shows almost identical temperature changes of storage in measurement period. Temperature inside of magazine during considered period was moving from 5˚C do 18˚C, which is extremely suitable for a long-term ammunition storage (Figure 9 and Figure 10).

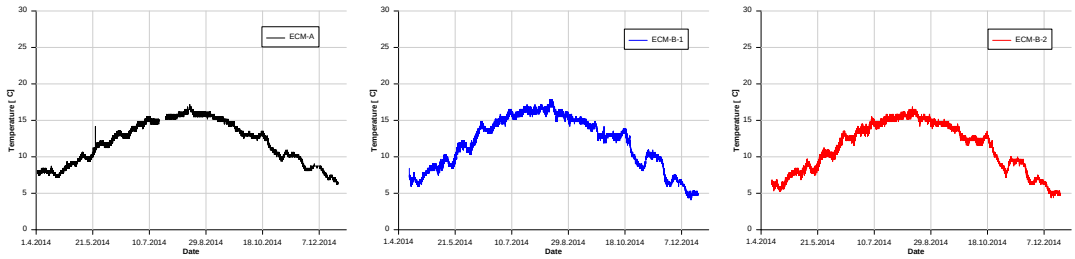

Figure 9. Temperature change inside of the object ECM on location A and B

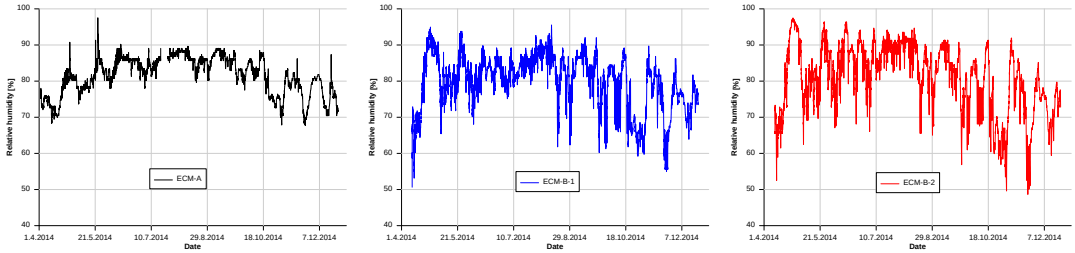

Figure 10. Relative humidity change inside of the object ECM on location A and B

Anaylsis of measurement results for relative humidity inside of three magazines type ECM on locations A and B, shows certain mutual deviations. Average relative humidity inside of these three objects type ECM was about 80%. In the object ECM-A, range of relative humidity change inside of the ammunition magazine varied between 70% to 90%, with relatively small amplitudes of relative humidity change within a short

measurement period. Inside of the objects ECM-B-1 and ECM-B-2, range of relative humidity change was between 50% to 95%, with very large amplitudes of relative humidity change within a short measurement period, which clearly points on problems with natural ventilation system of the objects.
Analysis of measurement results for the internal temperature of magazines AGM-A and AGM-C, shows perceptible differences in temperature changes of storage in particular measurement period, which is objectively result of large differences of outside temperature on considered ammunition storage locations (Figure 11 and Figure 12).

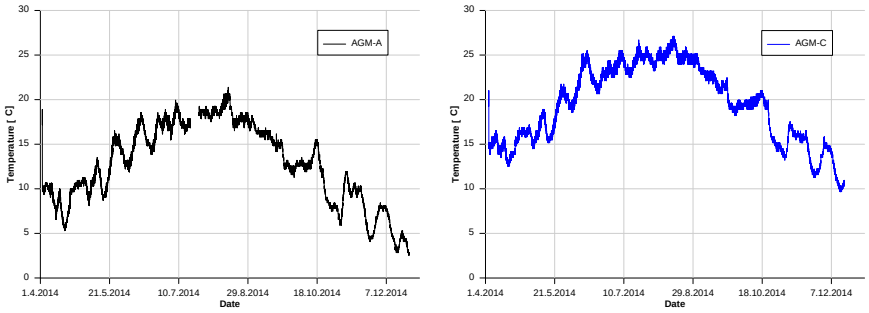

Figure 11. Temperature change inside of the object type AGM on location A and C

Temperature range inside of magazine AGM-A in particular measurement period was from 3˚C do 22˚C, while the temperature range inside of magazine AGM-A in particular measurement period was from 10˚C do 27˚C, which is suitable for a long-term ammunition storage.

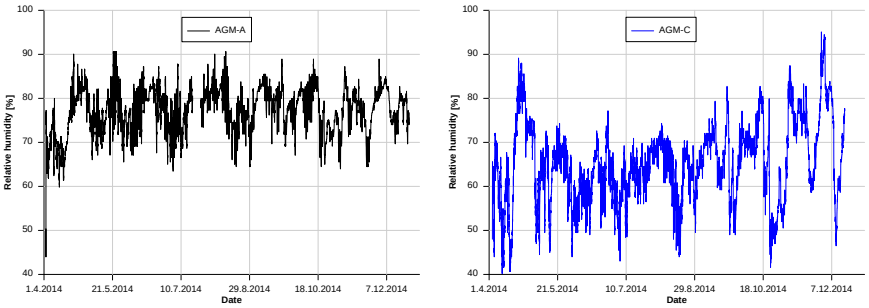

Figure 12. Relative humidity change inside of the object type AGM on locations A and C

Analysis of measurement results for relative humidity inside of these two magazines type AGM on locations A and C, shows mutual significant deviations. Average relative humidity inside of the object AGM-A was about 77%, inside of the object AGM-C was about 65 %.

Inside of the object AGM-A, range of relative humidity change inside of the magazine varied between 65% and 90%, with relatively small amplitudes of relative humidity change within shorter measurement period. Inside of the object AGM-C, range of relative humidity change was between 45% to 95%, but with very large amplitudes of relative humidity changes within shorter measurement period, which clearly points on problems with natural ventilation system of the objects.

2.3. Influence of Climatic environmental parameters on the inside of ammunition packaging

Modern ammunition packaging is consisted of internal and external packing (Figure 13). External packing can be wooden box or metal box, which has primarily task to prevent ammunition from physical damage during transport, operation and storage. Internal packing needs to be hermetic and to protect ammunition from impact of significant temperature and humidity changes. It is usually fiber container in which is ammunition placed, and recently plastic containers are more often used. Unfortunately, significant amount of ammunition of eastern concept does not consist internal packing (Figure 14) and ammunition is directly exposed to the influence of climatic changes inside of magazine.

Figure 13. Wooden box with inner fiber container (Western concept)

Figure 14. Wooden box with ammunition without internal packing (Eastern concept)

Environmental measurement parameters inside of ammunition packaging were compared, especially for the objects type ECM, or AGM. Objects ECM-A i ECM-B are identical by design and performance, but minor differences were noticed in registered values of maximum temperatures in wooden box, but registered values of minimum temperatures in wooden box that were placed in objects ECM-B-1 and ECM-B-2 are lower for about 5˚C. Besides that, temperature amplitudes inside of these boxes are higher than temperature amplitudes inside of considered magazines (Figure 15).

Figure 15. Temperature change inside of wooden box in the objects type ECM on locations A and B

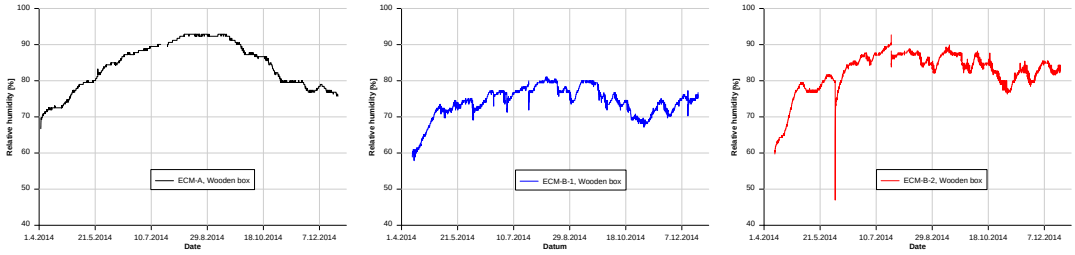

Figure 16. Relative humidity change inside of wooden box in the objects type ECM on locations A and B

Relative humidity in wooden boxes in all three ECM objects is in the range between 60% to 90% (Figure 16), which represents a great danger for ammunition that does not have inner packing, because of the conditions that are suitable for corrosion of metals.

Registered changes in temperature values inside of fiber containers are almost identical to temperature changes in wooden boxes in all three ECM objects for particular measurement period. The maximum registered temperature inside of fiber container was 17˚C (Figure 17), which is extremely suitable from the point of explosive materials stability inside of ammunition.

Relative humidity values in fiber containers in all three ECM objects is about 70 % for the object ECM-A, or 75% for objects ECM-B (Figure 18), which represents a great danger for corrosion of metal. A relative humidity change in fiber containers for a total measurement period is within interval of 5%. That data is very important, because it requires that the process of ammunition mounting into fiber container is carried out in controlled atmosphere, when ambient temperature should not be lower than 20˚C, and relative humidity should be in the range between 40% to 50%. When fiber container with ammunition is hermetic, the current parameters of atmosphere are frozen for a longer period.

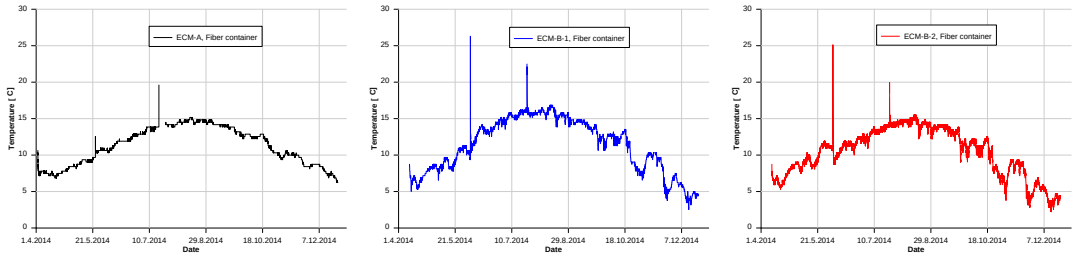

Figure 17. Temperature changes inside of fiber container in objects type ECM on locations A and B

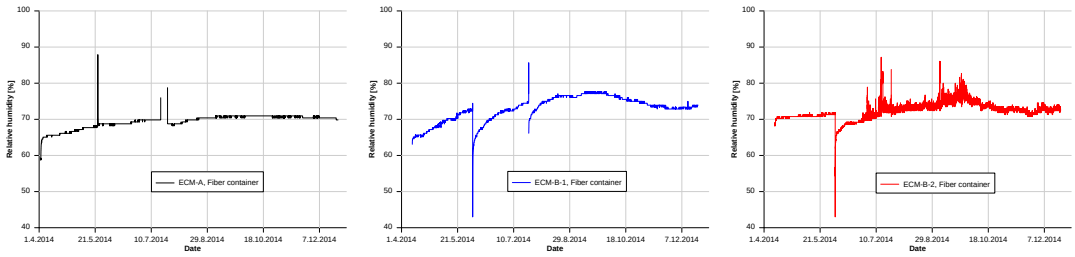

Figure 18. Relative humidity change inside of fiber container in objects type ECM on location A and B

During analysis of atmospheric parameters in boxes that are placed above ground of magazine – AGM, it is perceived that character of air temperature changes is similar to the temperature change at magazine.

Temperature in the box in object AGM-A is higher for about 5˚C comparing with the temperature inside of the box in object ECM-A, that is placed at the same location of ammunition storage. Temperature in the wooden box in object AGM-C is higher for about 5˚C comparing with the temperature inside of the wooden box in the object AGM-A (Figure 19), which is result also of higher ambient temperature at the ammunition storage location C.

Relative humidity changes inside of wooden box in objects type AGM at locations A and C are not in the accordance with temperature inside of wooden box, because of influence of natural ventilation and characteristics of production wooden boxes (gaps between wooden boards).

Registered changes of temperature values inside of fiber containers are almost identical to the temperature changes in wooden boxes in both AGM objects for particular measurement period.

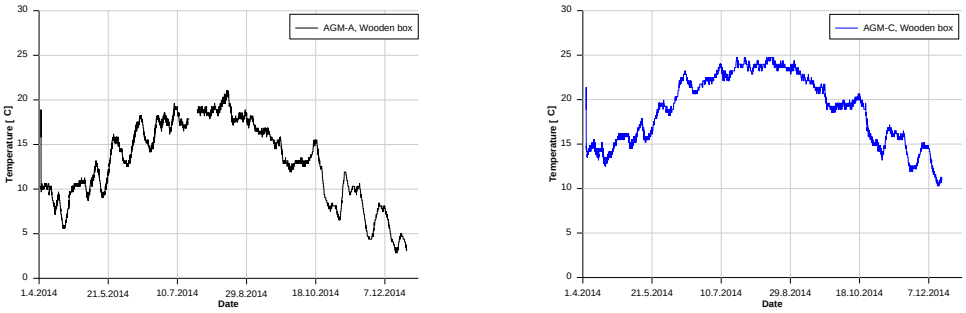

Figure 19. Temperature change inside of wooden box in objects type AGM on locations A and C

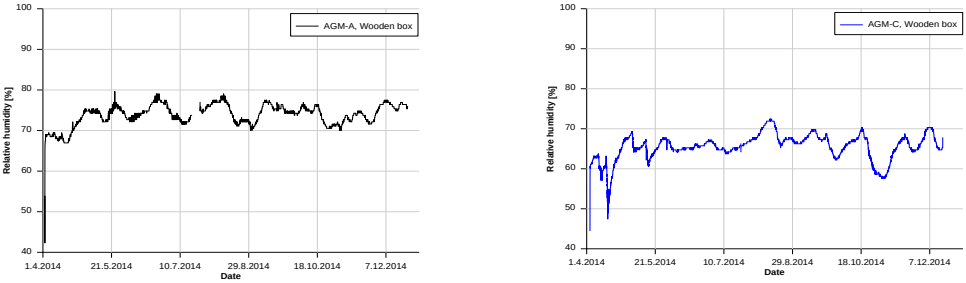

Figure 20. Relative humidity change inside of wooden box in objects type AGM, on locations A and C

The maximum registered temperature inside of fiber container, placed in object AGM-A was 20˚C, and maximum temperature of 25˚C was measured in the object AGM-C, which is suitable from the point of explosives stability inside of ammunition. Total range of temperature changes during a total measurement period was about 15˚C (Figure 21).

Relative humidity values in fiber container in AGM-A object was about 75%, or 65% for AGM-C object, which presents a great danger for ammunition because of metal corrosion. Changes in relative humidity values in fiber containers for a total measurement period are in the range within interval of 10% for AGM-A, or about 15% for AGM-C (Figure 22).

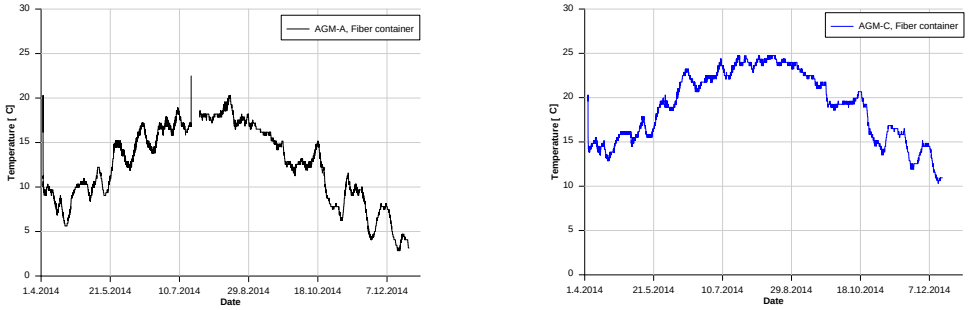

Figure 21. Temperature change inside of fiber container in objects AGM, locations A and C

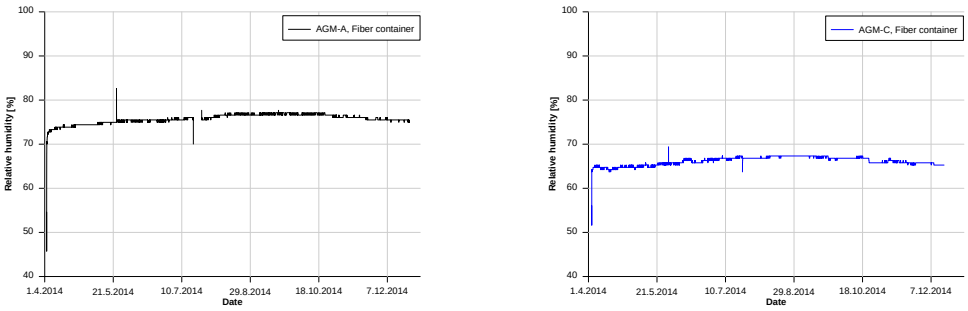

Figure 22. Relative humidity changes inside of fiber container in objects type AGM, location A and C

3. CONCLUSION

Temperature and humidity changes were monitored at ammunition storage on three locations, that are geographically and climate completely different in the period of four seasons.

Three objects for ammunition storage were type ECM, and two objects were type AGM.

On every location, sensor for temperature and humidity measurement was mounted, resistant to external conditions. Inside of every object, one device with sensors for temperature and humidity measurement was mounted, characterized as safe to work with it in storage for ammunition and explosives.

The ambient temperature at all three locations during summer months can be significantly above 30˚C, and sometimes it reaches temperature close to 40˚C.

The maximum temperature inside of the object type ECM was about 15˚C, and inside of the object AGM it reached values of 20˚C (AGM-A), or 25˚C (AGM-C).

From the point of temperature inside of magazines, conditions that can raise rapid degradation of weaker explosives (propellant, black powder and pyrotechnics) did not occur.

Unfortunately, relative humidity on all locations often reached the level of 100% relative humidity.

Average relative humidity inside of magazines type ECM was about 80%, and inside of the object type AGM was in the range between 65% to 77%.

Relative humidity inside of wooden box varied between 60% and 90%, and character of changes was very often similar to the changes of relative humidity inside of magazines.

Relative humidity inside of fiber container (card boarded, impregnated with bitumen layer outside) varied within interval between 65% and 75%.

This high relative humidity inside of wooden box and fiber container represents a great danger for intensifying corrosion process of metal ammunition surfaces, and especially if there is possibility for negative impact on pyrotechnic elements (traces, fuse, ignition charge etc) and on electronic components like guided ammunitions etc.

During ammunition mounting into fiber container or during inspection or ammunition remount, this process needs to be carried out in controlled atmosphere, when ambient temperature should be lower than 20˚C , and relative humidity should be in the range from 40% to 50%. When fiber package with ammunition is hermetic, then current parameters of atmosphere are frozen for a longer period.

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Phosphorus Recovery from Sewage Sludge Filtrate

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Abstract

Phosphorus (P) is one of the fundamental element for all living organisms, also the phosphate reserves are rapidly being depleted in the world. Therefore phosphate should be recovered various source such as wastewaters, sludge, sludge ash. The current depletion of phosphorus has led to the development of various phosphorus recovery techniques and finding new phosphorus sources. In this study, phosphorus recovery potential of sludge filtrate which obtained by electro dewatering process was investigated. In this process ,recycled sludge of secondary settling tank of Bolu Municipal Wastewater Treatment Plant in Turkey was used. Phosphorus was recovered as a struvite which consists of magnesium, ammonium and phosphorus. Pumice stone was used as a seeding material. A Box-Behnken experimental design was used to determine the effects of temperature, mixing time and concentration of the added magnesiumhydroxide on phosphorus recovery efficiency from the sludge filtrate and to determine the optimum conditions. Experimental results were evaluated by using Minitab 17 statistical software method. According to the results, predicted and observed phosphorus recovery values are compared and R squared was found as 0.91. Phosphorus recovery was reached 37 percent at 80^{0}C sample temperature, 2.0 M magnesium hydroxide concentration and 45 minutes mixing time as 15.81 mg PO_4-P /L.

Keywords: Box-Behnken, electro dewatering process, MAP, phosphorus recovery, sewage sludge, struvite.

1. INTRODUCTION

Over the years importance of the phosphorus has better understood but the source of the phosphorus is depleting day by day. One of the phosphorus source is phosphate rocks but rocks cannot be processed economically. Even if these reserves could be processed economically in the future, they are not a renewable resource. The other option for the phosphorus source is phosphorus recovery from wastewater, sewage sludge and sewage sludge ashes. Taking into account the scarcity of this resource, phosphorus recovery from wastewater and sewage sludge is becoming necessary for sustainable development. Municipal wastewaters may contain approximately 5 to 20 mg/L of total phosphorous, of which 1-5 mg/L is organic and the rest in inorganic form. During the wastewater treatment 40 - 95 % of the incoming phosphorus load is transferred into the sewage sludge depending on the technology applied [1]. A modern wastewater treatment process removes phosphorus from sewage using an activated sludge process or a chemical precipitation process, transferring over 90% of the incoming phosphorus to the sludge fraction [2]. Concentration of the phosphorus in wastewater depends on many factors such as people's lifestyle, industrialization and the others.The phosphorus recovery rate from the liquid phase can reach 40 to 50%, while recovery rates from sewage sludge and sewage sludge ash can reach up to 90% [2]. In this study investigation of phosphorus recovery potential from sludge filtrate and parameter's effects were aimed. For this purpose, filtrate of sludge samples which were obtained by electro-dewatering process and transported from Bolu was used. Sewage sludge samples were taken from secondary settling tank's recycled line of Bolu Municipal Wastewater Treatment Plant.

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2. PHOSPHORUS RECOVERY PRODUCTS

Phosphorus recovery products are formed by using crystallization/ precipitation process. Phosphate recovery from the sludge phase, which contains phosphorous in chemically and/or biologically bound form, includes recovery from the digested sludge before and after the dewatering unit [3]. Most implementation cases in full scale are based on the largely researched technologies: the crystallization or precipitation of phosphorus as calcium phosphate [4], [5] or struvite [6].

2.1. Magnesium Ammonium Phosphate (MAP)

The municipal sewage sludge has a great concentration of phosphorus, nitrogen and magnesium. The combination of these ions found in sludge produced from nutrient removal, can result in the formation of a mineral called struvite. Struvite is named after the Russian diplomat H.G. von Struve (1772-1851). Struvite was identified in wastewater treatment plants in 1939 [7]. Struvite is magnesium ammonium phosphate ($MgNH_4PO_4$) and forms a hard crystalline deposit when the molar ratio of Mg: NH_4: PO_4 is greater than 1 : 1 : 1. Struvite forms according to the general reaction shown below in Eq. 1;

$$Mg^{2+} + NH_4^{+} + PO_4^{3-} + 6\,H_2O \rightarrow MgNH_4PO_4\,6\,(H_2O) \quad (1)$$

Struvite has the following properties [8]:

- Struvite is highly soluble at acidic pH and highly insoluble at alkaline pH;
- It has an orthorhombic shape;
- Struvite crystal size vary on different production conditions and found from 15 µm to 3.5 mm in length, [9]; [10];
- White crystalline powder in its pure form but can also occur either as large single crystals, very small crystals, large curds or a gelatinous mass;
- Specific gravity is 1.7, and so struvite might be described as a soft mineral.

Struvite crystal shape can be seen in Figure 1. [11].

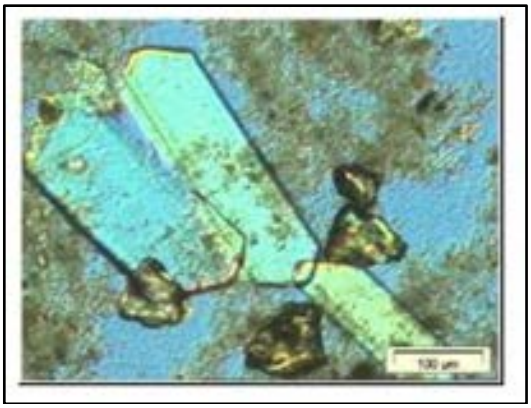

Figure 1. Struvite crystals via X-ray diffraction (XRD)

Struvite reduces sludge generation so it reduces the chemical costs of wastewater treatment plant. Additionally, struvite is a valuable agricultural fertilizer. Struvite (MAP) is a precious fertilizer and it's usage as a fertilizer was discovered in the 1960s in Germany and the USA. The advantages of struvite as a fertilizer are [12]:

- It is slow release fertilizer;

- Nutrient which are in the fertilizer can be used more because nutrients are release slower than the other fertilizer types;
- Application rate is less frequent;
- Fertilizer is not burn even at high application rates;
- Heavy metal concentration of the product is lower than the other supplied fertilizers.

2.2. Hydroxyapatite (HAP)

Phosphorus is also recovered as a calcium phosphates and it calls hydroxyapatite (HAP). The HAP crystallization on crystal seed can be described as given in Eq. 2. [13];

$$10\ Ca(OH)_2 + 6\ H_3PO_4 \rightarrow Ca_{10}(PO_4)_{6.}(OH)_2 + 18\ H_2O \quad (2)$$

The seed is needed for this reaction occurring and HAP growing. Many types of seeds crystals can be used for this purpose such as sands, calcite, cow bone, tobermorite and apatite. pH effect on the phosphorus recovery as HAP is so important and complex. The hydroxyapatite crystallization process is affected by concentration of calcium and phosphate, pH and temperature of process [14].

Hydroxyapetite can be used production of the industrial fertilizer directly or can be mixed with other nutrients or used directly to the soil as a slow release fertilizer.

3. MATERIALS AND METHODS

In this study, phosphorus recovery potential of filtrate which obtained by electro dewatering process was investigated. In this process, recycled sludge of secondary settling tank of Bolu Municipal Wastewater Treatment Plant was dewatered at the model electro-dewatering systems. The sludge filtrate (effluent water) obtained after electro-dewatering processing was used for recovering of phosphorus as a struvite (MAP). Pumice stone was used as a seeding material.

3.1. Methods

3.1.1. Statistical Methods- Box Behnken Design

The Box-Benhken experimental design (BBD) was used to determine the effects of temperature, mixing time and concentration of the added magnesiumhydroxide on phosphorus recovery efficiency from the sludge filtrate and to determine the optimum conditions. Box-Behnken designs are experimental designs for response surface methodology (RSM) and it offers the advantage of requiring a fewer number of runs for three factors. The Box Behnken Design (BBD) coming under RSM, was devised by George E.P. Box and Donald Behnken in 1960. Box-Behnken designs (BBD) are a class of rotatable design and this design requires 3 levels of each factor such as +1, 0 and -1 [15]. +1 is the maximum, 0 is the medium and -1 is the minimum level.
The number of experiments (N) required for the development of Box Behnken design is defined as below Equation 3;

$$N=2k*(k-1)+C_0 \quad (3)$$

Where:

k: number of the factor,

C_0: number of central points.

In this study three independent variables were used. These three variables were coded as X1 (temperature), X2 (concentration), and X3 (mixing time). These variables and values are represented in Table 1.

Table 1. Variables coded and levels

	Codes	Temperature (^{0}C) (X_1)	Concentration (M) (X_2)	Time (minute) (X_3)
Minimum	-1	24	0.1	30
Average	0	52	1.05	45
Maximum	+1	80	2.0	60

The mathematical functions defining variations in the response variables as a function of the explanatory variables can be described as follows:

$$Y = B_0 + \sum_{i=1}^{k} B_i X_j + \sum_{i=1}^{k} B_{ij} X^2 + \sum_{i\rangle 1}^{k} B_{ij} X_i X_j \quad (4)$$

where Y is the predicted response, B0 is a constant, Bi and Bij are cross-product and quadratic coefficient, respectively Equation 4.

3.1.2. Analytical Methods

Filtrate properties were analyzed at the beginning of the experiment. These analyses included chemical oxygen demand (COD), soluble chemical oxygen demand (SCOD), total solids (TS), volatile solids (VS), suspended solids (SS), pH, ammonium nitrogen (NH_4-N) and phosphate phosphorus (PO_4-P). All analyses were done according to Standard Methods (APHA, 2005) and all measurements were done in triplicate.
For researching the effects of variables firstly the characterization studies were carried out. Characterization of filtrate samples are shown in Table 2.

Table 2. Characteristics of the filtrate

Parameters	Average Values
pH	5.12
Total Solids (mg/L)	2167
Total Volatile Solids (mg/L)	1287
Suspended Solids (mg/L)	280
COD (mg/L)	320
SCOD (mg/L)	240
PO_4-P (mg/L)	46

Three different concentrations of $Mg(OH)_2$ solutions were used for struving procuring. 0.1, 1.05, 2 M Mg(OH)2 solutions were prepared by using distilled water. Three different mixing time period were applied to the jars for searching the mixing time effect. Jars were mixed during 30, 45 and 60 minutes. The last factor was temperature. Three different temperatures were applied to the samples which are 24^{o}C, 52^{o}C, 80^{o}C.

Jar test apparatus were used for the experiments. 300 mL filtrate samples were filled in the jars. Filtrate samples were heated to desired degree with water bath and $Mg(OH)_2$ in three different molar concentration was added to each jar. The samples were mixed during 30, 45, 60 minutes.

4. RESULTS AND DISCUSSION

The results of this study were obtained by laboratory scale experiments and statistical design experiments. Minitab 17.0 (Minitab Inc., 2014) software program was used for predicting the efficiency of phosphorus recovery (%). The Phosphorus recovery efficiency was calculated by Eq. 5 where Ci and Ce are the phosphorus concentration of filtrate before and after processing, respectively.

$$\text{Phosphorus Recovery (\%)} = \frac{(C_i - C_e)}{C_e} \times 100 \quad (5)$$

Response function coefficients (B_0, B_1, B_2, B_3 etc.) were used for determining the predicted phosphorus recovery values. Coefficient of the responses are shown in Table 3.

Table 3. Response function coefficients

Response function coefficient codes	Response function coefficient values
B_0	4.0
B_1	2.6250
B_2	-1.0625
B_3	1.4375
B_{12}	2.75
B_{13}	-0.25
B_{23}	-1.625
B_{11}	2.9375
B_{22}	4.5625
B_{33}	-1.6250

These coefficient of responses were used for determining the predicted phosphorus recovery values. According to experiments which were done in laboratory, observed phosphorus recovery values were found. Observed and predicted P-recovery values are shown in Table 4.

After analyzing responses with Minitab 17 statistical software program, it was seen that predicted values and observed values for phosphorus recovery were similar to each other. R squared value is 0.91 for our design and it means that experiments result are successful.

Table 4. Observed and predicted P recovery values

Number of Experiment	P Recovery (Predicted)	P Recovery (Observed)
1	0.9375	3
2	4.3125	5.5
3	6.6875	5.5
4	9.0625	7
5	4.875	4
6	11	11
7	6	6
8	5.625	6.5
9	12.6875	11.5
10	12.4375	14.5
11	5.0625	3
12	15.8125	17
C	4.0	4
C	4.0	4
C	4.0	4

With Minitab 17 statistical software, we can get contour plot profiles. In Figure 2, Figure 3.and Figure 4. Two dimensional surface plots can be seen.

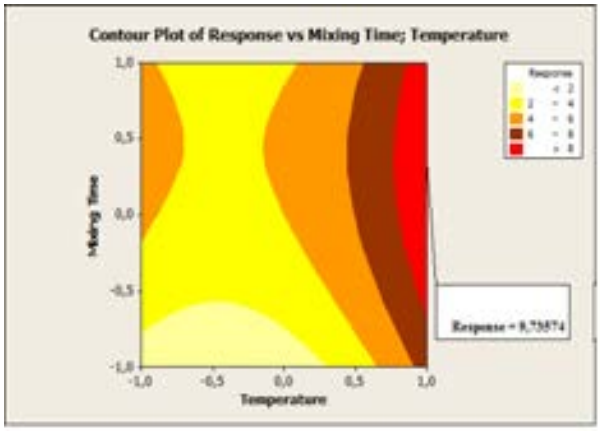

Figure 2. Contour plot of temperature vs time at constant level of concentration

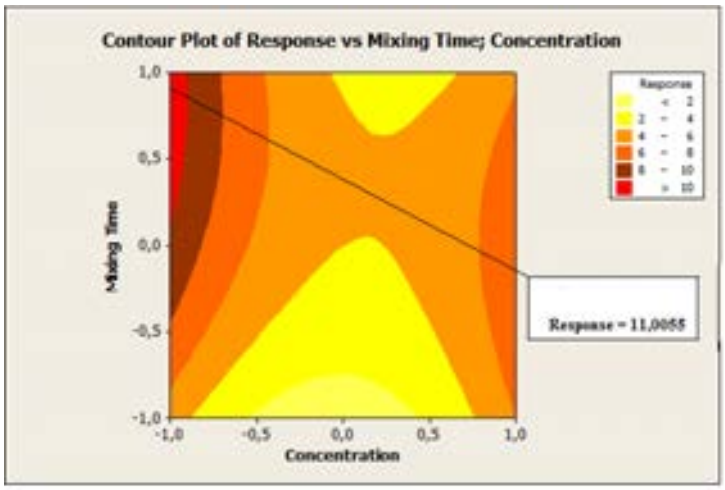

Figure 3. Contour plot of concentration vs time at constant level of temperature

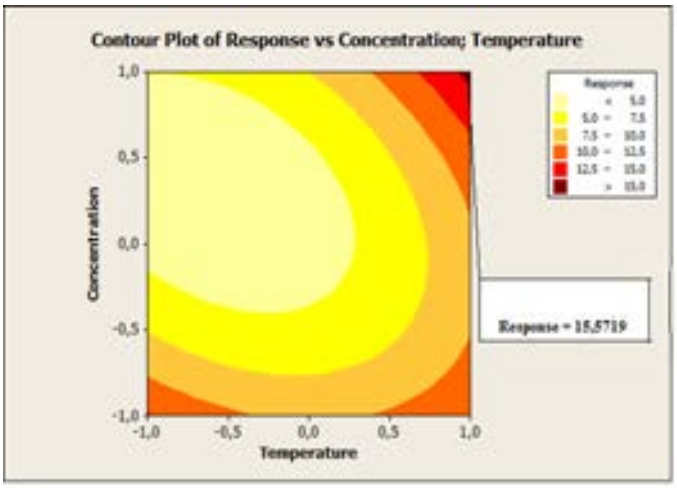

Figure 4. Contour plot of concentration vs temperature at constant level of time

According to contour plot of Minitab 17 for temperature vs time (Figure 2.) high level of time and medium level of temperature give the optimum P recovery for the constant level of concentration that can be seen from the flagged point and the region that is deep red.

As a result of Figure 3, low level of concentration and high level of mixing time give the optimum phosphorus recovery percent for the constant level of temperature and this part can be seen deep red.

In Figure 4, high level of temperature and high level of concentration give the optimum level for recovery of phosphorus. This region is deep as can be seen in this figure.

5. CONCLUSION

The effective parameters on P recovery such as temperature, mixing time and $Mg(OH)_2$ concentration were investigated in this research and investigations were done by lab-scale experiments. According to studies, most appropriate conditions were determined. Three different variables were applied to the filtrate samples, for each of them three value were determined. The design results and lab-scale experiment results gave the same results and the maximum value were obtained at 80^0C sample temperature, 2.0 M $Mg(OH)_2$ concentration and 45 minutes mixing time. Maximum value is 15.8125 mg PO_4-P /L at the end of design studies and 17.0 mg PO_4-P /L at the end of lab-scale experiments. Response surface analyze was used for the comparison these two results and correlation coefficient (R^2) was found as 91%.

In the literature the recovery potential, based on the incoming load, is limited to approximately 10–40 % at the end of the various recovery technologies. In our study, maximum phosphorus recovery can reach 37 % by adding $Mg(OH)_2$ as a magnesium source, heating up to 80^oC and mixing about 45 minutes.

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BIOGRAPHY

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The Thermodynamic Analysis of a Beta Type Rhombic Drive Stirling Engine

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Abstract

In this study, kinematic and thermodynamic analysis of a beta type Stirling engine with rhombic-drive mechanism was conducted. The variations in the hot and cold volumes of the engine were calculated using kinematic relations. The effects on engine performance of rhombus length were calculated by using of nodal analysis in FORTRAN for 200, 300 and 400 W/m^{2}K convective heat transfer coefficients. The optimum rhombus length was 80 mm for convective heat transfer coefficient of 400 W/m^{2}K and 2 bar charge pressure. In this condition, the maximum engine powers were determined for 300, 400 and 500 W/m^{2}K the convective heat transfer coefficients.

Keywords: Stirling engine, rhombic drive mechanism, beta type engine, thermodynamic analysis.

1. INTRODUCTION

Energy consumption is important evidence showing economic and social development of countries [1-2]. Economic development of the countries varies in proportion to the energy consumption per person [3]. In order to compensate the energy demand, mostly coal, oil and natural gas are used. As long as these fuels are consumed to improve the life quality, air and water pollution are going to increase. In addition to this, exhaust gases resulted from the combustion in internal combustion engines damage environment in a great amount. Because of the environmental aspects of fossil-based sources, the studies on renewable energy sources have gained a significant importance [4].

Due to the fact that thermal energy is provided from an external source in Stirling engines, the use of renewable energy sources in energy production is rather high. Also, compared with internal combustion engine, its low noise and vibration levels are important advantages [5]. Stirling engines can be used as heat machine, heat pump and cooling machine [6].

Stirling engines can be classified in three types as operating mode, engine configuration and driving mechanisms. According to the operating mode, Stirling engines can be classified as single-acting, double-acting, single-phase and multi-phase etc. [7]. Single-acting Stirling engines consist of expansion volume, compression volume and a heat exchanger connecting these volumes to each other, which are either on the same cylinders or on the different ones. Double-acting Stirling engines include multiple cylinders. In double-

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acting Stirling engine, the expansion volume of one cylinder is connected through heat exchangers to compression volume of adjacent cylinder [6]. Phase state of working fluid inside Stirling engines varies at single-phase and multi-phase operation modes [8].

According to piston configuration, Stirling engines are usually divided into two groups as kinematic and free-piston engines [9]. There is not mechanical linkage between the moving components in the free-piston Stirling engines and usually a linear alternator connected to the piston rod generates power [5]. Driving mechanisms such as crank-driven, rhombic drive, Swash plate and ross-yoke etc. are used in kinematic Stirling engines [7].

In this study, kinematic and thermodynamic analysis of a beta type Stirling engine with a rhombic-drive mechanism was performed by using for nodal analysis method with FORTRAN code. The effects of rhombus lengths on engine performance were investigated. The engine powers at optimum rhombus length were calculated for different convective heat transfer coefficients.

2. THERMODYNAMIC MODEL: KINEMATIC RELATIONS AND NODAL ANALYSIS

Schematic view of the rhombic driven engine is given in Figure 1. Gear angle was taken as independence variable in order to define kinematic relations. Accordingly, in order to determine the angle made by rhombus rods with the vertical axis, following equations were used:

$$R_r = \frac{l_r}{2.666} \quad [1]$$

$$\beta_r = \arcsin\left(\frac{1}{2} - \frac{R_r}{\ell_r}\sin\theta_r\right) \quad [2]$$

θ_r, β_r, ℓ_r and R_r are gear angle, angle made by rhombus rods with the vertical axis, rhombus length and rotation diameter, respectively. By assuming the gear center as the reference point, positions of the displacer and the piston were described as follows:

$$u_{pt} = R_r\cos\theta_r + \ell_r\cos\beta_r + \lambda + \frac{h_p}{2} \quad [3]$$

$$u_{db} = R_r\cos\theta_r - \ell_r\cos\beta_r + u_{dr} \quad [4]$$

$$u_{dt} = R_r\cos\theta_r - \ell_r\cos\beta_r + u_{dr} + u_d \quad [5]$$

u_{pt}, u_{db} and u_{dt} are distances between the gear center and the piston top center, the displacer bottom center and the displacer top center, respectively. By using these distances, cold and hot volumes of the rhombic engine were calculated with the following equations, respectively:

$$V_{cr} = \left(A_c - A_r\right)\left(u_{db} - u_{pt}\right) \quad [6]$$

$$V_{hr} = A_c\left(u_c - u_{dt}\right) \quad [7]$$

Total working volume of the engine with rhombic mechanisms was divided into 22 nodal volumes. It is an open system consisting of a hot volume space, a cold volume space and 20 spaces in the regenerator. Flow loss was ignored and working gas pressure was assumed to be equal in all nodal volumes. The instantaneous value of working gas pressure was calculated by [10-12],

$$p = \frac{m_t R_g}{\frac{V_c}{T_c} + \frac{V_h}{T_h} + \sum_{i=3}^{n-2}\frac{V_{Ri}}{T_{Ri}}} \quad [8]$$

Time dependent temperature changes in nodal volumes were calculated using the first law of thermodynamics for open system,

$$\Delta T_i = \frac{h_i A_i \left(T_{w,i} - T_i\right)\Delta t - \Delta m_i c_v T_i + E_i - p\Delta V_i + \Delta T_i \Omega}{m_i c_v + \Omega} \quad [9]$$

where Ω is an arbitrary constant. If Ω is taken as zero, the numerical solution of the equations does not converge and cannot be solved. Preferably, Ω is taken as 1. Instantaneous values for mass (m_i) can be calculated using the ideal gas equation. E_i in Eq. 10 is the enthalpy flow in or out of the nodal volume and was calculated by [10-12],

$$E_i = -c_p \frac{T_i + T_{i+1}}{2}\left(\Delta m_{i+1} + \Delta m_{i+2} + ... + \Delta m_n\right) - c_p \frac{T_{i-1} + T_i}{2}\left(\Delta m_1 + \Delta m_2 + ... + \Delta m_{i-1}\right) \quad [10]$$

The cyclic work generation was calculated by,

$$W = \oint PdV \,. \quad [11]$$

In Stirling engines, compression takes places in the cold volume, while expansion and work generation occurs in the hot volume. Therefore, generally the cold volume and the hot volume are respectively called as compression volume and expansion volume. Total volume was divided into 22 nodal cells. Heating and expansion take place in the first nodal volume whereas cooling and compression occur in the last nodal volume. The remaining nodal spaces are in the regenerator. In the analyses, the hot end temperature and the cold end temperature were taken as 800 K and 300 K, respectively. The temperature in regenerator nodal spaces was assumed to decrease linearly between the hot end and cold end temperatures. Kinematic relations and technical characteristics of engine designed have been shown at Figure 1 and Table 1, respectively.

Table 1. Technical Characteristics of Engine

Parameter	***Specifications***			
Gas constant (J/kgK)	*287*			
Cold end temperature (K)	*300*			
Hot end temperature (K)	*773*			
Regenerator volume (cm^3)	*115*			
Regenerator area (cm^2)	*1280*			
Cylinder diameter (m)	*0.086*			
Engine speed (rpm)	*1000*			
Displacement piston rod cross sectional area (cm^2)	*2.5447*			
Rhombic rod length (mm)	***50***	***66***	***80***	***94***
Cylinder length (m)	*0.427*	*0.453*	*0.655*	*0.677*
Piston rod length (m)	*0.07*	*0.07*	*0.12*	*0.12*
Displacement piston rod length (m)	*0.290*	*0.322*	*0.4*	*0.427*
Displacement piston length (m)	*0.155*	*0.155*	*0.285*	*0.285*
Power piston length (m)	*0.12*	*0.12*	*0.12*	*0. 12*

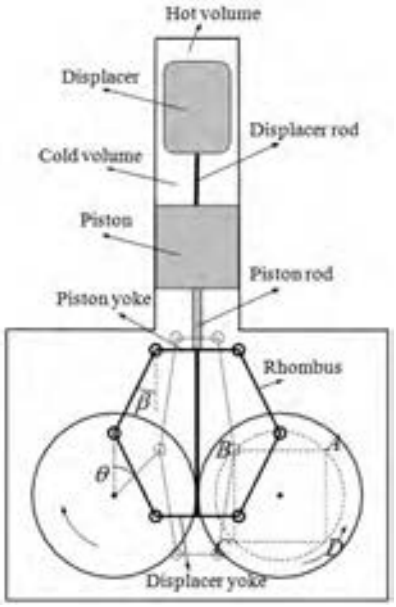

Figure 1. A Schematic view of beta type engine with rhombic drive mechanism

3. TEST ENGINE AND WORKING PRINCIPLE

Beta type Stirling engine with rhombic drive mechanism consists of crankcase, crankcase crankshafts lids, gears, connecting rods, a displacer yoke, a piston yoke, four rhombuses, power piston, displacer and its rod, power cylinder, displacer cylinder and flywheel. The displacer rod passes through the center of power piston. The cold volume is between power piston and displacement piston, the hot volume is the top of displacer. Regenerator takes part between cold and hot volume, and there is no external regenerator. The surface area of displacer cylinder has augmented with rectangular channels having 2 mm width and 3 mm depth and these channels have been used as regenerator.

The rhombic drive mechanism consisted of a piston yoke, a displacer yoke, four rhombuses with equal length hexagon, two symmetric helical gears of equal diameter and two crankshafts. Crankshafts are embedded by means of bearings on the side lids of the crankcase. Two helical gears of equal diameter have been placed as symmetric to the cylinder axis and move in opposite directions to each other. The displacer and power piston rhombuses are connected to pins on helical gears. While power piston is connected to a piston yoke at the upper end of the hexagon, displacer is connected to a displace yoke at the upper end of the hexagon by passing through into the power piston. Figure 1 shows a schematic view of beta type Stirling engine of rhombic drive mechanism. As seen in Fig. 1, when the helical gear pin is at A, working fluid is compressed in the cold volume and the hot volume is at its minimum. At this position, Θ is assumed to be zero. Stirling cycle consist of four process; heating process at constant volume (A-B), isothermal expansion process (B-C), cooling process at constant volume (C-D) and isothermal compression process (D-A).

4. RESULTS AND DISCUSSIONS

In the Figure 2, the variations of engine power with rhombus length for 200, 300 and 400 W/m^{2}K heat transfer coefficients and 2 bar charge pressure are shown. The engine powers for 50 mm, 66 mm, 80 mm and 94 mm rhombus lengths were calculated at different convective heat transfer coefficients. In the literature, Ozgoren and Aksoy performed in the analytical heat transfer analysis of a Stirling engine. In this analysis, the convective heat transfer coefficient in regenerative channel was estimated between 350 and 400 W/m^{2}K with use of air as working fluid [13]. Therefore, the maximum convective heat transfer coefficient was taken as 400 W/m^{2}K in this analysis. Maximum engine power was 240.4 W at 400 W/m^{2}K with 80 mm rhombus length.

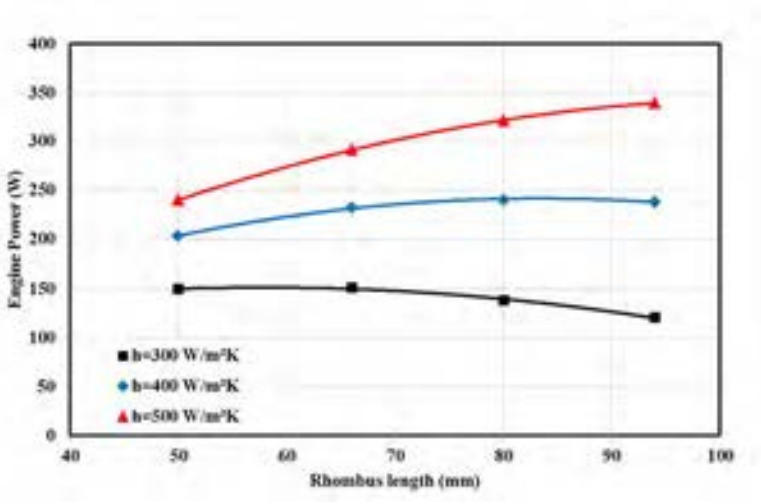

Figure 2. The variations of engine power with rhombus length at 2 bar charge pressure

The variations of hot, cold and total volume of the engine are given in the Figure 3. The engine total volume is 693 cm^3. The expansion process take places between 45^o-135^o crank angles. While the hot volume increases in this process, the cold volume remains constants nearly. Almost all of the working fluid in this process remains in the hot volume and keep on the heated. Thus, this process approaches to ideal Stirling cycle. The process between 135^o and 225^o crank angles is named as cooling process at the constant volume. The work production proceeds with increasing of total volume. The compression process at constant temperature takes place between 225^o-315^o crank angles. It is desired that compression process performed completely at cold volume in this process. The flow of the working fluid the hot volume to cold volume provides an increase in the convective heat transfer coefficient and, thus working fluid is cooled easily [10]. The process between 315 and 450 crank angles is called as heating process at the constant volume. The cold volume continues to decrease during this process and therefore heating performance decreased.

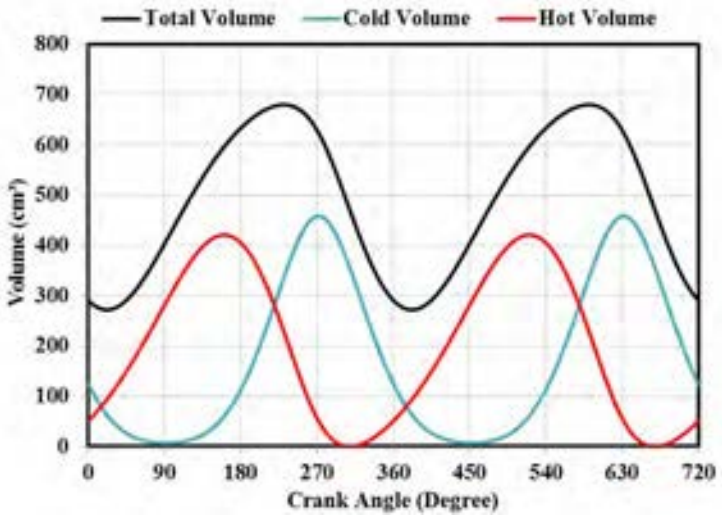

Figure 3. Changes of hot, cold and total volume of engine with rhombic drive mechanism

Figure 4 illustrates p-V diagrams of the engine. Pressure traces were obtained at charge pressure of 2 bar and 300, 400 and 500 W/m^2K the convective heat transfer coefficients. Compression ratio of engine with rhombic drive mechanism was calculated as 2.5. For 300, 400 and 500 W/m^2K the convective heat transfer coefficients, the maximum engine power was determined as 138.3 W, 240.4 W and 321.5 W respectively.

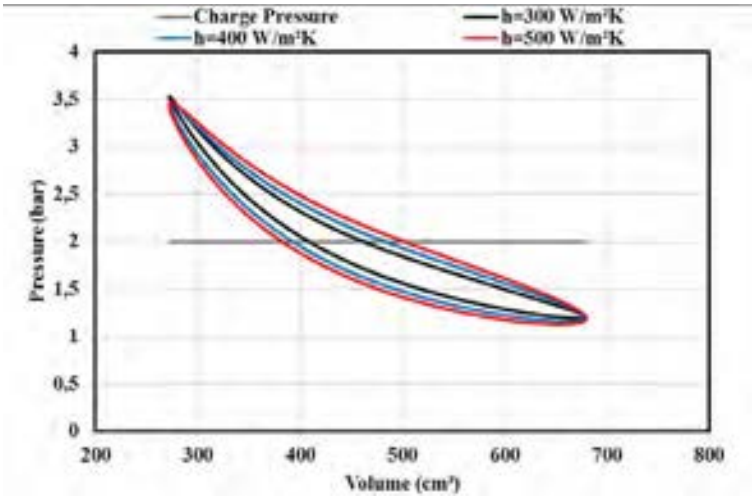

Figure 4. P-V diagrams for different convective heat transfer coefficient at 2 bar charge pressure

5. CONCLUSION

In this study, the effect of rhombus lengths on engine performance was investigated by using of nodal analysis method. The optimum rhombus length was determined as 80 mm for 400 W/m^{2}K convective heat transfer coefficient. The maximum engine powers at optimum rhombus length were calculated as 138.3W, 240.4 W and 321.5 W, for 200, 300, and 400 W/m^{2}K, respectively.

ACKNOWLEDGMENT

This study was supported by The Scientific and Technological Research Council of Turkey (TUBITAK) in frame of the Project code of 113M192. As researchers, we thank to Scientific and Technological Research Council of Turkey.

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Performance and Emissions Characteristic of Diesel Like Fuel Distillated from Tire Oil

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Abstract

In this study, performance and exhaust emission characteristics of a Diesel engine are investigated by using Diesel-Like Fuel (DLF) produced from waste tire oil (WTO). These characteristics such as engine torque, engine power, brake specific fuel consumption (Bsfc), exhaust temperature, nitrogen oxides (NO_x), sulfur dioxides (SO_2), carbon monoxides (CO) and total unburned hydrocarbon (HC) are tested. The DLF is distillated at fixed bed system that consists of filters, a reactor, condenser, collector, thermocouple and an electronic panel. As for the fuel properties of DLF; its viscosity, density, heating value, flash point, sulfur content and distillation characteristic are also tested. Many of the thermophysical and chemical properties and distillation curves of the DLF are seen to be similar to diesel fuel. The results for torque, power, and Bsfc are also quite close to those of diesel fuel. Brake thermal efficiency is decreased while the Bsfc is a little increased for DLF. Emission characteristics are good agreement with those of the diesel fuel. It can be concluded that the DLF can be combusted in a diesel engine without any problem.

Keywords: Tire oil, pyrolysis, diesel fuel, diesel like fuel, engine performances, exhausts emission.

1. INTRODUCTION

Increases in petroleum fares and emission rules have activated researchers to develop an alternative fuel for engines in the world. Petroleum fuels are bounded in certain areas in the world, and are getting depleted from day to day [1-3]. Thus, a large number of research activities about fuel and energy sources have been presented in the literature. There are important waste fuel resources, which include oils, trees, plastics, tires and so on. Unfortunately, these emphasized waste fuel sources cannot be directly used in engines, so they must be reprocessed into the international fuel standards to be utilized for reducing lots of negative effects on environment and other creatures.

A large quantity of waste resources emerges everyday at our living environment. For example, tires are significant waste energy resources. Every year, many tires are disposed of into the environment. Each year approximately 242 million tires are disposed of in the United States, which corresponds to nearly one tire per US citizen per year [4]. Along the next decades, Turkey will be disposing 180,000 tons of waste tires [5]. The rate of waste tire recycling does not keep pace with the rate of new tire generation. The waste tire volume comprises 80% of the total waste tires generated, which are disposed of in stockpiles. These tire stockpiles relate with many problems such as increases in mosquito and rodent populations, long-term tire fires, and illegal tire dumping. On the other hand, these problems can be effectively reduced via proper recycling applications. As a result, the idea of generating a recycling method for the development of new products is crucial, affordable and plentiful resources.

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Generally, a tire includes some certain components, such as rubber loader, vulcanized rubber, fabric belts, steel cord and wire reinforced rubber beads in order to manufacture it in different designs. Mostly, a tire is composed of 24-28% of carbon black, 40-48% of natural rubber (NR) and 36-24% of synthetic rubber, including styrene butadiene rubbers (SBR) and butyl rubber (BR). As mentioned before, different types of rubber are mixed at different ratios to manufacture new vehicle tires [6]. As a consequence, the rubber structure becomes a very complicated carbon and hydrogen compound treated to form cross-links and brunches with each other through the vulcanization application.

Pyrolysis is a hygienic, environmentally friendly and a useful method to produce fuel from waste tires. Some studies presented that vehicle tires are heated into a fixed bed system in order to distillate liquids, solid and gas [7-9]. In addition to waste tire pyrolysis, for upgrading the quantity and quality of fuel, some catalysts have been used in several experiments [10–12]. The waste automobile tires are burned at a customized kiln for emission examinations [7, 13]. In exhaust emission results, the amounts of NO_x and SO_2 gases are approximately calculated as 1.4 % and 0.45 %, which are closed to diesel fuel. The WTO is more viscous than diesel, and it includes high sulfur and carbon soot. Murugan et al. [14] pyrolyzed waste tire to produce tire pyrolysis oil (TPO). Then, TPO sulfur is removed by vacuum method. Besides that, desulphurized tire pyrolysis oil (DTPO) and diesel fuel (DF) are mixed at lower and higher concentrations which are used in diesel engine without any engine adjustment. The 100% DTPO was run at a diesel engine but the engine was failed. Thus, the 90% DTPO and 10% DF (DTPO 90) were blended to be burned in a diesel engine. Aydin et. al. [15] pyrolyzed tires under nitrogen atmosphere (N_2) by adding calcium hydroxide ($Ca(OH)_2$) catalyst. The $Ca(OH)_2$ decreased the sulfur amount in liquid at various amount to obtain its minimum level. The tire fuel (TF) was blended with diesel fuel by 5% (TF5), 10% (TF10), 15% (TF15), 25% (TF25), 35% (TF35), 50% (TF50), and 75% (TF75) ratios. Afterwards, these mixtures and the pure TF (TF100) were burned in a diesel engine to find out the engine performance and exhaust emission. Finally, results were compared and TF was found to be mixed with diesel fuel for burning.

In this study, tire was recycled by pyrolysis method. The chemical and physical features of DLF and the performance and emission parameters of DLF were discussed. The HHV of DLF (42.8 MJ/kg) was found as close as of diesel (46.5 MJ/kg) or petroleum (42 MJ/kg) values [14]. In consequence, chemical and physical features of DLF were tested to determine whether DLF can be burned in engine or not. It was noticed that DLF produced WTO could be combusted in the engine, and the as-obtained results would be discussed deeply in the following sections.

2. PYROLITIC DISTILLATION UNIT

The fixed bed reactor system is manufactured to pyrolyze solids and liquid fuels. The WTO was mixed with additives such as lime (CaO) that converts it into DLF [16]. Main components of the system shown Fig. 1, are a reactor, condenser, filters, collector, thermocouple and an electronic panel. All of these components' functions are shortly explained in this section. The significant part of the system is the reactor in which the heating procedure was calibrated to liquefied oil. The cylindrical reactor is 30 cm in diameter and 40 cm in height and was well-insulated. In the reactor, 20 L of liquid can be treated. The liquid amount should be enough to be used for thermophysical properties and engine tests. The insulation was wrapped up by a glass wool mat with 5 cm thickness to prevent heat losses. The 5 kW heaters were placed around the reactor. Fuel samples could be heated up to 600 ^{o}C by the heaters. The control unit was adjusted through voltage, and managed the heating rate that should be kept at desired temperature. Thermocouple was used for temperature measurement. It was placed at mid-center of the reactor. One other component was the mixer, which blended the sample into the supply with a uniform temperature distribution. Another component was the condenser which liquefied the gas by using cooling water. The non-condensable gas was released into the atmosphere.

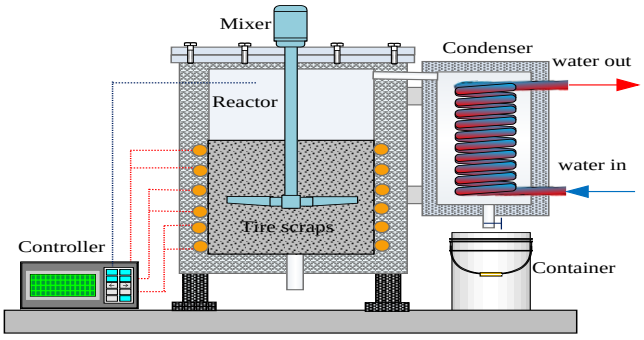

Figure 1. Schematic diagram of the pyrolitic distillation unit

3. PROCEDURES FOR THE EXPERIMENTAL STUDY

In present study, the DLF was produced by using the pyrolytic unit shown in Fig. 1. The DLF was burned in a diesel engine to determine its performance and exhaust emission parameters. The experimental procedures can be explained in three steps. First one is the fuel production process, second one is the fuel characteristics, and last one is the engine and emission parameters. Each step will be discussed in the following sections.

3.1. Production of the DLF

The DLF is produced from waste tire oil by using the pyrolitic distillation unit. It can be expressed in three subtitles as purification, heat degradation and pyrolysis method. The tire is brought from industrial waste. Firstly, it was cleaned from dust and other impurities. Then, it was charged to liquefy in reactor of the unit. Secondly, the WTO was mixed with an additive at a mass ratio of 10% of CaO according to a previously explained study [16]. The WTO was heated up to 400 ^{o}C via slow pyrolysis for 270 min at an incrementally increased temperature shown by Fig. 2. During pyrolysis, the mixer was operated until the end of the process. Light compounds were firstly evaporated and then condensed by circulating water through the condenser. Then, the fuel condensed was taken into a container. At the end of the liquefaction process, the new derivation liquids were separated into light and heavy fractions. They were collected in two different containers. The heavy sample was named as DLF, and its properties and the distillation test were tested whether the DLF was used in a diesel engine or not.

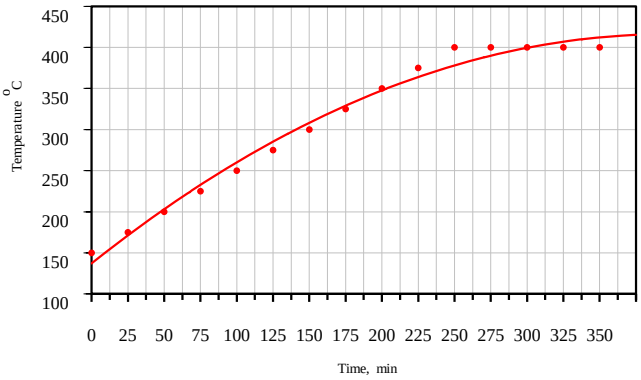

Figure 2. Variation of distillation temperature with time for the DLF

3.2. Characteristics of the DLF

The chemical and physical characteristics of the WTO mixture such as viscosity, density, flash point, heating value, sulfur and distillation were analyzed [16]. According to the results, the WTO mixture was separated into light and heavy fractions which resemble to diesel and gasoline fuels. The heavy fraction amount is % 72 of the total sample which known as DLF. The properties and distillation curve results were given in Table 1 and Fig. 3 for the DLF and a diesel fuel, and also all these would be discussed in Section 5.

Table 1. Characteristics of DLF and diesel fuel

Properties	**TS3082-EN 590**	**DLF**
Chemical formula	$C_{12,226}H_{23,29}S_{0,0575}$	—
Molecule weight	120-320	—
Density at 15 ^{o}C (kg/m^{3})	820-860	818
Viscosity at 40 ^{o}C (cSt)	2.5-3.5	3.49
Flash point, open cup (^{o}C)	>55	57
Sulfur amount (ppm)	650	3500
Water (mg/kg)	<200	130
Lower heating value (kJ/kg)	42700	42500
Temperature at 250 ^{o}C, max. volume (% v/v)	65	20
Temperature at 250 ^{o}C, min. volume (% v/v)	85	90
Volume at % 95, max. temperature, ^{o}C	360	360

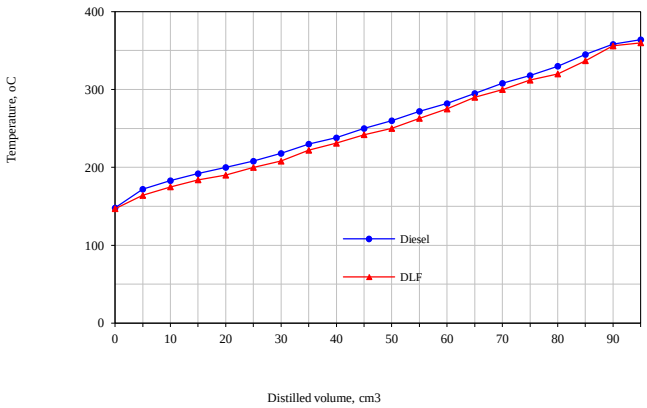

Figure 3. Distillation curves for a Diesel fuel and DLF

3.3. Performance and emission tests

The DLF must be the center of attention to determine and detect the performance and exhaust emission, as a result of combustion in the engine. Therefore, the DLF and a Diesel fuel were used as fuel in a Diesel test engine. Performance and emission parameters were examined by the control panel and the exhaust analyzer. The engine and a hydraulic dynamometer were connected each other to measure performance and emission parameters. The engine model was 4 LD 820. It has a single-cylinder; four-stroke, air cooled, and naturally aspired direct injection. The cylinder bore was 102 mm with a stroke of 100 mm. The maximum power output was 15 hp at 2600 rpm. Schematic and picture of the engine setup are shown in Figs 4. The engine performance parameters are brake torque (T), brake power (P_b), brake mean effective pressure (Bmep), brake specific fuel consumption (Bsfc) and the brake thermal efficiency. In addition to these, engine parameters were computed by fuel and air tken into combustion chamber, HHV_{fuel}, torque and speed [2]. In order to measure the exhaust emissions, Testo 350 model gas analysis device from Drager was used. This device could detect carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen dioxide (NO_x) emissions with a sensitivity of ±1 ppm, and also oxygen (O_2) and (CO_2) emissions with a sensitivity of ±0.1 ppm. After the engine reached the measurement conditions, the analyzer probe was placed in the exhaust pipe. The emission results and performance parameters results would be explained and discussed in Section 5.

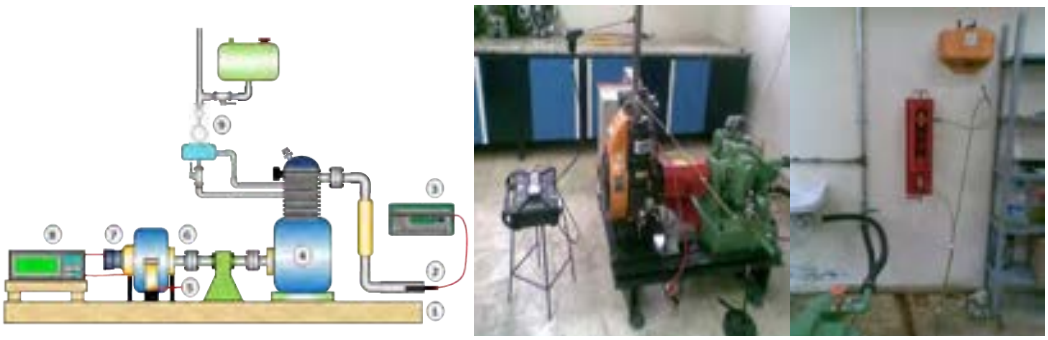

Figure 4. Schematic diagram and picture of the test engine, its dynamometer and exhaust analyzer.
1) Engine chassis, 2) Exhaust gas analyzing probe, 3) Exhaust gas analyzer, 4) Single cylinder diesel engine, 5) Load cell, 6) Dynamometer, 7) Tachometer, 8) Control unit, 9) Fuel burette, 10) Fuel container

4. RESULTS AND DISCUSSIONS

In this study, waste tire was cleaned from dusts and the other impurities by washing, and then dried. The clean waste tire was pyrolyzed, and its liquid called as Waste Tire Oil (WTO) was mixed with 10% CaO. The mixture was exposed to chemical reaction in the reactor, and the liquid was separated into light and heavy fractions by distillation. Furthermore, the pyrolitic temperature with time variation was obtained for the Diesel fuel and DLF. According to the test results, the DLF was burned in a Diesel test engine to obtain

performance and emission parameters. The physical and chemical properties, the distillation tests and performance and emission parameters for the DLF and diesel fuel were declared in figures, tables and discussed in this Section.

4.1. Characteristics of DLF and its distillation test

Fig. 2 demonstrates the relationship between DLF production temperature and pyrolysis time. As seen from the figure, the DLF temperature was increased gradually up to 400^{o}C in 300 min. Afterwards, the temperature became stable at 400^{o}C for 100 min. Characteristics of the DLF and diesel fuel such as density, flash point, sulfur, viscosity, water, HHV and distillation graph were declared, and discussed in Table 1 and Fig. 3.

4.2. Engine performance tests

The DLF and diesel fuel were tested in a four stroke, direct injection, and naturally aspirated single cylinder diesel engine to detect its performance and emission characteristics. Schematic drawing and main components of the engine were given in Figs. 4. The DLF and diesel fuel were burned in engine to evaluate its performance parameters such as torque, Bmep, Bsfc, and thermal efficiency. The DLF and diesel fuel results were given in figures for comparison.

Figures 5, 6, 7, 8 and 9 show variations of power, torque, Bmep, thermal efficiency and Bsfc along with the engine speed. It was observed that torque and Bmep were increased with the engine speed and reached the maximum value at 1500 rpm, whereas the Bsfc reached the minimum value at the same speed. The maximum torque value for the DLF and diesel around at 1500 rpm were observed approximately around 33 Nm. The thermal efficiencies for both fuel samples were shown in Figure 8, in order to support the findings presented in other Figures. Therefore, the figures clearly showed that the DLF does not seem to have any inconvenience. The Bsfc is the ratio of mass fuel consumption to effective brake power and inverse to the thermal efficiency [17]. The Bsfc increases by the brake power increases up to 2500 rpm engine speed. The Bsfc was increased by friction, heat loses and deterioration at high speeds [18]. The performance curve of the DLF was the same with the performance curve of the diesel fuel. The power, torque, and Bmep of the DLF were found to be very close to diesel fuel, which are seen from Figures 5, 6, and 7. Additionally, thermal efficiency for diesel was seemed to be higher than that of DLF in Figure 8, because Figure 9 shows that the Bsfc of the DLF was higher than diesel. So, it is a disadvantageous criterion for the DLF's fuel consumption. Finally, it was understood that the DLF could be combusted safely in diesel engines as observed from figures.

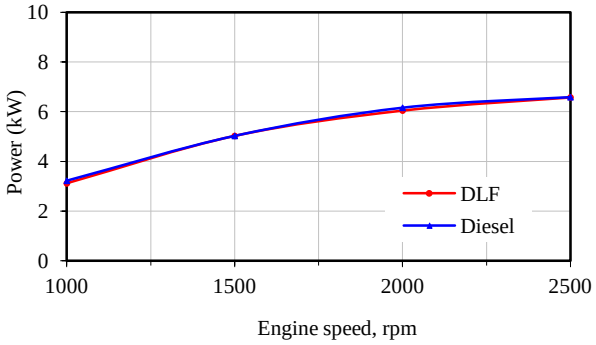

Figure 5. Effects of the DLF on engine power

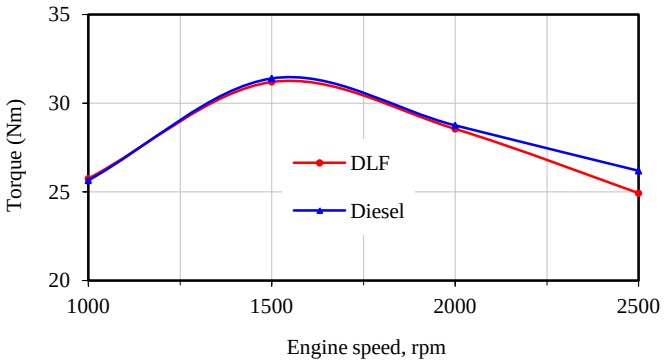

Figure 6. Effects of the DLF on engine torque

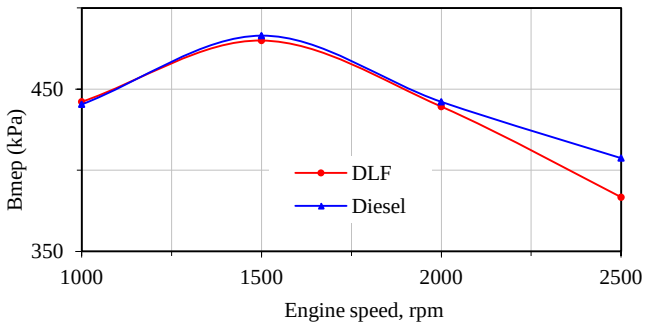

Figure 7. Effect of the DLF on the Bmep

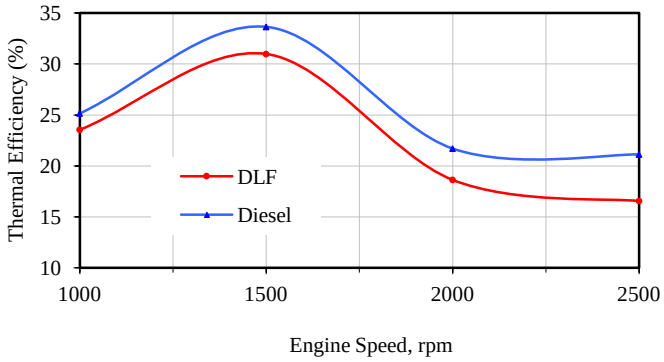

Figure 8. Variation of η_{th} with engine speed

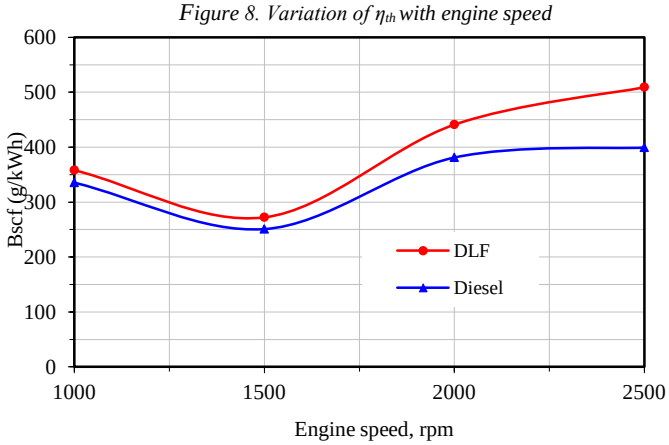

Figure 9. Variation of Bscf with engine speed

4.3. Emission tests

The exhaust temperature and emission values are extremely significant for the engine performance. Thus, the exhaust temperature was measured continuously during the experiment. The exhaust temperature of the DLF and diesel fuel, which were very close to each other, was presented along with the engine speed variations in Figure 9. The exhaust temperatures change between 500 ˚C and 615 ˚C for the DLF, and change between 520 ˚C to 600 ˚C for diesel fuel, which indicates significant change in their values. If any fuel has high distillation temperature, it increases the burning temperature in engine. Accordingly, the higher DLF temperature values correspond to the higher distillation temperatures. Thus, the higher combustion temperature affects the increase in the exhaust temperature. A high exhaust temperature is not preferable, due to the high heat transfer amount into the environment. At a finite value, engine's thermal efficiency decreases with high heat transfer. So, the performance parameters can be agitated by thermal efficiency.

The exhaust emission results were analyzed, in their relation with sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxide (NO_x) and oxygen (O_2), by a gas analysis device. The SO_2, CO, NO_x and O_2

values were verified with both DLF and diesel engine speeds in Figures 10, 11, 12 and 13, respectively. The SO_2 values for the DLF were seen to be higher than that of diesel fuel, as shown in Figure 10. As seen from Table 1, the sulfur presence in DLF was higher than diesel fuel, which had a direct effect on SO_2 emissions at engine combustion. The sulfur was remarkable in the environment due to the fact that sulfur compound gases reacted with water vapor and formed sulfuric acid (H_2SO_4) in the atmosphere. The sulfur rains are detrimental to nature from all aspects. Thus, the sulfur amount in DLF must be decreased to the standard values.

In an ideal burning, CO and NO_x emissions should not be produced after combustion. Such emissions have toxic effect on the environment, as shown in Figures 11 and 12. Emission values of these gases for DLF were found slightly higher than that of diesel fuel for all engine operations. The O_2 emission value of DLF was quite close to that of diesel fuel as shown in Figure 13. The carbon and nitrogen elements were also present in the fuel. The air and fuel were reacted to produce CO_2 and N_2. The excess O_2 was also released in the emissions. The engine emissions are affected by fuel characteristics [19]. The air–fuel ratio, engine temperature [18], inadequacy of oxygen and the minimum combustion time [20] can lead to incomplete combustion. The air-fuel ratio is the other main parameter that affects CO and HC emissions. The NO_x and CO values reached their minimum and maximum points between 1500 to 2000 rpm. Figure 12 11 clearly show that these emissions were reduced at 2500 rpm engine speed. The highest and the lowest points of the figure are the inflections on the curves. The increase in CO amount in combustion chamber was influenced by the deficiency of oxygen and the minimum time of combustion cycle at high speed [20]. The fuel physical properties as density, viscosity, surface tension affect on atomization which determine HC emission. Figure 14 shows that HC of DLF and diesel fuel were closed to each other's.

High emission values, which lead to energy losses and ambient pollutions, are not desirable. In addition, compared to diesel fuel, the low O_2 amount in DLF exhaust could be explained by low air-fuel ratio. It was obviously seen that by decreasing the CO amount, the air-fuel ratio could be increased. As result of ignition, if CO and NO_x emissions were highly decreased, then both the energy consumption and also, the trouble effect on the environment would decrease. So, it also contributes positively to the economy.

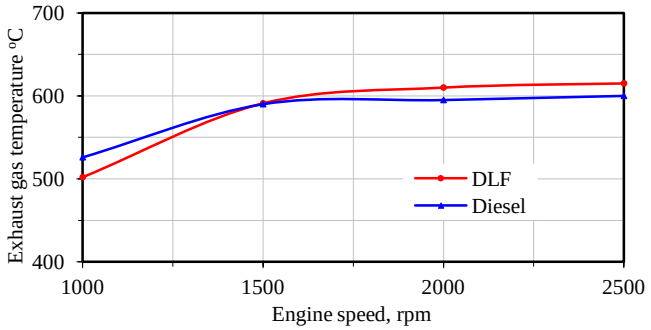

Figure 9. Variation of exhaust gas temperature

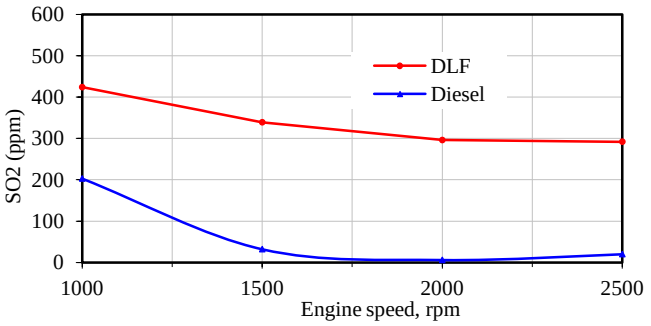

Figure 10. The SO_2 emissions

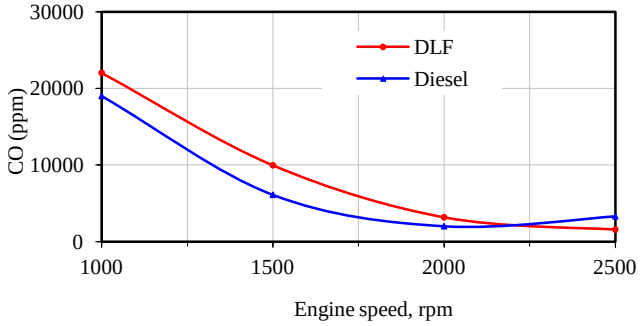

Figure 11. The CO emissions

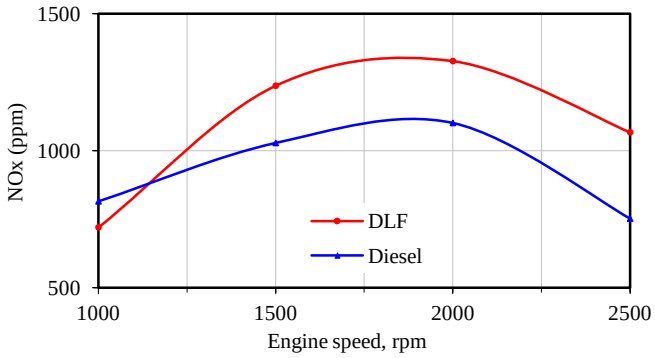

Figure 12. The NOx emissions

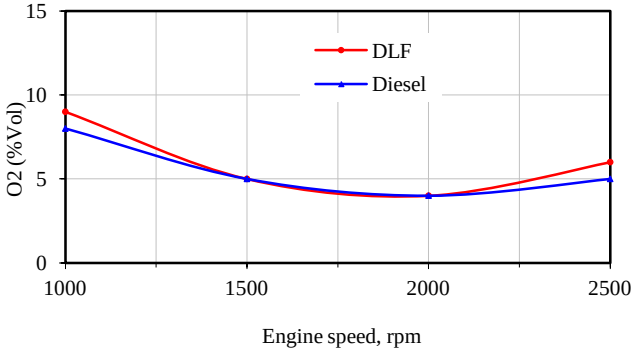

Figure 13. The O_2 emissions

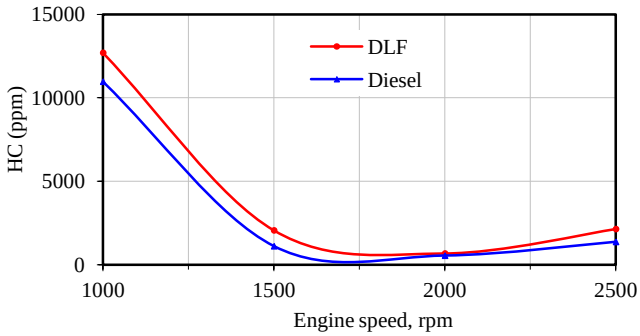

Figure 14. The HC emissions

5. CONCLUSIONS

The chemical and physical characteristics of the DLF and diesel fuel, and their distillation, performance and emission tests were performed in order to compare effects of the DLF fuel produced from waste tire oil on engine performance and emission parameters. Based on these tests, the most important results were given as:

1. The chemical and physical properties of DLF were observed to be similar to diesel fuel. Furthermore, its distillation curve gradually increases or goes to parallel with the diesel fuel, which gives an idea about its use in Diesel engines. The results were corresponding with the diesel fuel standards, except sulfur amounts.
2. The DLF can be used as fuel in Diesel engines without any trouble. According to DLF test results, its torque, power and Bmep were similar to diesel fuel, while its Bscf value was higher than that of diesel fuel, and its thermal efficiency was lower than that of diesel fuel.
3. The cost of DLF was estimated to be 0.8 ¢/l. The DLF provides a big economic advantage for both Turkey and the World. By using the waste tire for this purpose, both the economic expenses of diesel fuel production in different countries and the hazardous materials' release in the environment and atmosphere will be decreased.
4. The DLF's sulfur content was found to be far higher than the standard values. Thus, its value must be decreased. Therefore, desulfurization as the most popular, easy and high efficiency method will be applied in future experimental studies.

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Education and Knowledge of Medical Students about Environment

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Abstract

The aim of this study was to determine the level of knowledge of the students attending a medical faculty about the environment and environmental awareness and to highlight education programs that will be organized in this area. The study is a descriptive, cross-sectional study conducted between September 1 and October 31, 2013. A questionnaire form, which was prepared by the investigators, was applied to the students by face-to-face interview. The data were evaluated by frequency, percent, ratio and chi-square test. The mean age of the subjects who participated in the study was 22.95 ±3.56 years (min=17; max=30). 49.4% of these subjects were female and 50.6% were male. 49.4% students were in the final class and 50.6% students were in the first class. 57.3% of the students lived their childhood in big cities and 23.6% lived their childhood in rural areas. When the questions given by the first and sixth class students were compared statistically, it was observed that environmental awareness was higher in the sixth class students (χ^2 = 9,748, p=0.021). In this study, it was noted that the knowledge of medical faculty students about environment and their environmental consciousness increased over time.

Keywords: Education; Environment; Medical Students; University; Awareness.

1. INTRODUCTION

The aim of the efforts made to protect, improve and rehabilitate the environment in the community is to allow humans to live in a healthier and safer environment.

One of the main reasons emerging in the subject of the environment is the defects confronted in terms of acquisition of knowledge and consciousness rising. Although it is late in the present time when environmental problems have reached the limits where they threaten life, it is necessary that all children and adolescents change their behavior by efficient and continuous education in the area of the environment before the environment is damaged further, and natural sources are eliminated completely, without neglecting adults. The United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 first brought the issue of sustainable development to the attention of the public. The United Nations has designated the period 2005 to 2014 as the decade of “Education for Sustainable Development”. The objective is to integrate the concept of sustainable development in education processes around the world. Environmental education is an integral aspect of this concept [1].

In this context the aim of this study was to determine the level of knowledge of the students attending a medical faculty about the environment and environmental awareness and to highlight education programs that will be organized in this area.

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2. MATERIAL AND METHODS

This study was conducted with individuals who were students in the first and sixth classes of a medical faculty in a university in the province of Istanbul and who were selected by random sampling. The study is a descriptive, cross-sectional study conducted between September 1 and October 31, 2013. A questionnaire form, which was prepared by the investigators, was applied to the students by face-to-face interview. The data obtained were evaluated in a computer environment and statistical analyses were performed using the SPSS 21.0. For statistical analyze of the data frequency, percent, ratio and chi-square test were used.

3. RESULTS AND DISCUSSION

The mean age of the subjects who participated in the study was 22.95 ±3.56 years (min=17; max=30). 49.4%) of these subjects were female and 50.6% were male. 49.4% students were in the final class and 50.6% students were in the first class. 57.3% of the students lived their childhood in big cities and 23.6% lived their childhood in rural areas. When we asked about the interest of the parents of the students included in our questionnaire study for environmental problems, 42.7% of them stated that their parents did not have much interest and 36% stated that their parents had adequate interest. The results of our study are similar with studies investigating environmental knowledge and attitudes in the international literature [2-3-4-5]. Research findings of Oguz et.al, [6] show that; environmental awareness and sensitivity levels were independent from students' grades and although they had basic knowledge on environmental problems and resource protection, they haven't developed enough environmentally responsible attitudes and behaviors. Environmental Problems Attitude Scale was applied the science teacher candidates by the Güven [7] found attitudes of candidate teachers 'in the middle level. According to research of Yurtseven et al.,[8] the first three prior environmental risk factors which were perceived as high/very high risks were reduction of natural areas, water scarcity and shortage and chemical wastes by the university students. The findings of Pooley and O'Connor**'s** [9] study suggest that for environmental educators interested in changing environmental attitudes, emotions and beliefs, rather than knowledge, need to be targeted as sources of information on which to base their environmental programs. In the study which carried out by Atlı and Uzun [10], the environment-related interest and behavior scores of the students were found to be "medium", opinion scores were found to be "high". According the research of Ronkainen **e**t al., [11] over half of the students were very concerned about water pollution and destruction of the rain forests in Finland. It was determined that most of environmental risk factors were not perceived as risk factors by students in the research of Beyhun [12] et al. Hokka et al., [13] realized that environmental attitudes had a connection to some indicators of personal risk behavior such as heavy drinking and smoking. Erten [14] researched whether there is a difference in their perspectives about environmental consciousness between the Turk and Azeri university students. He found that Turkish students are more environment conscious than the Azeri students with respect to environmental consciousness.

67.4% of the group (n=60) thought that environmental pollution was one of the two or three problems which humankind was currently confronted with. 56.2% of the students (n=50) who participated in the questionnaire study reported that they had a certain level of information about environmental issues and problems and 49.4% (n=44) reported that they were adequately interested in environmental problems. 46.1% (n=41) thought the most important source of carbon monoxide which caused air pollution was motor vehicles. 58.4% of the group (n=52) thought that generation of electricity in Turkey was provided by hydroelectric power stations to a great extent and 69.7% (n=62) thought that the reason for river and sea pollution was untreated wastewater discharges. 51 individuals (57.3%) reported that trees were edible resources. 37.1% of the students (n=33) marked that there was an opportunity of recycling for solid wastes in Turkey. 73.0% of the students (n=65) knew that the formal institution, which gave decisions in the direction of protecting the environment, was "the Ministry of Environment and Urban Planning". 41.6% (n=37) of the participants reported that plastic material was more harmful for the environment and 56.2% (n=50) reported that batteries were more harmful for the environment. 82.0% (n=73) thought that the most important reason for gradual extinction of animal species was elimination of living spaces by humans. 47.2% (n=42) of the group marked that nuclear waste was being stored under control in appropriate packages. When the questions given by the first and sixth class students were compared statistically, it was observed that environmental awareness was higher in the sixth class students (χ^2 = 9,748, p=0.021).

4. CONCLUSIONS

Education and teaching of young people in the subject of establishing environmental consciousness and environmental awareness should not be omitted and should be continuous. This education should not remain limited with the personal efforts of some educators who have developed environmental consciousness and environmental awareness. With this objective, all youngsters who receive higher education should be given efficient and continuous education in the subject of the environment and they should be made to develop an environmental consciousness and sensitivity. In medical faculties, theoretic and practical education is given on the subjects of diseases which occur due to environmental factors, the effects of inappropriate working and life conditions on health, air, earth and water pollution and management of solid waste in classes of both public health and environmental health. In this study, it was noted that the knowledge of medical faculty students about environment and their environmental consciousness increased over time.

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Noise Mapping on an University Campus Area: Case Study for Istanbul Technical University Ayazaga Campus

Başak Aydın[1], İsmail Toröz[2]

Abstract

By the help of noise mapping, the area and the amount of population which exposure more noise than regulatory limits can be detected. If it is needed, the ways of noise reduction or control can be estimated. Insulation may be applied or noise barriers may be designed. Noise maps may be done both by measurements or simulation programs. Measurements supply more reliable results but noise mapping by measurement requires a few number of sound level analyzers and experts on noise measuring which increase the costs of projects. Also it takes really long time compared to using simulation programs. Thus, the method that includes using simulation programs and after controlling by some measurements is more feasible. Therefore, in this study firstly noise maps are prepared by a simulation program called SoundPLAN and after measurements are done at 10 different and specific points by Brüel&Kjaer-Type 2250 sound level analyzer. The parts of Buyukdere Street and Istinye Street covering campus are selected as noise source. The purpose of choosing a campus area for noise mapping is that campus includes different kind of noise sensitive buildings which are used for different aims such as education, office works and socialization. Noise maps show that the campus area is as silent as it is supposed to be by regulatory limits. Between working hours (08:30-17:30) most of the buildings inside campus area are exposed to noise level which is lower than 65 dBA, the limit value of day time according to regulations.

Keywords: Noise control, noise mapping, sound level measurement.

1. INTRODUCTION

1.1. The Aim of Study

When the negative effects on environment quality and human health are considered, it is clear that the noise is an environmental problem which should be under control. For this purpose, firstly the area and the population exposed to noise should be determined. Identifying how much the limits are exceeded is necessary to determine the precautions. Noise mapping is the first and main step of noise control. Noise map is identified by Probst as digital and visual modeling of the real environment and noises sources [1]. It is a presentation of changes on sound pressure levels by physical factors on an area. Maps are formed by curves which combine the equal sound levels that obtained by measurements or calculations at certain points.

Overall objectives of the noise maps:

- Calculation of the average sound level of a region at the urban scale;
- Determination of sound levels in a special region whether they exceed the legal limits;

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- Determination of regions that legal sound level limits are exceeded and population who live on these regions;
- Determination of environmental effects of a new or planned to be changed sound source;
- Calculation of noise level of particular source for evaluation of environmental effect report;
- Providing data on work of being affected by noise;
- Determination of current status for action plan preparation.

In this study, noise maps are prepared to determine how much ITU Ayazaga Campus is effected by road traffic noise from Buyukdere and Istinye Strees covering the campus area and to take precautions if it is necessary. The aim of noise control over the campus area is that different types of noise sensitive buildings used for education, accommodation or office works are located together.

1.2. National Noise Control Regulation

Basis for noise control is comparison of the current legislation limits and the sound pressure levels. Therefore, firstly it must be determined which legislation will be taken into account. The basis of noise control activities in Turkey is 14th article of Environmental Act published on 11/08/1983 and numbered 2872. The Article prohibits the creation of noise and vibration which may disrupt physical and mental wellbeing of people and indicates that the precautions should be taken by authorities [2]. Noise Control Regulation prepared in accordance with this Article and came into force in 1986. The basic concepts regarding noise, noise sensitive areas, legal limits and regulations for the various noise sources are explained and the authorities who should implement the regulations are identified. Following the publication of 2002/49/EC numbered Environmental Noise Directive by European Council and Parliament, Noise Control Regulation is revised to comply with European Union conditions, Assessment and Management of Environmental Noise Regulation (AMENR) is entered into force on 01/07/2005. The Regulation indicates that environmental noise maps which determine noise levels caused by a specific noise source, regions that legal noise levels are exceeded and the population exposed to noise, should be prepared [3].

In this study, AMENR which is revised on 04/06/2010 is taken into account. In the Regulation the limit values are given in terms of dB and A weighted-frequency which represents the capacity of the human ear to hear in the best way. The meanings of indicators used in environmental noise maps and shown as L are as below:
L_{day} (day time noise indicator between the hours 07:00-19:00): Average of A weighted and long-term noise levels, based on all daylight hours during a year.

$L_{evening}$ (evening time noise indicator between the hours 19:00-23:00): Average of A weighted and long-term noise levels, based on all evening hours during a year.

Lnight (night time noise indicator between the hours 23:00-07:00): Average of A weighted and long-term noise levels, based on all night hours during a year.

1.3. The Factors Affect Noise Control

The energy generated from any source cause pressure changes on medium while spreading and the pressure changes perceptible by human hearing system is called sound. Sound waves have specific wavelength, frequency and speed. According to these properties, sound waves are affected by environmental conditions such as the distance between sound source and receiver, meteorological conditions, reflective or absorptive surfaces and natural or manmade barriers [4, 5]. These environmental factors are considered both during noise level measurements and preparation of noise maps. To avoid reflection or absorption of noise, if possible, a certain distance should be placed between reflective/absorptive surfaces and measurement point. Some corrections on measured sound levels should be made, if there is not enough distance.
The walls surrounding the campus, mostly made of raw concrete which absorbs sound, and at some points they are covered with reflective materials. The Standard TS-ISO 1996-2 which explains how to do road noise level measurement on site, defines the location information of sound level analyzer such as height of analyzer, minimum distances from absorptive/reflective surfaces and central axis of the road [6]. In accordance with the Standard the analyzer is located 2 m away from surfaces, 7.5 m away from central axis of road and 1.5 m height.
To prepare noise maps some data such as meteorological conditions (average temperature, wind speed, relative humidity and air pressure), the surface character of road, in case of noise barrier existence the dimensions, material information and surface type, is necessary. Simulation programs are designed to determine the behavior of sound by analyzing all data and doing the essential calculations and corrections. In this study road face is smooth asphalt, average temperature is 10˚C, wind speed lower than 5 m/s, relative humidity is 70% and the air pressure is 1013,25 mbar.

2. MATERIAL & METHODS

2.1. Road Noise Map

The major data for road noise mapping are average speed, average number of vehicles per day, ratio of heavy vehicles to light vehicles, properties of traffic and geometry of road [7]. The average speed is obtained from sensors which are placed on Buyukdere and Istinye Streets by Istanbul Metropolitan Municipality. Good Practice Guide published on 13/01/2006 by European Commission and explaining the ways and methods to prepare strategical noise maps, is used as a guide to get traffic data [8]. Due to authorities do not have enough and sufficient traffic data, they are obtained as explained in Guide which indicates that if there is not any datum about number of vehicle per day and ratio of heavy vehicles to lights, observations and counting should be done. Therefore, counting are done three times per day and for four days. Due to not to be able to do counting at night hours the traffic data from the master thesis of Ascigil which includes noise maps from Zincirlikuyu to Maslak covering all the area of this study, are updated according to annually numbers of vehicles from TUIK [9]. The counting results are showed in Table 1. Traffic flow is accepted as fluent for all day long. The geometry of road is obtained from the AutoCAD drawing of campus prepared by Department of Technical and Construction Works of ITU. Noise maps are prepared by SoundPLAN program and to support the results of simulation program sound levels are measured by Brüel&Kjaer brand Type 2250 Sound Level Analyzer.

Table 1. Traffic Data

	Buyukdere Street		Istinye Street	
	Number of heavy vehicles	Number of light vehicles	Number of heavy vehicles	Number of light vehicles
Day	19728	115572	10449	59211
Evening	4460	40936	2230	20070
Night	76	2144	63	1497
Total	24264	158652	12742	80778
Average	182916		93520	

2.2. Noise Mapping by SoundPLAN

SoundPLAN provides software for both noise modeling and air pollution simulation, also it allows to achieve the desired results according to any regulations. Road, rail and aircraft noise, indoor noise and industrial noise can be modeled by SoundPLAN. Grid, facade or mesh noise maps can be prepared. In this study, grid maps are used. The grid noise map comes in two variants, as a horizontal map where the receivers follow the terrain or in the vertical format as cross-sectional noise map. Spacing of receivers and height above the ground are user selectable. There is no size limit for grid noise maps, however as SoundPLAN can load an unlimited number of grid noise maps into each sheet, it is probably wise to partition the grid noise maps for very big areas. In this study, noise maps are prepared in a horizontal plane, distances between grids are selected 100 m and the elevations of grids are 1.5 m. The smaller distances between grid increases the sensitivity of noise levels but computing time gets longer. Therefore the optimum distance between grids is 100 m that provides both sufficient precision in a short computing time. The elevation of grids are selected 1.5 m to make the results comparable with noise level measurements. Since, the noise level analyzer is located at 1.5 m according to the TS-ISO 1996-2 Standard.

2.3. Measurement with Brüel&Kjaer Noise Level Analyzer

Class 1, Type 2250 Brüel&Kjaer hand-held sound level analyzer is used for noise level measurements. An advanced, single-channel hand-held analyzer and sound level meter that has everything needed to perform high-precision, Class 1 measurement tasks in environmental, occupational and industrial application areas. Type 2250 is a highly versatile, cloud enabled, modular platform with many optional application modules such as frequency analysis, advanced logging (profiling) and sound recording.

As shown in Figure 1, six measurement points on Buyukdere and Istinye Streets which represents the properties of traffic flow and four points through the campus are chosen. Five minutes per measurement, three times a day and for four days sound level measurements are done.

Figure 1.Locations of measurement points

3. RESULTS & DISCUSSION

3.1. Noise Maps

Figure 2, 3 and 4 show the noise maps for day, evening and night time respectively. Besides, Figure 5 is a 3D noise map for day time. As clearly seen on maps noise levels are higher than evening and night time due to heavy traffic flow.

All faculties, institutes, laboratories, administrative buildings, lodging buildings and student dormitories are shown on maps. Aforementioned buildings are accepted as noise sensitive in Regulation. As shown in Table 2, noise limits for existing roads where the majority of buildings around the roads are noise sensitive are 65 dBA for day, 60 dBA for evening and 55 dBA for night. Results of noise maps are due to these limit values.

Table 2. Environmental noise limit values for roads

Areas	Planned/Renovated/Restored roads			Existing roads		
	L_{day} (dBA)	$L_{evening}$ (dBA)	L_{night} (dBA)	L_{day} (dBA)	$L_{evening}$ (dBA)	L_{night} (dBA)
Areas where the majority of buildings are used for education, culture, health and camping areas or summerhouses which are noise sensitive	60	55	50	65	60	55
Areas where commercial and noise sensitive buildings located together, majority of buildings are dwellings	63	58	53	68	63	58
Areas where commercial and noise sensitive buildings located together, majority of buildings are work places	65	60	55	70	65	60
Industrial sites	67	62	57	72	67	62

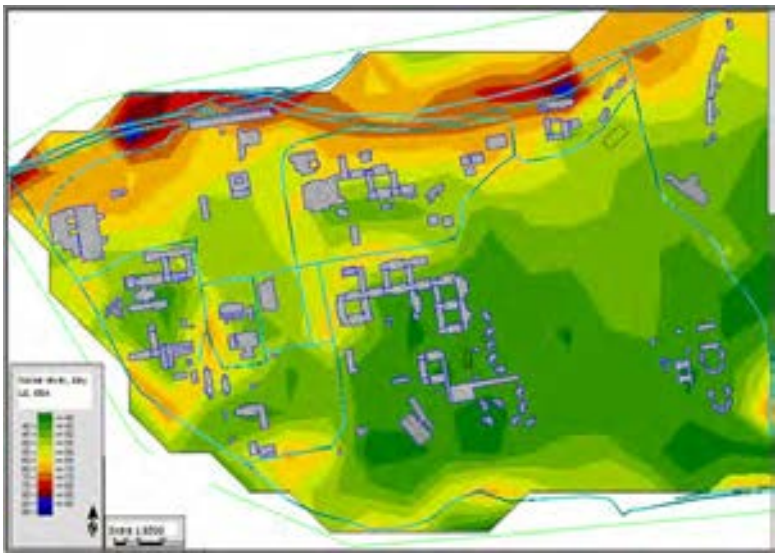

Figure 2. Noise levels, day

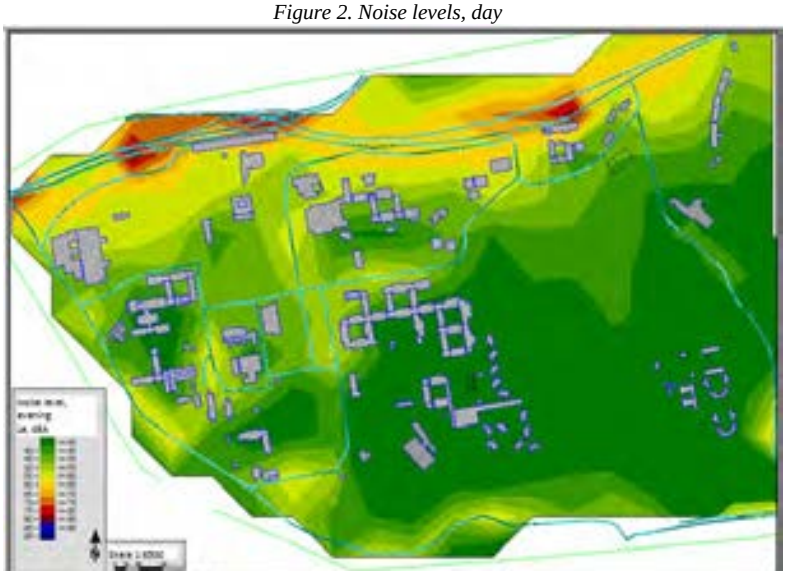

Figure 3. Noise levels, evening

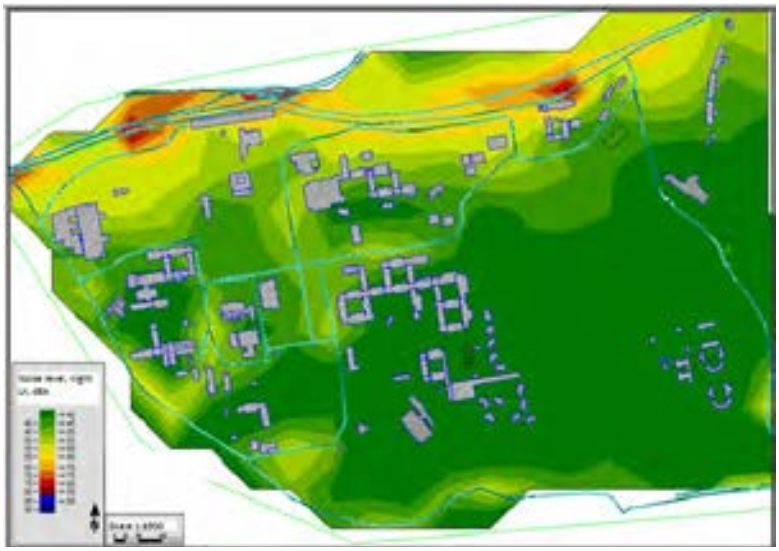

Figure 4. Noise levels, night

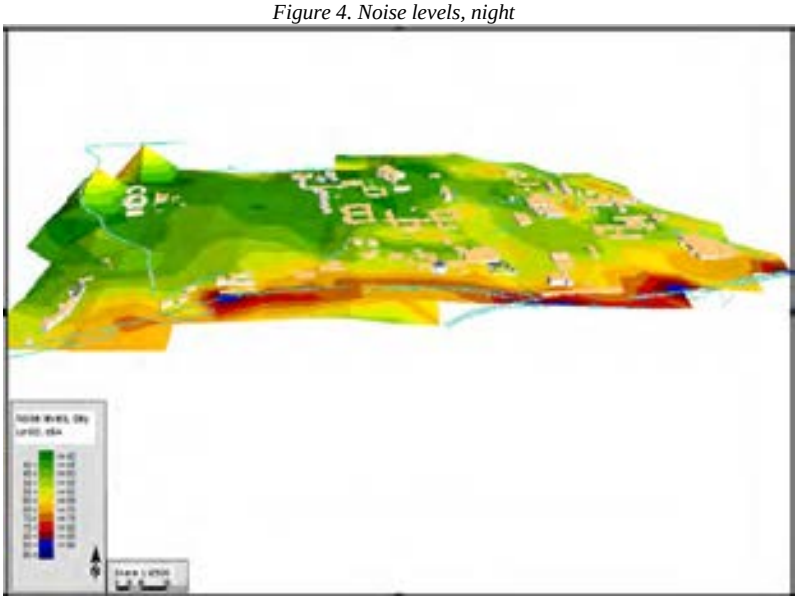

Figure 5. Noise levels-3D, day,

3.2. Noise Level Measurements

The results of noise level measurements at points which are shown on Figure 1 are listed in Table 3 and 4.

Table 3. Sound pressure levels at the points inside the Campus

Results of measurement points inside the Campus			LA eq	Results of measurement points inside the Campus			LA eq
Measurement point 1	04.11.2014	morning	58,3	Measurement point 3	04.11.2014	morning	60,6
		afternoon	60,7			afternoon	57,5
	05.11.2014	morning	58,4		05.11.2014	morning	57,4
		afternoon	62,0			afternoon	60,7
	06.11.2014	morning	58,1		06.11.2014	morning	57,2
		afternoon	66,5			afternoon	58,5
	10.11.2014	morning	63,1		10.11.2014	morning	63,2
		afternoon	62,3			afternoon	57,0

Measurement point 2	04.11.2014	morning	68,0	Measurement point 4	04.11.2014	morning	63,1
		afternoon	64,8			afternoon	65,1
	05.11.2014	morning	69,9		05.11.2014	morning	64,7
		afternoon	67,3			afternoon	64,6
	06.11.2014	morning	64,5		06.11.2014	morning	67,2
		afternoon	66,4			afternoon	64,0
	10.11.2014	morning	66,2		10.11.2014	morning	61,2
		afternoon	60,5			afternoon	63,6

Table 4. Sound pressure levels at the points outside the Campus

Results of measurement points outside the Campus			LA eq	Results of measurement points outside the Campus			LA eq
Measurement point 1	04.11.2014	morning	80,0	Measurement point 4	04.11.2014	morning	75,3
		afternoon	82,6			afternoon	75,2
		evening	82,8			evening	78,7
	05.11.2014	morning	83,3		05.11.2014	morning	74,8
		afternoon	82,7			afternoon	75,4
		evening	82,2			evening	76,6
	06.11.2014	morning	78,4		06.11.2014	morning	74,6
		afternoon	82,1			afternoon	75,8
		evening	83,2			evening	75,9
	10.11.2014	morning	75,9		10.11.2014	morning	77,0
		afternoon	82,7			afternoon	76,0
		evening	82,8			evening	76,3
Measurement point 2	04.11.2014	morning	77,3	Measurement point 5	04.11.2014	morning	68,7
		afternoon	81,5			afternoon	69,6
		evening	80,5			evening	68,2
	05.11.2014	morning	77,6		05.11.2014	morning	67,8
		afternoon	80,8			afternoon	68,3
		evening	83,1			evening	66,3
	06.11.2014	morning	77,2		06.11.2014	morning	70,1
		afternoon	81,8			afternoon	73,5
		evening	80,5			evening	69,4
	10.11.2014	morning	76,1		10.11.2014	morning	69,6
		afternoon	81,7			afternoon	71,5
		evening	79,1			evening	66,3
Measurement point 3	04.11.2014	morning	75,7	Measurement point 6	04.11.2014	morning	76,3
		afternoon	77,8			afternoon	75,4
		evening	78,5			evening	68,3
	05.11.2014	morning	75,1		05.11.2014	morning	76,1
		afternoon	79,4			afternoon	74,5

	evening	76,4		evening	69,9
06.11.2014	morning	77,1	06.11.2014	morning	75,2
	afternoon	78,5		afternoon	76,8
	evening	77,2		evening	72,1
10.11.2014	morning	75,2	10.11.2014	morning	77,2
	afternoon	79,1		afternoon	76,4
	evening	76,0		evening	71,1

4. CONCLUSION

Noise levels on maps and measurement results are both in terms of dBA and they represents the levels at same elevation. Therefore they are comparable. However, measurements are done between 08:30-17:30 hours. So that only day time (07:00-19:00) noise map results should be compared with measurements. Table 5 shows the averages of measurements and intervals of noise maps for same points.

Table 5. Comparison of noise map levels and noise measurements

Measurement points	Measurement results, dBA	Grid noise map results for day time, dBA
Measurement point 1	82	80-85
Measurement point 2	80	80-85
Measurement point 3	77	75-80
Measurement point 4	77	75-80
Measurement point 5	69	70-75
Measurement point 6	74	70-75
Measurement point 7	61	55-60
Measurement point 8	65	55-60
Measurement point 9	58	55-60
Measurement point 10	63	55-60

First 6 points are from outside and the last 4 points are from inside the Campus. The results from outside points mostly equal to the measurement results. On the other hand the results of measurements inside the campus are a little higher than noise map levels. The reason of this situation is excavation works around measurement points. Landscaping sounds interference to noise measurements. If these sounds are ignored it can be said that noise maps give accurate results.

Especially day time sound levels need to be evaluated. Because both offices and classes are mostly used between day time hours (08:30-17:30). Therefore if the limit values for day are taken into account, only three building completely exposure more noise than regulatory levels. Besides some parts of five buildings exceed limits. Totally just eight of dozens of buildings exposure high levels of noise. For this reason to take measures covering the entire campus would not make sense and it is more feasible and economic to take individual precautions for these eight buildings. The Regulation indicates how to take precautions for individual buildings in Appendix 4, Part 3 [10].

It is clearly seen that the noise levels across the campus, between day hours are mostly between 55-60 dBA which are within acceptable limits. At evening and night hours library, student dormitories and lodging buildings are used. When the location of these noise sensitive buildings are considered noise levels do not exceed 55 dBA. In conclusion Buyukdere and Istinye Streets do not affect the campus negatively even in day time. Also regulatory limits are not exceeded across the campus at any time.

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BIOGRAPHY

Basak Aydin had her bachelor's degree on environmental engineering in 2011 at Istanbul Technical University. After one semester break, she decided to study about environmental noise control. By the guidance of her advisor, Prof. Dr. Ismail Toroz, she started master program of environmental sciences and engineering in 2012 at ITU. During master program she took courses about acoustic, noise control and management from departments of mechanical engineering and architecture. Owing to the course she took from Department of Arhitecture of Yildiz Technical University she learned to use SoundPLAN program and how to create noise maps. Owing to all these courses she set the topic of graduate thesis and studied on noise maps of ITU Ayazaga Campus. After graduating from master she began PhD in 2015. She still studies on noise and engineering acoustics.

Evaluation of Heavy Metal Fraction Values in Golden Horn Estuary

Gurdal Kanat[1], G.Onder Erguven[2], Bahar Ikizoglu[3]

Abstract

A study of total and partitioning of heavy metal concentrations in sediments collected from a rehabilitated estuary was conducted. Partitioning of speciation of each heavy metal in sediments showed that heavy metals were mainly from terrestrial and anthropogenic sources. Relative proportions of metals in the acid soluble fraction were very low but speciation of the metals in sediments still exhibited high bioavailability. Sediment quality of the estuary showed that the sedimentary environment was relatively in good condition but still exhibited potential ecological risk of heavy metals.

Keywords: Heavy metals, sediment, metal fractions, estuary.

1. INTRODUCTION

Heavy metals in ecosystems have received extensive attention because they are toxic, non-biodegradable in the environment and easy to accumulate and magnify in organisms. Industrial development accompanied by population and consumption growth has imposed heavy pollution loads to natural resources [1]-[3]. Heavy metals are among the most common environmental pollutants, and their occurrence in waters and biota indicate the presence of natural or anthropogenic sources. Estuarine and coastal areas are often regions of high population density and intensive human activity. The main natural sources of metals into the aquatic system are the weathering of soils and rocks and also from anthropogenic activities, whereby industrial and urban wastes are discharged into water bodies [4]. Sediment analysis is often included in environmental assessment studies because the overall quality of aquatic systems is related to sediments characteristic. Metal accumulation in sediments poses an environmental problem due to possible metal transfer from the sediments to aquatic media [5]. The metals can be either adsorbed onto sediments or accumulated in benthic organism, sometimes to toxic levels. Therefore, the bioavailability and subsequent toxicity of metals have been a major research area [6], [7].

The total sediment concentration of a metal does not provide information concerning its mobility, availability, or toxicity. Fractions extraction is a well-established approach for the investigation of different forms of trace metals in soils and sediments. Fractionation analyses of the metals are not only very useful to determine the degree of association of metals in sediments, and to what extent the metals may be remobilized into the environment, but also to distinguish those metals with anthropogenic origins. Metals with anthropogenic origins are mainly found in the first three extraction fractions (soluble in acid, associated with Fe and Mn oxides, and associated with organic matter and sulfides), while metals with lithogenic origins are found in the residual fraction obtained in the last stage of the extraction process [8]. The metals in acid soluble fraction (i.e., the exchangeable and bound to carbonate fractions) are mainly introduced by human activities and are considered to be weakly bound. This fraction may equilibrate with aqueous phase and thus become more

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rapidly bioavailable and cause environmental toxicity. The reducible fraction (bound to Fe/Mn oxyhydroxides) and the oxidizable fraction (bound to organic matter) can be mobilized when environmental conditions become increasingly reducing or oxidizing, respectively [9], [10].

In this study, the aim was to find the distribution of heavy metals in sediment of a rehabilitated estuary in Istanbul city, namely the Golden Horn estuary. In the paper, comparative studies of concentration and speciation of heavy metals in sediments from the estuary were conducted. The results provided a comprehensive look at the current sediment contamination status of heavy metals and the potential origin of contamination. The study will provide accurate risk appraisal of heavy metals in the environment, which is helpful to engineers and decision makers to manage, control, and further eliminate the pollution.

2. MATERIALS AND METHODS

2.1. Study Area

The Golden Horn (Halic in Turkish) is a 7.5 km long, 200–900m wide hornshaped body of water that connects the Alibeykoy and Kagithane Rivers to the Bosphorus strait (Figure 1). Estuarine surface area covers 2.6 km^2 and maximum depth is 36m at the mouth, sloping to <1 m near tributary inflow. In the past decades, unplanned, uncontrolled urban development around the Golden Horn and its waste production gave rise to anoxic sediment buildup, stifling hydrogen sulfide odor, high concentrations of harmful bacteria [11]-[14]. However, reorganizing and strengthening municipal institutions proved critical in reversing the effects of pollution by undertaking one of largest rehabilitation efforts of its kind [15].

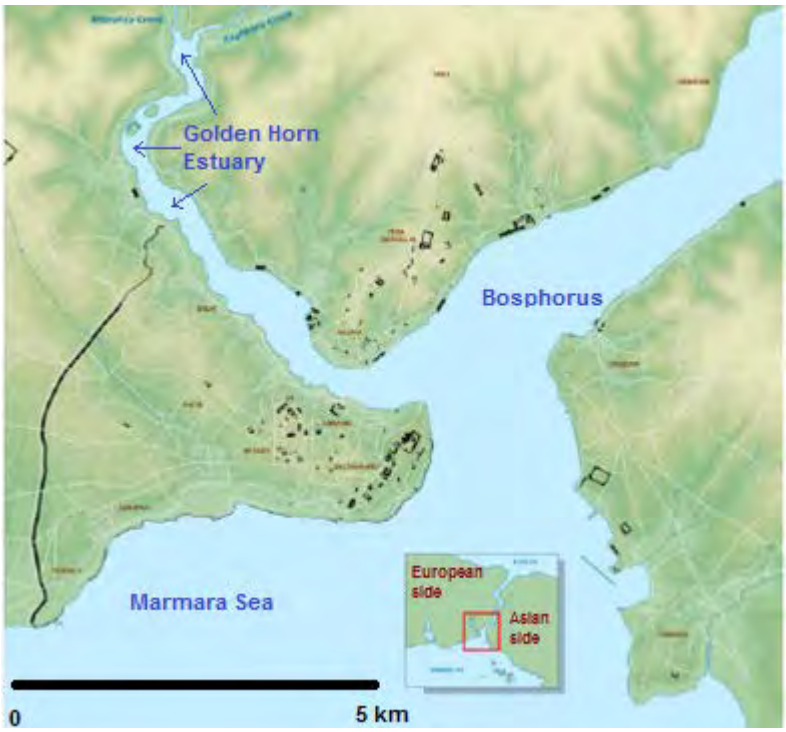

Figure 1. The location of the Golden Horn

2.2. Sample Analysis

Sediment of the estuary was sampled and placed in acid-rinsed polypropylene vessels using a plastic spatula. The sediments were oven-dried, homogenized in a porcelain mortar and stored in plastic containers until the analyses were performed. PTFE vessels were used throughout the entire procedure. All glassware and plastic utensils were washed with 10 %v/v nitric acid for 48 h, and rinsed with ultrapure water prior to use. All reagents in the experiments were analytical grade (Merck, Germany). Stock metal standard solutions (1,000 mgL−1) were prepared from standard vials. Calibration standards of each metal were obtained by suitable dilutions of the stock solutions.

Sediment samples were processed using a microwave oven (BERGHOF, MWS-3) for determination of metal concentrations. Extraction procedure fractionates metals into five fractions: exchangeable, bound to carbonates and specifically adsorbed, bound to Fe–Mn oxides, bound to organic matter and sulfide, and residual. The extractants and operationally defined chemical fractions were as follows: Fraction 1: For each 1 g of sample 40 mL of a 1 M of magnesium chloride ($MgCl_2$) was added at pH 7.0 with continuous agitation in an orbital shaker at room temperature. Fraction 2: 40 mL of a 1M of sodiumacetate (1M NaOAc; adjusted to pH 5.0 with acetic acid, HOAc) was added with continuous agitation in an orbital shaker for 5 h at room temperature. Fraction 3: 100 mL of a 0.04 M with hydroxylammonium hydrochloride ($NH_2OH.HCl$) in 25% (v/v) HOAc was added. The extraction was performed at 96°C with occasional agitation for 6 h. Fraction 4: 7 mL of a 0.02M HNO3 solution and 5 mL of 30% hydrogen peroxide (H_2O_2; adjusted to pH 2.0 with HNO_3) were added. The sample was heated progressively to 85 °C, and maintained at this temperature for 2 h with occasional agitation. A second aliquot of 3 mL of 30% H_2O_2 (adjusted to pH 2.0 with HNO_3) was then added, and the mixture was heated again at 85 °C for 3 h with occasional agitation. After cooling, 12 mL of a 3.2 M of ammonium acetate (NH_4OAc) in 20% (v/v) HNO_3 solution was added, the tubes were then continuously agitated in an orbital shaker for 30 min. Fraction 5: 2 mL HNO_3 and 6 mL HCl were added.

Analyses were performed using an atomic absorption spectrometer equipped with flame atomization and inductively coupled plasma optical emission spectrometry (ICP-OES). All absorbance readings were made in triplicate. The operating parameters for the individual metals were set as recommended in the manufacturer's operating manual.

3. RESULTS AND DISCUSSION

Heavy metal contents of the analyzed sediment are summarized in Table 1. Based on the mean concentrations, the heavy metals in the surface sediments exhibited the following descending order: Cu > Zn > Cr > Ni > Pb. Relatively lower concentrations of the metals were found in the study. It is known that the Golden Horn estuary has been much polluted area in the last decades [14], [15]. One of the reasons of low values is rehabilitation of the estuary but another reason may be location of sampling. Samples contain low amount of volatile (organic) matter.

Table 1. Total heavy metal concentrations of the samples (mg/kg DW)

	Zinc (Zn)	**Chromium (Cr)**	**Copper (Cu)**	**Lead (Pb)**	**Nickel (Ni)**
Range	50-80	22-32	51-88	5-7	7-13

It can be said that the concentrations of the metals studied at the site reflect less anthropogenic influence on heavy metals. For the comparison purpose, the average values are lower than the range identified in the other marine areas in the literature, which were much heavily polluted coastal zones in the world [16].

Metal fractionation: The percentages of heavy metal concentrations that were extracted in each step of the sequential extraction procedure used in this study were presented in Table 2. On average, the Fe–Mn oxides fraction was the most dominant one for all the studied metals, indicating the mineralogical origin of these metals; while differences among samples were obvious, which might result from the combined effects of the physicochemical conditions of the sedimentary environment, the intensity of human activities and so on.

Table 2. Concentrations of metal fractionation in the samples (%)

Fraction	**Cr**	**Cu**	**Ni**	**Pb**	**Zn**
F1, exchangeable	2	1	2	4	3
F2, bound to carbonates	8	17	14	69	33
F3, bound to Fe–Mn oxides	71	70	59	2	56
F4, bound to organic matter and sulfide	7	8	7	22	6

Generally, the relative proportions of metals in the acid soluble fraction were very low. In the sediment of estuary, very low concentrations of the acid soluble fraction could still be partly from mineral sources. Only Pb had observable contents of the acid soluble fraction with the mean values of 4%. The exchangeable fraction had the greatest tendency toward remobilization from the sediment phase to the more bioavailable pore water phase. Compared with other heavy metals, Pb possessed the highest carbonated and exchangeable fractions in the sediments. The percentages of carbonate-Pd accounted for 69%, which likely resulted from the high concentration of HCO^{3-} in the sediments. Carbonate fraction is sensitive to environmental conditions such as decreased pH. When pH decreases, Pb bound to carbonate is released into the water, thus causing

pollution. The oxide-Cu and Cr likely were bound to ferric oxides, which would be released when environmental condition changed. The percentages of oxide-Cu and Cr were 71% and 70%, respectively, which were greater than other metals. These data suggest that Cu and Cr in the sediments posed some ecological risk. Overall, the speciation of the metals in sediments exhibited high bioavailability and consequently posed a high ecological risk. Similarly to our study, chemical fraction profiles of sediments in the literature studies show different range values [5].

4. CONCLUSIONS

This study investigated the total concentrations and fractionation of heavy metals in the surface sediments from the Golden Horn estuary. The relatively lower concentrations of metals in the estuary are related to rehabilitation work. All the metals studied in the sediments were mainly from terrestrial and anthropogenic sources. The sediment quality of the estuary showed that the sedimentary environment was in good condition. We suggest that toxicity tests, bioaccumulation tests, and other related experiments should be further carried out in order to make the risk assessment methods more accurate and reliable in the analysis of sedimentary heavy metals.

ACKNOWLEDGMENT

We are thankful to Berivan Akgun and Fatma Kazak, and Istanbul Greater Municipality, Sea Cleaning Department.

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Determination of Clarithromycin Antibiotic Concentration in Wastewater

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Abstract

Antibiotics are defined as all kinds of pharmacological agents which can be produced by any microorganism or artificially to kill or stop proliferation of another microorganism. The main sources of antibiotics are; homes, hospitals, nursing homes (medical treatment, direct disposal of unused products), livestock and poultry breeding (growth stimulation purposeful drugs) and pharmacological agent producers [1]. Disposal rates of antibiotics without being metabolized ranges between 10% to 90%. Therefore, human and animal feces can contain large amounts of antibiotics. 30% of the all antibiotics used are metabolized in the body on average. 70% of all antibiotics used is mixed sewage through feces or urine unchanged [2]. Thus, waste water treatment plants are becoming a serious business releasing antibiotic to the environment. It leads to antibiotic contamination in the environment as conventional methods applied in the treatment of waste resulting from the manufacturing process for human and animal antibiotics, waste resulting from livestock raising and household wastewater are inadequate [3].

It is stated in the studies conducted abroad that, currently used conventional treatment plants for the treatment of antibiotics are inadequate. It is known that antibiotics adversely affect the ecosystem as they can reach to the receiving environment and food chain due to the fact that they are biodegradation resistant compounds.

Disposal of clarithromycin; which is a macrolide and has a higher amount of use in our county; in waste water treatment plant inlet, biological treatment output and advanced biological treatment output were examined and evaluated in this study.

Keywords: antibiotics, clarithromycin, wastewater, biological treatment.

1. INTRODUCTION

Antibiotics are classified based on their chemical and structural qualities [2]. Antibiotics include betalactams, sulphonamides, macrolides, trimethoprims, fluoroqionolones and other groups. The antibiotics considered in the same group are of similar structures, act with similar mechanisms and their behaviours in the ambience may be resemblance [2],[4].

Macrolide-group antibiotics are activated against many gram positive bacteria through reverse linkage to 50 S ribosomal sub-units, and prevention of protein synthesis in microorganisms[5],[6]. Due to unstable and persistent structures of antibiotics, challenges are faced in elimination of antibiotics formulation waters through classic biological treatment methods, and these waste waters significantly contribute to environmental pollution. Antibiotics are generally eliminated in secondary and further steps at waste water treatment facilities. Due to the fact that classical water treatment facilities are designed for treatment of pollutants such as drugs, drugs can be eliminated only with a low efficiency, and thus, untreated components mix into surface water [7],[8] [9].

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Macrolides mix into the sewage with a ratio more than 60% by their structures remaining unchanged after application [10]. This means that the sewage reaching waste water treatment facilities in countries, particularly where macrolides are highly prescribed, may include high density of macrolides [4],[11],[12]. They reported the macrolide density in raw waste waters in Switzerland as 0,01 and 0,06 µg/L; nevertheless, [13]. determined the macrolide density in waste water treatment facility input water in the U.S.A. as 1,5 µg/L.

Macrolide antibiotics cannot be usually fully eliminated from classic waste water treatment facilities' waste waters [14]. Erythromycin (including erythromicin-H_2O) was eliminated in the range of 43% and 99% in biological treatment processes carried out through active sludge or aerated lagoon practice[13]. In 3 different classic water treatment facilities in Japan, average elimination efficiency of macrolide antibiotics like clarithromycin and azithromycin was reported as 50% [15]. Ref. [10] reported that macrolides up to 100 ηg/L density were found in discharge processes of all waste water treatment facilities examined in Germany. The studies using 24-hour composite samples showed that macrolides were eliminated at a ration varying within the range of 80% and 44% in classic active sludge treatment[16],[17]. It was put forward that the elimination of the compounds resulting from urine and excrement during biological treatment is more effective than the presence of non-degradable metabolites in the elimination of macrolides [17].

2. MATERIAL METHOD

Generic and additional names: Clarithromycin
CAS name: 6-O-Methylerythromycin
CAS registry : 81103-11-9
Molecular formula: C38H69NO13
Molecular weight: 747.95
Solubility: Clarithromycin is soluble in acetone, slightly soluble in
methanol, ethanol, and acetonitrile, and practically insoluble in water
Water solubility 0.33 mg/l
Acidity/basicity: pKa 8.99
Melting point: 2170-220oC(DrugBank).

2.1. Sample collection

The sample was taken from input waste water, biological treatment output and advanced biological treatment output of Istanbul - Tuzla Biological Treatment Facility, and analysed.

2.2. LC-MSMS analyses

In LC-MS/MS technique, the sample molecules divided into its physico-chemical qualities is analysed by mass detector thanks to UHPLC device. Molecules are not normally charged particles, and mass spectrometers turn them into ionized molecules by stimulating the molecules through ionization process. Molecules segregated into m/z (mass/charge) ration in the initial quadrupole filter are subject to decomposition through a high-purity special gas called the collision gas. Detection and amount determination are carried out over ions (daughter or product ion) occurring as a result of decomposition in the second quadrupole filter.

Despite the fact that there are many molecules having the same m/z ratio, the number of molecules having the same decomposition ions is 1/10000 in the nature. Therefore, LC-MS/MS enables one to determine the amount of the matter in quite low concentrations. Furthermore, there is no need to confirm the results.

The LC system is an Ekspert Liquid Chromatography (Eksigent, USA), and Venesil AQ C18 column (with a pore size of 2,1mm×50mm, 3µm) was used for degradation of antibiotics in the mix.

In a single MS and ESI (+) mode, through the conversion of antibiotics into protonated molecular ions, which are used as pilot ions, in order to determine the amount of antibiotics, a qualitative ion was selected during the process in terms of detection for each antibiotic.

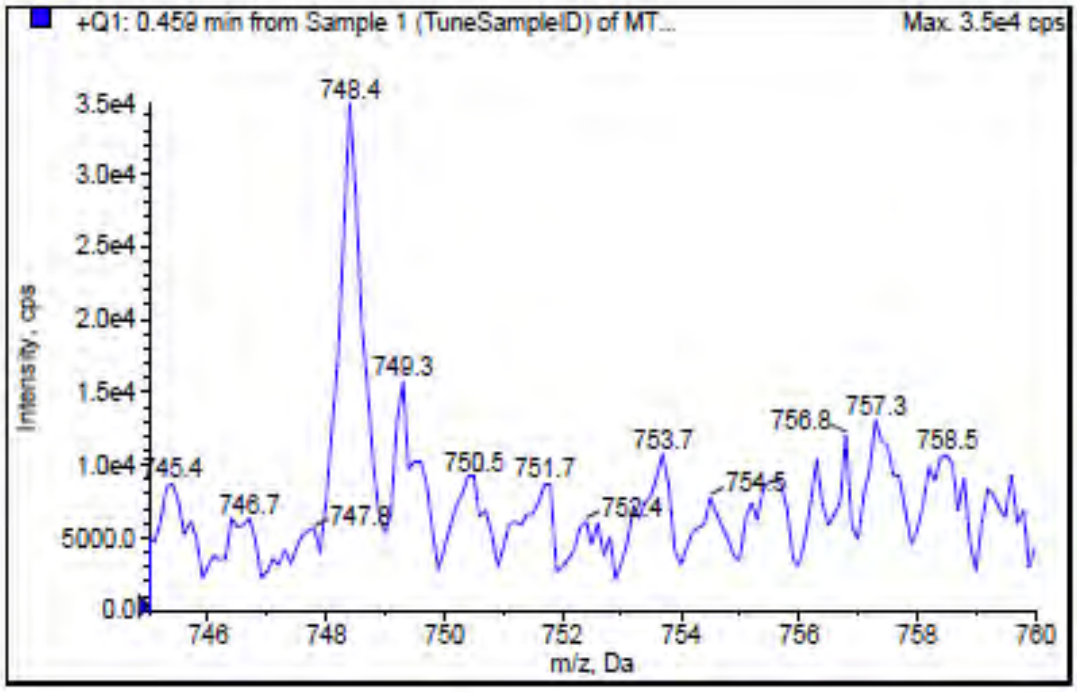

Figure 1. Precursor ion of clarithromycin

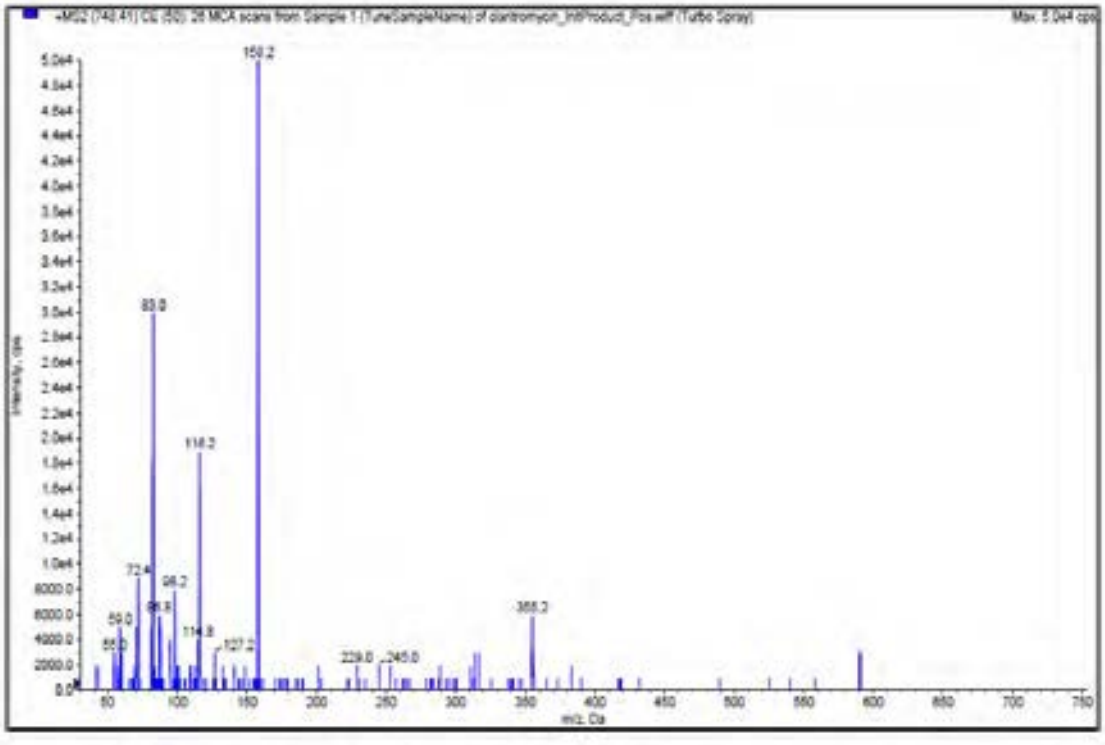

Figure 2. Product (doughter) ions of clarithromycin

2.3. Solid Phase Extraction

Antibiotics are generally seen in little amounts in the nature, therefore, solid phase extraction (SPE) procedures are generally used for preliminary concentration of antibiotic samples found in little amounts, and

for separation of antibiotics from watery matrices. Solid phase extraction method was applied on the following waste water samples respectively.

As per the literature research carried out for solid phase extraction, it was seen that the SPE column was used the most OASIS HLB Waters 500 mg 6ml, and analyses were carried out with this cartridge.

3. RESULTS AND DISCUSSION

Following the determination of the precursor and product (daughter) ions of clarithromycin through reference standards, a matrix-compatible calibration curve was formed. It was determined as R2 0.9994 in the calibration curve formed. As per the analysis results, it was determined as 1433 ηg/L in Tuzla Domestic Waste Water treatment facility input, 164.65 ηg/L in biological treatment output, and 45.412 ηg/L in advanced biological treatment facility output.

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Battersea Gas Holders Demolition Works Environmental Noise Impacts Study

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Abstract

Battersea Gas Holders Storage Area is located in the London Borough of Wandsworth; within the site there were four redundant gasholders and associated buildings. It was proposed in 2012 that the redundant gas holders were to be dismantled to free up the land for new redevelopment. The Demolition Works had the potential to impact on a range of environmental and social receptors. This article focuses on the environmental noise assessment of Battersea Gas Holders Demolition Works. This article reviews the methodologies and guidance to be used to assess the environmental noise impacts; describes the study area and baseline conditions existing before the Demolition Works. After identification of noise sensitive receptors, a baseline noise survey was undertaken to establish the current noise levels in the area surrounding the gas holder site. Then, key impacts during Demolition Works are identified and evaluated. After calculations of noise levels at noise sensitive receptors, it was discussed that without appropriate mitigation measures, the resulting levels, when combined with existing ambient noise levels, would exceed the limit values at noise sensitive receptors during Demolition Works. Noise mitigation measures to prevent any significant negative effects at the noise sensitive receptors and the likely residual effects after these measures have been adopted were discussed.

Keywords: construction noise, environmental impact assessment, environmental noise.

1. INTRODUCTION

The Battersea Gas Holder Storage site is located in the London Borough of Wandsworth and occupies a site of approximately 2 hectares. It was proposed in 2012 that these redundant gas holders were to be dismantled. The Demolition Works comprised the dismantling of the four redundant gasholder structures, de-watering, de-de-sludging works and demolition of associated buildings and structures.

Atkins Acoustics and Vibration, which is a part of a multi-engineering firm based in United Kingdom, was commissioned by the client to do environmental noise assessment as part of the Environmental Impact Assessment (EIA) to contribute to the Environmental Statement (ES) which accompanies the planning application for the proposed demolition. Any deconstruction work of this nature may generate airborne noise and vibration, which have the potential to create noise nuisance to the noise sensitive receptors in the vicinity. This article firstly reviews the relevant methodologies and guidance to be used to assess the environmental noise impacts and describes the study area and baseline conditions. A baseline noise survey was undertaken to establish the current noise levels in the area surrounding the gas holder site. Then, key impacts during demolition works were identified and assessed and specific mitigation recommendations were given to avoid, reduce and remedy of potentially significant effects.

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2. BASELINE NOISE SURVEY

2.1. Relevant Guidance Documents

BS 5228:2009 Parts 1 & 2 "Code of Practice for Noise and Vibration Control on Construction and Open Sites" [1] was the principal Code of Practice document in United Kingdom at the time of the project and detailed guidance is available in this Standard. The methodology in this Standard provides guidance on how to assess potential noise impacts using quantitative methods of estimating construction noise and with reference to measured ambient noise levels in the study area.

In this article, the ABC method detailed in Annex E.3.2 of BS 5228 Part 1 [1] has been used. The ABC method defines threshold noise levels and arranges these threshold levels into categories as shown in Table 1 below. Based on the ABC method, a significant effect has been deemed to occur if the total LAeq noise level, including construction, exceeds the threshold level for the category appropriate to the ambient noise level. The impacts from demolition works within the site, are classified as either "significant" or "not significant".

Table 3. Example Threshold Levels of Significant Effect at Dwellings (BS5288)

Assessment Category & Threshold Value Period (LAeq)	Category A	Category B	Category C
Night Time (2:00-07:00)	45	50	55
Evenings (19:00-23:00 weekdays) & weekends (13:00-23:00 Saturdays & 07:00-23:00 Sundays)	55	60	65
Daytime (07:00-19:00) & Saturdays (07:00-13:00	65	70	75

2.2. Study Area

The Battersea Gas Holder Storage site is located in the London Borough of Wandsworth and is surrounded by mixed residential, light industrial and recreational land use. Within the site there were four redundant gasholders. The site was accessed by vehicles and pedestrians from the southern boundary to the site. Along the eastern and western boundaries the site was enclosed by raised railway tracks running into Victoria Rail Station. In between the eastern boundary and the raised railway lines was a thin strip of land which is currently occupied by Battersea Cats and Dogs Home. The northern boundary was defined by ancillary buildings, which form part of Battersea Cats and Dogs Home and Network Rail operations. Beyond the adjacent land uses, the area to the north comprises ancillary land associated with the Battersea Power Station, which has planning permission for a major new residential development. Land to the west of the railway lines, adjacent to Battersea Park, has been redeveloped for high density residential development. To the south, uses included residential, business, education and religious buildings.

2.3. Noise Survey

A survey of ambient noise levels was undertaken between the 8th and 21st June 2012 by Atkins. Following a detailed look at the study area and consultation with the local environmental health officer (EHO) at Wandsworth Borough Council, the survey comprised two continuously monitoring noise meters. The existing site structures and details of the measurement positions (Noise logger A and Noise Logger B) are shown in Figure 1. The logarithmic mean of the LAeq measurements and linear mean of the LA90 measurements for the continuous noise monitoring data was calculated for weekday and for weekend periods as defined within BS 5228:2009. [1]

The average day-time level during weekday was between 65 dB LAeq and 68 dB LAeq. The average day-time levels during the weekend were between 66 dB LAeq and 68 dB LAeq. The average background noise levels during the weekdays were between 50 dB LA90 and 59 dB LA90 and those during the weekend were between 53 dB LA90 and 58 dB LA90.

The average evening levels during weekdays were between 63 dB LAeq and 66 dB LAeq. The average evening levels during the weekend were measured as being 66 dB LAeq. The average background noise levels during the weekend and weekdays were between 47 dB LA90 and 55 dB LA90.

The average night-time noise levels during both the weekend and weekdays were between 58 dB LAeq and 65 dB LAeq. The average night-time background noise levels during the week varied between 45 dB LA90

and 50 dB LA90. The corresponding average background noise levels during the weekend were between 44 dB LA90 and 48 dB LA90.

The measured levels were to be used as the basis on which demolition noise would be assessed.

Figure 14. Plan showing the gas holder storage site and the noise measurement positions.

3. ASSESSMENT OF KEY IMPACTS AND MITIGATION

3.1. Noise Sensitive Receptors

As part of this assessment, all dwellings to the west of the site, dwellings and the church to the south of the site and Battersea Dogs and Cats Home and associated offices to the east and north of the site were considered noise-sensitive receivers and are assumed to have a high level of sensitivity.

The assessment of the significance of effect on each receiver is based on the residual effects of the complete effects taking into account the measures to avoid or reduce noise impacts. According to the ABC method detailed in BS 5228:2009 Part 1 [1], and with reference to the measured ambient noise levels in the site, three different category values would apply to three noise sensitive receptors as demolition noise limit, as described below in Table 2.

Table 2. Assessment category and threshold value for each receiver

Noise Sensitive Receptor	Assessment Category	Threshold Value (day time)	Treshold Value (Evening/ weekend)	Treshold Value (night)
Dwellings at the southern boundary	Category C	75dB	65dB	55dB
Dwellings at the western boundary	Category B	70dB	60dB	50dB
Battersea Cats and Dogs Home	Category A	65dB	55dB	45dB

It was expected that most of the activities would be undertaken during day-time periods 08:00-18:00 on weekdays. Therefore, the noise levels from demolition works, when combined with ambient noise levels in the areas, should not exceed levels stated in day time threshold values L_{Aeq}. However, during de-sludging and de-watering works, the required plant would run 24/7 throughout the week. Then the noise levels from de-sludging and de-watering works when combined with ambient noise levels should not exceed the day time, evening/weekend and night time threshold values L_{Aeq}.

If the total noise level exceeds the appropriate category values highlighted above, then a significant effect is deemed to occur.

3.2. Demolition Works

Works on the site would comprise the dismantling of the four redundant gas holder structures, de-watering, de-de-sludging works and demolition of associated buildings and structures. Some of the typical plant and equipment expected to be in use during the demolition works were typical construction plants as; electric pumps, chisels, concrete crusher, hot water pressure washer, hammers, generators, excavators etc.

For each of the demolition phases identified, the main items of plant and equipment to be employed and the corresponding noise levels in dB L_{Aeq} were determined according to BS 5288:2009. [1] The percentage of the assessment period for which an item of plant is operational had to be taken into account. Based upon the details of the anticipated operations provided by the contractor, on–times of equipment were estimated. The calculations assumed that a single item of plant could be in operation with an on-time of 50% during a typical working day.

3.3. Effects of Demolition Works & Noise Control Mitigation Measures

The potential cumulative noise impacts that would arise from a number of activities at noise sensitive receivers during demolition works and de-sludging and de-watering works were calculated based on the type of the plant, corresponding noise levels and on times of equipment. Calculations were made to show the potential cumulative noise impacts arising from a number of activities at key receptors. The detailed calculations are not shown in this paper. However, the calculations indicated that without appropriate mitigation measures, the resulting levels, when combined with existing ambient noise levels, would exceed the limit values at each noise sensitive receiver during demolition works and de-sludging and de-watering works. Therefore the impacts from demolition works within the site, were classified as 'significant'. The following mitigation measures were recommended to avoid, reduce and remedy potentially significant effects:

- HGV movements should be limited to working hours between 9:00 and 15:00 hours on Mondays to Fridays and between 10:00 and 13.00 hours on Saturdays;
- Noisy activities shall not commence prior to agreed hours; no working outside of agreed hours;
- Plant and equipment is regularly serviced and has preventative maintenance regime which would help controlling noise levels;
- During de-sludging and de-watering of Gas Holders, some plant might operate during evening and night. The number of equipment that will be working should be kept to minimum;
- The concrete crusher proposed for use during construction of hard standing should be located a minimum of 100m from Battersea Dogs and Cats Home and be completely shielded, so no line of sight exists;
- Low noise attenuated exhaust system should be selected for excavators, dozers, dump trucks and cranes. Calculations assume that a 10 dB reduction can be achieved through appropriate selection of low noise equipment;
- Hand tools used on site, particularly compressor powered tools, should be used with some element of shielding between the user and the Battersea Dogs and Cats Home;
- Noise barriers around the demolition site (especially close to the Battersea Dogs and Cats Home) should be designed according to local variation in ground height. The implementation of the noise barrier will be subject to other visual, amenity issues and engineering considerations. These should be discussed and agreed with the residents of the property;

Calculations at the noise sensitive receptors indicated that by implementing the noise mitigation measures as described above, dwellings at southern boundary of the site and dwellings at the western boundary would not exceed the threshold values and therefore, no significant noise impact would be observed. However, Battersea Cats and Dogs Home offices to the north of the site might be experiencing a "significant "noise impact due to its proximity and relatively low noise ambient noise levels. In reality, the resulting noise levels would exceed the threshold values at the Battersea Dogs and Cats Home offices by marginal amounts only, not exceeding an increase of 2dB, when added to the existing ambient levels. This 2 dB exceedance is not considered significant particularly as the scenarios assessed may present a worst case scenario.

To achieve the levels outlined within this paper, it was recommended that all mitigation was incorporated. It was further recommended that the Battersea Dogs and Cats Home offices to the north of the Site were fully informed over the scale and nature of the works, when they were to take place, and who to contact if they are disturbed.

4. CONCLUSIONS

In this paper, environmental noise impacts from the demolition and de-sludging and de-watering works of Battersea Gasholders, which is located in the London Borough of Wandsworth, was assessed. A number of noise measurement surveys were undertaken to establish and describe the baseline noise environment. In considering the impact of demolition noise of particular importance was the exact nature of the activities, plant and equipment types, the distance between receivers and activities and the hours of working. This information was gathered from the contractor. After calculations of noise levels at noise sensitive receptors, it was discussed that without appropriate mitigation measures, the resulting levels, when combined with existing ambient noise levels, will exceed the limit values at each receiver during demolition works. Therefore the impacts from demolition works within the site, are classified as either "significant".

Noise barriers around the demolition site, limiting HGV movements to working hours, reducing number of plant that would be working during the evening and night time, specific guidance on use of concrete crusher, regularly servicing and maintenance of plant and implementing low noise attenuated exhaust systems were recommended as mitigation measures. Calculations at the noise sensitive receptors indicated that by implementing the noise mitigation measures as described above, no significant noise impact would be observed at the dwellings to the south and west of the site. However, Battersea Cats and Dogs Home offices to the north of the site might be experiencing a "significant" noise impact due to its proximity to the site and relatively low noise ambient noise levels. However, it was discussed that the exceedance level of 2dB is not considered significant particularly as the scenarios assessed may present a worst case scenario.

The noise impact assessment of Battersea Gas Holders Demolition Works described in this paper was part of the Environmental Statement submitted in support of the Planning Application. This paper provided the framework for implementation of measures to mitigate the potential noise impacts on the environment.

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BIOGRAPHY

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Fire Properties of Scots Pine Impregnated with Firetex

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Abstract

One of the most negative features of wood material is combustible. It has been using many chemical substances that are preventing burning or fire retardant in order to overcome its negative feature. When a wood material burns, carbon monoxide (CO) which is one of the harmful gases occurs. Thus, it causes poisoning mostly and sudden death.

In this research, it was aimed to determine fire properties of wood material which were applied Firetex as being impregnated material and fire retardant that do not damage human's health. For this purpose, the combustion experiments that were prepared by scots pine (Pinus sylvestris L.) wood have been done according to ASTM-E 69 standards.

As a result of the combustion experiments, the average amount of CO emission and the weight loss decreased at the wood samples impregnated with Firetex have been located. Moreover, while the average weight loss (21.80%) and amount of CO (50.00ppm) at the test samples, the average weight loss (57.72%) and amount of CO (92.70ppm) have been determined at the control samples as well.

According to these results, we found that Firetex which is succeed to protect the public health against to the fire, and retarded the fire. In addition, we observed that it induced to decrease the fire smoke, therefore the using of it in wood structures is definitely recommended.

Keywords: Firetex, wood fire retardant, impregnated material, public health.

1. INTRODUCTION

One of the most negative features of wood is combustible due to being organic of wood raw material and containing carbon (C) and hydrogen (H) of its compounds [1]. While other negative properties of wood excepting its combustibility only induce financial loss, there occurs a life threat in the case of combustion of the wood material. Flames and gases ensue during combustion of it, might cause sudden death [2] .

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When a wood material burns, carbon monoxide occurs. Thus, CO poisoning happens mostly; has many results, involving sudden death; includes complications and late sequelae; and often is overlooked [3]. Additionally, Reference [4] has stated that "Carbon monoxide (CO) intoxication is one of the most common types of poisoning in the modern world, and the leading cause of death by poisoning."

Being impregnated with fire retardant chemical substances of wood has been considered necessary in order to increase the strength of wood against to the combustion and prevent loss of life and property [1]. Reference [5] has stated in one of their research that they have impregnated with different chemicals as using of immersion and pressure methods to test samples which were prepared by scots pine wood, therefore they have identified that the combustion properties of test samples impregnated by immersion method were lower than impregnated by pressure method.

Impregnated substances such as: creosote, CCA (copper, chrome, arsenic) and PCP (pentachlorophenol) have been inhibited in many countries to be harmful to human health. There is a very serious research results related to disrupt the ecological balance and threaten human health and other creatures of these substances [6], [7], [8]. Thus, alkylammonium and boron compounds have been preferable due to their high performance against to biological pests, their applicability easily as dissolving in the water and considerably increasing of wood strength against to the combustion [6].

The purpose of this research is to focus on whether Firetex applied on wood material as an impregnated substance prevent to the CO emission or not, its fire properties and as determining the outlet amount of CO that is harmful for human health especially in case of fire.

2. MATERIALS AND METHODS

2.1. Wood Species

In this study, scots pine (Pinus sylvestris L.) woods were selected randomly from Kastamonu Forest Products Companies as a test material due to its wide usage in industry. These well-selected specimens were non-deficient, proper, knot-free, normally grown wood materials (without reaction wood and without decay, insect and fungal) according to the principles of TS 2470 [9].

2.2. Impregnation Material

In this research, it has been used Firetex provided by Kale Naturel company which is nature, and having fire retardant feature as an impregnated material.

In this study, according to the report of Istanbul University Department of Pharmacology and Toxicology [10], Firetex that is natural, not harmful for human health and environment; in the test results of Gazi University Faculty of Technical Education [11], it is applicable for short period, medium period and vacuum impregnated methods; it has been also reported in the test results of Balıkesir University Basic Sciences Application and Research Center [12] that Firetex which is not including any industrial additive or chemical is acquired transformation to water of rocks having the feature of limestone in nature, in addition it has been the standard of raw water according to the ICP AES analysis. The ICP AES analysis results of Firetex made by Balıkesir University were shown in Table 1 below.

Table 1. ICP AES analysis results of Firetex [12]

Parameters	Results
Ba	0,368 mg/L
Cd	<1 µg/L
Ni	0,012 mg/L
Mg	4,25 mg/L
Fe	<5 µg/L
Pb	<5 µg/L
Cu	<1 µg/L
Zn	<10 µg/L
Mn	<1 µg/L
Cr	<2 µg/L
Co	<0,5 µg/L

Hg	<5 µg/L
As	<0,5 µg/L

2.3. Preparation of Test Samples

Test samples were cut properly shaped bar in 9.5mm x 19mm x 1016mm ± 0.8 mm according to ASTM-E 69 [13] standards. 6 control samples, 6 test samples impregnated with Firetex, totally 12 samples were prepared.

Before the experiment, the test samples were dried until they were stable at 20±2◦C, 60±5% relative humidity and 12% moisture gradient in climate room.

The density values of scots pine wood were determined properly to the principles of TS 2472 [14]. The oven-dried density value was 0.50 g/cm2 and the air-dried density value was 0.52 g/cm2 as well were located.

2.4. Impregnation Process

In the impregnation process, immersion method with Firetex (pH= 7.50) was used. The test specimens were placed in the tank will be impregnated and they were exposed to impregnation for 48 hours.

2.5. Execution Test

The combustion test was implemented in the laboratory of Karabük University according to the principles of the ASTM E-69 [13]. Throughout the test, the amount of released gas CO (ppm: parts per million) and mass reduction (%) were determined as measuring in every 30 seconds. At the beginning of combustion test, flame source was used for 4 minutes then flame source was taken away and it was continued for 6 minutes. The test lasted totally for 10 min. The appearance of test machine and the sample that is burning were shown in Figure 1.

Figure 1. The appearance of test machine and the sample burning [15]

2.6. Data Analysis

It was applied on variance analysis at the prepared samples with the purpose of determining the impact of CO emission, mass reduction and impregnated material to the combustion. The effectiveness was determined with “Duncan” test in the case of being significant the differences between groups. According to the results of variance analysis, impregnated material, CO emission and mass reduction were compared between each other as evaluating their combustion time.

(1)

3. FINDINGS

The variance analysis of CO values in Table 2, Duncan test in Table 3, diagram regarding homogeneity groups in Figure 2, the variance analysis regarding mass reduction values in Table 4, the Duncan test in Table 5, the diagram regarding homogeneity groups in Figure 3 were shown.

Table 2. The variance analysis regarding CO values in terms of combustion time in the test samples impregnated with Firetex

Source	df	Sum of Squares	Mean Square	F	Sig.
Between Groups	39	550966,600	14127,349	161,234	,000
Within Groups	200	17524,000	87,620		
Total	239	568490,600			

According to the Table 2, effects of CO values in the samples impregnated with Firetex were found significant (α=0.05) statistically.

Table 3. The Duncan test regarding CO values in terms of combustion time in the test samples impregnated with Firetex

Time (sn)	**Control X (ppm)**	**HG**	**Firetex X (ppm)**	**HG**	**Time (sn)**	**Control X (ppm)**	**HG**	**Firetex X (ppm)**	**HG**
30	9,00	PR	3,17	R	**330**	99,33	EF	71,17	IJK
60	6,67	R	4,17	R	**360**	105,00	E	74,00	HIJ
90	7,00	R	8,17	PR	**390**	116,67	D	72,67	HIJK
120	18,67	P	19,17	P	**420**	131,33	C	76,67	HI
150	35,67	NO	37,83	NO	**450**	146,67	B	80,17	GHI
180	56,67	LM	55,17	LM	**480**	159,00	A*	76,17	HI
210	70,67	IJK	61,33	KL	**510**	160,67	A*	63,17	JKL
240	79,67	GHI	63,33	JKL	**540**	162,33	A*	46,83	MN
270	84,00	İJKL	67,17	IJKL	**570**	158,67	A*	30,67	O
300	89,00	İJK	69,67	IJK	**600**	157,33	A*	19,33	P

Table 3 shows that the releasing CO emission in consequence of combustion, having maximum value was equal average 159.60 ppm in the last 5 measurement at the control samples. The value was located at the samples impregnated with Firetex was 80.17 ppm. In general, when viewed to the averages, it was determined that the CO emission was 92.70 ppm at the control samples; this amount was 50.00 ppm at the samples impregnated with Firetex as well.

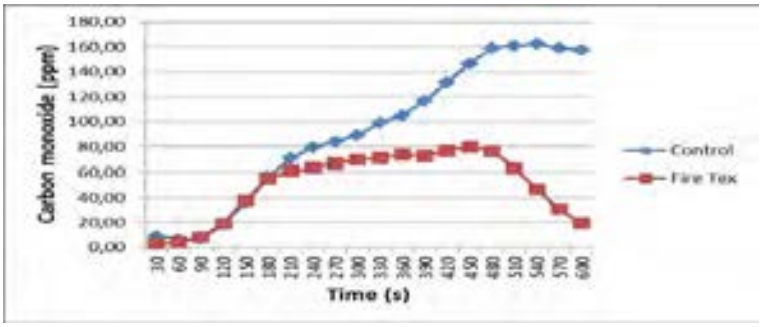

Figure 2. CO values in terms of combustion time in the test samples impregnated with Firetex

As clearly seen in Figure 2, while CO emission in the control samples continues to increase until the end of combustion, reached to the value of 159.60 averagely, this value in the samples impregnated with Firetex at 450 seconds was 80.17ppm to reach the maximum level, then decreased. When viewed the maximum levels, it was clearly seen that CO emission of the samples impregnated with Firetex was two times lower than CO emission of the control samples.

Table 4. The variance analysis regarding mass reduction values in terms of combustion time in the test samples impregnated with Firetex

Source	df	Sum of Squares	Mean Square	F	Sig.
Between Groups	39	219321,391	5623,625	176,607	,000
Within Groups	200	6368,531	31,843		
Total	239	225689,922			

According to the Table 4, effects of mass reduction values in the samples impregnated with Firetex were found significant (α=0.05) statistically.

Table 5. The Duncan test regarding mass reduction values in terms of combustion time in the test samples impregnated with Firetex

Time (sn)	**Control X (ppm)**	**HG**	**Firetex X (ppm)**	**HG**	**Time (sn)**	**Control X (ppm)**	**HG**	**Firetex X (ppm)**	**HG**
30	3,07	S	3,30	S	**330**	66,94	E	24,76	İJKL
60	5,58	RS	5,22	RS	**360**	72,49	DE	25,93	İJKL
90	9,33	PRS	7,92	PRS	**390**	78,72	D	27,04	İİJK
120	14,98	NOP	11,03	OPR	**420**	86,14	C	27,42	İİJK
150	23,29	JKLM	14,17	NOP	**450**	89,852	BC	28,63	İİJ
180	31,81	Hİİ	16,73	MNO	**480**	91,587	ABC	29,89	İİJ
210	38,29	H	18,65	LMN	**510**	93,882	AB	31,38	Hİİ
240	45,14	G	20,82	KLMN	**540**	95,462	AB	32,00	Hİİ
270	52,82	F	22,75	JKLM	**570**	97,542	A	31,37	Hİİ
300	59,02	F	23,52	JKLM	**600**	98,520	A	33,64	HI

Table 5 shows that the mass reduction in consequence of combustion, having maximum value was equal average 98.03% in the last 2 measurement at the control samples. The value was located at the samples impregnated with Firetex was 31.37%. In general, when viewed to the averages, it was determined that the mass reduction was 57.72% at the control samples; this amount was 21.80% at the samples impregnated with Firetex as well.

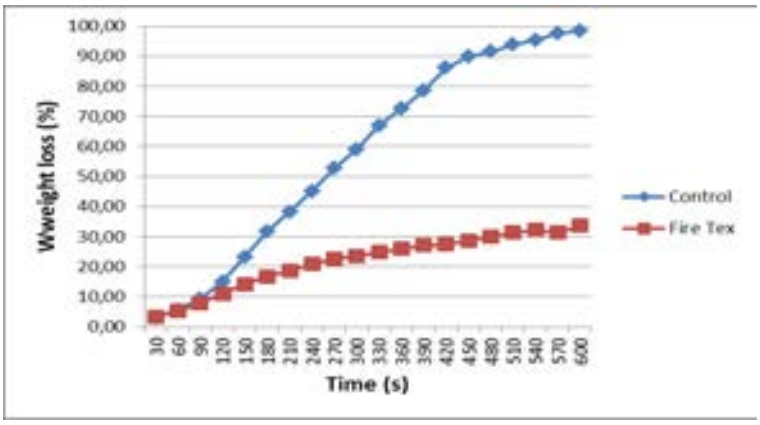

Figure 3. The mass reduction values in terms of combustion time in the test samples impregnated with Firetex

As seen in Figure 3, while the mass reduction in the samples impregnated with Firetex was 20% at the end of combustion with flame source, it has reached to the value of 40% in the control samples, after removing the

flame source, the combustion has continued for a while in the samples impregnated with Firetex, at the end of experiment the combustion was completed with 34% mass reduction. The control samples with 98% mass reduction under the same conditions have burned to ashes completely. It was clearly seen that the samples impregnated with Firetex was three times more high fire reliant than the control samples.

4. CONCLUSION AND RECOMMENDATION

In this research, it was investigated that the combustion properties of scots pine wood impregnated with Firetex, which has the feature of fire retardant. According to the combustion experiment results, the maximum value of mass reduction (98.03%) and the maximum value of CO emission (159.60 ppm) at the control samples; the minimum value of mass reduction (31.37%) and the minimum value of CO emission (80.17 ppm) were determined at the samples impregnated with Firetex.

In the combustion experiment, it was determined that scots pine wood impregnated with Firetex as applying immersion method decreased the CO emission and mass reduction values, it was supposed that the using of pressure methods with Firetex will able to be decline them as well. In the literature, [5] support this assumption.

In addition to combustion tests of wood impregnated with Firetex, as determining of its biological performance properties, to what extent for effect of it against to insects and fungi is a subject of new research. Using of Firetex against to biological degradation will provide to bring Firetex to the wood protection sector.

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Thermodynamic Analyses of Gaziantep Municipal Solid Waste Power Plant

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Abstract

Municipal solid waste landfill has been benefited as an alternative fuel and a renewable power source in recent years. Landfill gas (LFG) contains mostly methane and carbon dioxide, both of which are greenhouse gases that contribute to global warming. Generally, LFG to electricity technology is established in worldwide. Internal combustion engines used to generate electricity are most commonly lean fuel burn turbocharged designs. When operated on LFG, engine power ratings are commonly reduced by 5 to 15 percent compared to operation on natural gas. In this paper, starting from a historical overview of LFG driven power plants, the thermodynamic analysis is presented for a Jenbacher 416 GS type landfill gas engine which uses LFG gas produced by Gaziantep Municipal solid waste power plant. Operation of the municipal solid waste power plant is described in details.

Keywords: Municipal solid waste, LFG, gas engine.

1. INTRODUCTION

Rapid urbanization, increase in industrial facility and economic development in Gaziantep city have increased the amount of municipal solid waste (MSW), dramatically. Until the end of 1990s, there was only one unsanitary landfill that had serious environmental problems because of uncontrolled gas emissions and air pollution. MSW management in Gaziantep city has been directed positively into feasible practice during the past years. Sanitary landfill was constructed in 1996 and electricity production was started in 2008. This plant which has 5.66 MW installed power produces a portion of 1.25% of total power demand of Gaziantep.

Thermodynamic analysis of Gaziantep Municipal Solid Waste Power Plant (GMSWPP) using actual operating data may be beneficial to optimize and improve electricity production when unexpected losses are taken into account. When recent studies are considered, Bove and Lunghi [1] analyzed different landfill gas (LFG) energy recovery systems, including traditional and innovative technologies, with a technoeconomic and an environmental comparison. Their results showed that although internal combustion engines gives the poorest environmental performance, they are the most widely used technology due to economical reasons. In contrary to this, fuel cells are the cleanest energy conversion systems, but the relative investment cost is still too high to compete with traditional energy systems. Carolino and Ferreira [2] performed the first and second law analyses of a cogeneration system driven with the biogas produced in a MSW in Porto. Their objectives were to identify locations where major irreversibilities occur, to evaluate their magnitudes, and to assess the energy and exergy efficiencies of the global system and of its constituent units. They stated that the internal combustion engine and one of the radiators are the most inefficient units, as judged by the parameters degree of thermodynamic perfection and exergy destruction quotient. According to the researchers the main potential for improvement in the plant is the harnessing of the energy in the exhaust gases. Ahrenfeldt et. al. [3]

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presented a series of different gasification process designs to give a better insight to the wide range of possibilities within this process. They focused on high reliability, flexibility and efficiency within cogeneration of energy from conversion of biomass and compared cogeneration processes with respect to production of heat-and-power, heat-power-and fuel or heat-power-and-fertilizer. They concluded that the optimal choice of technology for a given task depends on many factors including feed stock availability, know-how, project economy, local politics, environmental concerns and life cycle assessment considerations in addition to the desired product and process characteristics and demands. Abusoglu et al. [4] presented a thermoeconomic analysis and assessment of a municipal wastewater treatment system. Operation of an existing municipal wastewater treatment plant was described and a thermoeconomical methodology based on exergoeconomic relations and the specific exergy costing method was performed using actual operational plant data. Their results provided important information for identification of the sites with greater exergy destructions and consequently greater potential for improvements.

Bianchi et. al. [5] investigated an innovative and promising strategy to improve waste conversion through integration of a conventional waste-to-energy (WTE). power plant with a gas turbine (GT). Their study focused on the feasibility of utilizing the hot gases leaving the GT to superheat the steam leaving the WTE steam generator, as well as heating the feed water returning to the steam generator of the WTE condenser. They presented detailed modifications to the WTE cycle and the resulting enhancement of its performance. Raj et al. [6] presented a detailed literature survey of cogeneration technologies based on renewable energy sources like biomass, solar energy, fuel cell, and waste heat. They investigated various designs, numerical and simulation models, key development areas, economic and environmental considerations in this paper which can be useful for the researchers in cogeneration technologies to make effective decisions and generate more ideas. Their comparative paper highlighted the gaps in cogeneration technologies where there is scope for future research. Verbruggen [7] proposed appropriate methods for measuring cogeneration or combined heat and power (CHP) activities based on design characteristics of the plants in their paper. He investigated that the co-generated electric output is a necessary and sufficient indicator of CHP advantage and performance. He remarked that regulators can extend this indicator, but should avoid the perverse effects of biased external benchmarking as the EU Directive entails. The purpose of Xydis [8] is to analyze exergeticaly the electricity production from a landfill in the area of Greece. Biogas production technology is more than suitable for use and very valuable for the production of fuel that can act as substitute to the conventional sources of energy. This fuel can replace part of the natural gas used for power generation. An inactive landfill that has a major impact on global warming from the emission of methane is transformed into an energy production unit. The continuous new extensions of the landfill add on to the biogas production to the point of doubling the electricity production.

2. SYSTEM DESCRIPTION

Gaziantep Municipal Solid Waste Power Plant (GMSWPP) was installed in 1996, in Gaziantep, Turkey and the flow schematic of the power plant is given in Figure 1. This power plant has 32.3 ha solid waste storage area and also 10,000,000 m^3 solid waste capacities which will fulfill the need until 2046.

In GMSWPP, landfill gas (LFG) is created during the anaerobic decomposition of organic substances in municipal solid waste (MSW), industrial and medical wastes. The total MSW carried to GMSWPP is 1,500 tons which produce 20,203 m^3 landfill gas daily. All wastes which are collected in GMSWPP are subjected to mechanical segregation of plastic, metal and glass, and then rest of MSW is sent to sanitary landfilling area. On the other hand, medical waste is sterilized first as a pretreatment and then sent into landfilling area. MSWs which are buried underground in landfilling area are led to produce LFG for months. The produced LFG from the storage area is collected with 114 high density polyethylene (HDPE) funnels with a diameter of 800 mm and depths changing between 8-41 meters. The collected LFG is then transferred to 6 manifold stations. If the temperature of the LFG is higher than 40-45^{0}C, it is cooled through the heat exchanger by means of chilled water which is denoted with blue line in Fig. 4. The LFG which is under 40-45^{0}C or which is cooled by chilled water (nearly to 15^{0}C) is sucked into two same demisters/filters in order to eliminate water and particulates such as aluminum, ash, etc by using four root's blowers with an almost value of operating pressure of -6 kPa vacuum. There is one flare stack mounted at the exit of root's blowers in order to drain excess LFG at any emergency case. The collected water is sent back to drain tank. The filtered LFG sucked through four pipelines is collected in order to transfer to the A/C tanks for desulphurization process. At the exit of the A/C tanks, excess LFG is sent back to the beginning of the process pipeline by using a pressure control valve if the operating pressure at the exit of A/C tanks exceeds 14.5 kPa gage.

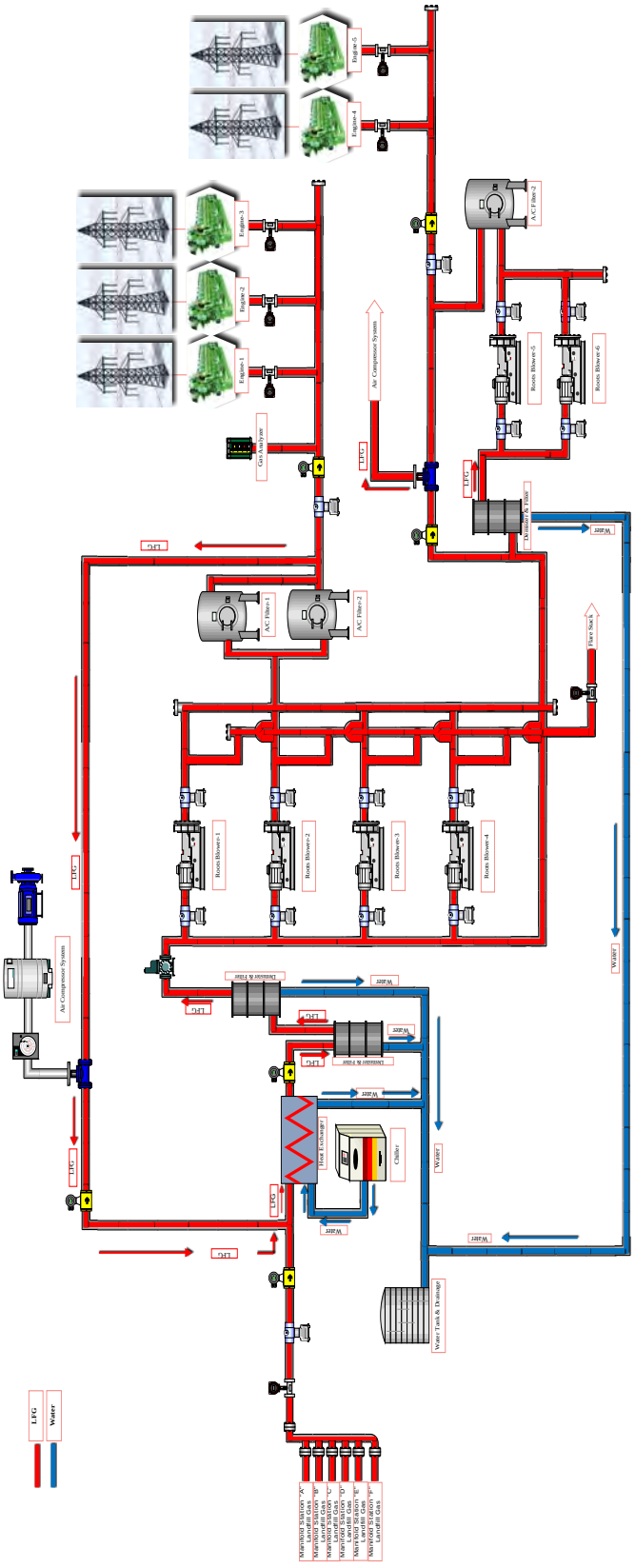

Figure 1. Schematic layout of Gaziantep Municipal Solid Waste Power Plant

At the same time, the content of LFG (CH_4, O_2, CO_2, H_2S and other gases) is measured continuously and recorded on the control panel. At any instant, the average values of the components of LFG are given in Table 1. The distribution of methane percentage in LFG content with respect to months in 2014 is given in Figure 2.

Table 1. Average volumetric composition of LFG produced in Gaziantep Municipal Solid Waste Power Plant

Components	Chemical Formula	(%) Dry Volume
Methane	CH_4	45-53
Carbon dioxide	CO_2	30-32
Carbon monoxide	CO	1-5
Nitrogen	N_2	2-6
Oxygen	O_2	3-5
Hydrogen	H_2	3-7
Hydrogen Sulfur	H_2S	0-2

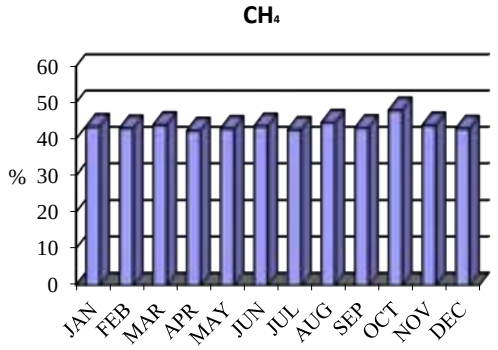

Figure 2. Monthly methane percentage in LFG content, produced in Gaziantep Municipal Solid Waste Power Plant

As can be seen from the figure, the average content of methane is between 45-50%. Moreover, the operation is stopped automatically when CH_4 content is decreased below 38% and O_2 is increased above 6%. The volumetric flow rate of LFG is measured as 14.03 m^3/min through the main pipeline. The LFG whose H_2S content is decreased to 100-120 ppm is pumped into three 1.13 MW, V type configuration, Janbacher-416 type gas engines which has 16 cylinder coupled with generators. The exhaust gas from engine is at nearly 450-500 ^{0}C. Due to the increasing amount of MSW in Gaziantep, two 1.13 MW Janbacher-4 type gas engines are constructed to the existing system in order to increase the capacity of the power plant operating with the same conditions with others. Figure 3 illustrates the monthly energy production in MWh in the power plant. The annual electricity production is 20.07 GWh using 7,374,095 m^3 landfill gas produced in the plant corresponding to the energy demand of 8,000 people in Gaziantep.

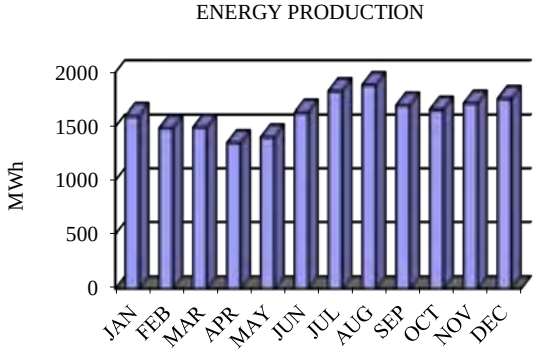

Figure 3. Monthly electricity production in Gaziantep Municipal Solid Waste Power Plant

3. THERMODYNAMIC ANALSIS

Mass, energy and exergy balances for any control volume at steady state with negligible kinetic and potential energy changes can be expressed, respectively, by [9]

$$\sum \dot{m}_i = \sum \dot{m}_e \tag{1}$$

$$\dot{Q} - \dot{W} = \sum \dot{m}_e h_e - \sum \dot{m}_i h_i \tag{2}$$

$$\dot{E}x_{heat} - \dot{W} = \sum \dot{m}_e \psi_e - \sum \dot{m}_i \psi_i + \dot{E}x_d \tag{3}$$

where the subscripts *e* and *i* represent the exit and inlet states, $\dot{Q}$ and $\dot{W}$ are the net heat and work inputs, $\dot{m}$ is the mass flow rate, *h* is the enthalpy, $\dot{E}x_d$ is exergy destruction and $\dot{E}x_{heat}$ heat is the net exergy transfer by heat at temperature T, which are given by

$$\dot{E}x_d = T_0 \dot{S}_{gen} \tag{4}$$

$$\dot{E}x_{heat} = \sum \left(1 - \frac{T_0}{T}\right) \dot{Q} \tag{5}$$

The specific flow exergy is given by

$$\psi = (h - h_0) - T_0 (s - s_0) \tag{6}$$

$$\dot{E}x = \dot{m}\psi \tag{7}$$

where the subscript 0 stands for the restricted dead state. Isentropic efficiencies of turbine and compressor can be defined as [10]

$$\eta_t = \frac{w_a}{w_s} = \frac{h_i - h_e}{h_i - h_{es}} \tag{8}$$

$$\eta_{comp} = \frac{w_s}{w_a} = \frac{h_{es} - h_i}{h_e - h_i} \tag{9}$$

where w_a is the actual specific work, w_s is the isentropic specific work, the subscript *es* is reversibility for exit state. The thermal efficiency of a power plant can be evaluated by means of the following equation [10]

$$\eta_{th} = \dot{W}_b / \dot{m}_f \dot{Q}_{HV} \tag{10}$$

where $\dot{W}_b$ is break power, $\dot{m}_f$ is mass flow rate of fuel and $\dot{Q}_{LHV}$ is lower heating value of fuel in equation 10. The exergetic (second law) efficiencies of turbine and compressor are given as follows:

$$\varepsilon_t = \frac{w_a}{w_{rev}} = \frac{h_i - h_e}{h_i - h_e - T_0 (s_i - s_e)} \tag{11}$$

$$\varepsilon_{comp} = \frac{w_{rev}}{w_a} = \frac{h_e - h_i - T_0 (s_e - s_i)}{h_e - h_i} \tag{12}$$

where w_{rev}, reversible specific work is equal to the sum of specific exergy destruction and actual work. The exergetic efficiency of a heat exchanger in a power plant is measured by the increase in the exergy of the cold stream divided by the decrease in the exergy of the hot stream

$$\varepsilon_{he} = \frac{(\dot{E}x_e - \dot{E}x_i)_{cold}}{(\dot{E}x_i - \dot{E}x_e)_{hot}} = \frac{\dot{m}_{cold} \left[h_e - h_i - T_0 (s_e - s_i)\right]_{cold}}{\dot{m}_{hot} \left[h_i - h_e - T_0 (s_i - s_e)\right]_{hot}} \tag{13}$$

where $\dot{m}_{cold}$ and $\dot{m}_{hot}$ are the mass flow rates of the cold and hot streams, respectively.

Energy and exergy analyses of the power plant are carried out by using actual operational data. Exergy rates of flow streams in the power plant are calculated. Thermodynamic properties, and exergy rates of flow streams are given in Table 2.

Table 2. Thermodynamic properties, and exergy rates in the plant

Number of states	Fluid	Pressure (bar)	Temperature (^{o}C)	Mass flow rate (kg/s)	Enthalpy (kJ/kg)	Entropy (kJ/kg.K)	Specific exergy (kJ/kg)	Exergy rate (kW)
0	Air	0.97	9.00	-	282.50	5.6530	0.00	-
0'	Water	0.97	9.00	-	37.89	0.1361	0.00	-
0 "	Lub oil	0.97	9.00	-	63.54	0.2408	0.00	-
0 '"	LFG	0.97	9.00	-	282.50	5.6530	0.00	-
1	LFG+Air	1.10	10.00	3.17	283.50	5.6200	10.31	32.67
2	LFG+Air	2.61	106.00	3.17	380.20	5.6660	94.03	297.89
3	Water	1.90	46.40	7.23	194.40	0.6568	9.59	69.37
4	Water	1.80	52.00	7.23	217.80	0.7295	12.48	90.25
5	LFG+Air	2.51	40.90	3.17	314.60	5.4870	78.94	250.07
6	Water	1.34	86.80	9.31	363.50	1.1550	38.13	354.97
7	Water	1.24	63.00	9.31	263.80	0.8686	19.24	179.08
8	Water	1.14	67.30	9.31	281.80	0.9218	22.22	206.91
9	Water	1.00	66.00	9.31	276.30	0.9058	21.24	197.74
10	Lub oil	3.37	83.10	20.00	207.40	0.6910	16.84	336.72
11	Lub oil	3.27	73.10	20.00	186.50	0.6314	12.75	255.04
12	Lub oil	1.00	72.00	20.00	183.90	0.6249	11.99	239.72
13	Air	1.80	10.00	38.84	283.50	5.479	50.09	1945.65
14	Air	1.80	33.00	38.84	306.60	5.557	51.19	1988.08
15	Exhaust	2.40	565.00	3.17	864.30	6.5210	336.89	1067.28
16	Exhaust	1.42	465.00	3.17	754.80	6.5330	224.01	709.66

Air and the exhaust gases are assumed as ideal gases. Heat transfer rates, work, exergy destructions and exergetic efficiencies are calculated using the governing equations given above for the subcomponents. The energetic and exergetic analyses of subcomponents are given in Table 3. In addition, the isentropic efficiencies of the compressor and turbine are also calculated. Isentropic efficiencies of compressor and turbine values are remarkably less than the exergy efficiencies of these components. The difference of the efficiencies are demonstrated that the isentropic efficiency and exergetic efficiency different from each other because of their definitions. Exergy efficiency of compressor is shown clearly less than turbine exergy efficiency. The reason for the lower exergy efficiency of the compressor compared to the turbine is exergy destruction values. The intercooler, heat exchangers and gas engine all have low exergy efficiencies.

Table 3. Energetic and exergetic analyses of subcomponents

Component	Rates of heat transfer or work (kW)	Exergy destruction (kW)	Exergy efficiency(%)
Compressor	306.35	41.12	86.58 ^{s}83.71
Intercooler	207.82	26.94	43.66
Turbine	346.90	10.73	97.00 ^{s}86.99
Gas Engine	1131.00	3435.50	24.77
Heat Exchanger	418.00	53.84	34.08
Heat Exchanger 2	928.21	133.46	24.12

4. CONCLUSION

The amount of waste produced by inhabitants or industrial companies can be considered as one of the most serious environmental problems in the world. Waste to energy techniques are crucial to dispose waste and energy recovery from waste. For this reason, energy recovery from waste is an alternative source for energy production. In this study, energy and exergy analyses of the power plant are performed as well as the analyses of all subcomponents. The exergetic efficiencies of the compressor and the turbine of the turbocharger are 86.58% and 97%, respectively. This represents that a remarkable exergetic performance is provided from the turbocharger. The exergetic efficiencies of the heat exchangers and the intercooler are calculated as 34.08%, 24.12%, and 43.66%, respectively. It is clear that the least efficient components of the plant are the heat exchangers.

By the aid of the thermodynamic analyses of all subcomponents, the exergetic efficiency of the power plant is found to be 36.94%. Beside this, thermal efficiency of gas engine is evaluated as 33.13%. which is compatible with the technical specifications of the Jenbacher 416 type. Higher exergy destructions represent the most potential for possible improvements in the performance of the plant in the frame of the presented analysis. This study can be a guide for other researchers in order to perform thermodynamic analysis for any municipal solid waste power plant in recent years.

ACKNOWLEDGEMENTS

This study is supported by TUBITAK (The Scientific and Technological Research Council of Turkey) with the project under the grant number of 114M142. The authors would like to thank TUBITAK and CEV (Clean Energy & Vehicles) Energy.

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Ecological Waste Management and Economic Concept of Sustainable

Veljko Đukić[1]

Abstract

Waste is one of the key problems of modern civilization and the consequences of man's way of life. The modernization of society, expanding and increasing the purchasing power of the population creates an increasing amount of waste which man distorts the natural balance. Resolving the problem of waste is recognized as one of the highest priorities to reduce environmental pollution, and therefore to protect human health, animal and plant life. The fact is that the developed countries have recognized this problem, and it is supported by their legislation and strategic documents in which they provide clear guidance on effective waste management.

Basic settings in general are almost everywhere identical: to produce as little waste as possible, reuse or recycle as much as possible, develop and apply new technologies, materials or energy, and finally the rest disposed of in an environmentally acceptable way.

In order to protect the ecosphere and all components of the environment (water, soil, air, flora and fauna, landscapes, built environment), environmental policy in the Republic of Srpska (BiH) must be based on international conventions.

Achieving the goals of environmental protection from the damaging effects of waste must be done to prevent pollution and reduce the effects on human health and the environment.

Keywords: environment, waste, sustainable management.

1. INTRODUCTION

Resolving the problem of waste is recognized as one of the highest priorities to reduce environmental pollution, and therefore to protect of human health, animal and plant life. The fact is that the developed countries have recognized this problem, and it is supported by their legislation and strategic documents in which they provide clear guidance on effective waste management[1].
Basic settings in general are almost everywhere identical: to produce as little waste as possible, reuse or recycle as much as possible, develop and apply new technologies, materials or energy, and finally disposing the residue in an environmentally acceptable way.
The amount of waste is growing while the infrastructure which should deal with waste is not sufficient. The waste management system doesn't function completely, and the regulations establishing the waste management have not been implemented completely. System which is disturbed in that manner has negative effects on the parts of eco-system such as water, air, soil, climate, human health and other living world. The underground waters have been endangered as they are the main source of drinking water storage supply and the basic national resources. By continuing with this undesirable practice we will face with a huge risk for greater and more serious consequences for health. Increasing pollution and losing surface waters will demand the expensive procedures of purification and remediation of the waters and soil.
The problem of waste cannot be successfully overridden with only one technology but with the mixture of greater number of available technologies. This approach, coloured with the sustainable development philosophy, is contained in the whole or integral management of the waste, based on the concept[2]:

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A–**A**void (reduction) of the waste
E- **E**valuation (using) of the unavoidable waste
R- **R**emoving (processing and disposing) of the remaining waste.

By this ecological-economic concept the priority is given to the prevention in the waste production, separate collection, material and energy recycling of the unavoidable waste (advanced technologies).

2. THE WASTE MANAGEMENT

The waste management is a complex activity covering all economic branches, production and consumption, and contains the series of procedures and technologies using most of them indifferent forms.
The Six Action Programme for the Environment Protection – "Six environment action programme 2010: our future, our choice", adopted in 2001 represents the stand point of the European Commission for Environment Protection, and within its new initiative on waste for the first decade of the 21st century[3].Increased consumption and the change in the life style will additionally burden already overburdened waste management systems and communal infrastructure. That is why, altogether with the improving of the existing waste management systems, the priority will be given to the investment into the initiative to avoid the production of waste, recycling and the infrastructure development.
Based on the continuing of the present approach, the Programme gives special attention to the need for the significant improvement of the implementation of the existing measures in the member-states. As the local governments are often those carrying the burden of the implementation of the demands of EU legislature on waste, the Commission is intending to improve their inclusion in the preparation of the legislature and supporting the mutual exchange of experience and the best practices.
The aims of the EU waste management policy contained in the Programme state that the main aims are to achieve the condition in which waste is non-hazardous or represents very low risk for the environment and health; and is reintroduced in the economic cycle by recycling or is returned to the environment in a useful way such as compost[3].The Six Action Programme has planned to adopt seven new strategies for the priority areas of the environment protection in which the most important strategy is prevention of waste and use of waste[3].
The management of the waste is a complex system with a large number of activities, which are in most cases, interdependent. The time when the waste management system was composed of two main parts: the collection and disposal are gone by. The waste, by definition, represents non useful and undesirable product, and is made as a result of the human activity, and the whole waste management system is composed of series of the following elements:

- waste production, evaluation the amount of waste and the possibility of the reduction in waste production;
- waste handling and separation include all waste activities until disposed into the garbage bin or waste collection container;
- waste collection includes all activities from collection and transport of waste to unloading vehicles for further waste processing as the secondary raw-material, readjusting for the use as energy source and disposing;
- waste separation and processing include processing of collected materials; conducted mostly in remote sites far from the location where it was generated;
- waste transport includes transport and reloading collection vessels and containers where waste is temporary stored in bigger transport equipment, and also transport to the distant locations for processing or disposal sites.

The whole waste management system includes all these intertwined elements; also evaluation of their functionality, economic advantages and their inter-relation in order to achieve the goal for establishing the efficient system. The system is defined as a choice and the use of existing techniques, management, programmes, and requires careful planning of the material flow from natural resources, production and consumption to the impact on the environment, whether positive or negative.
(Figure 1)[4]

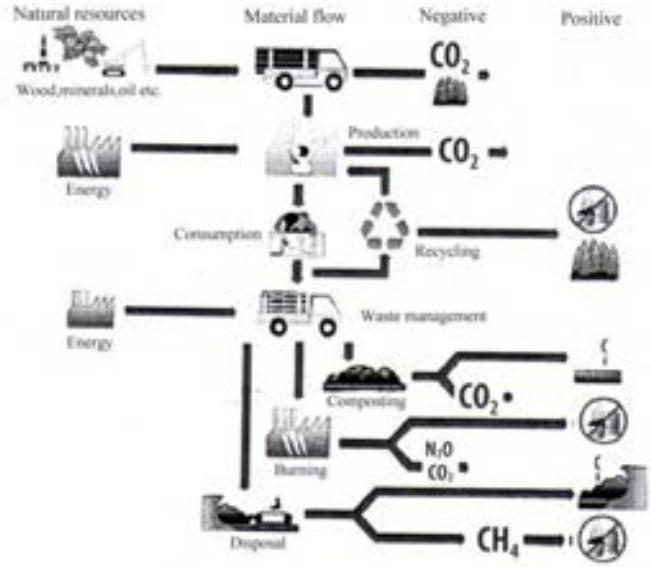

Figure1. .Portrayal of the life cycle of the material(Source:EPA,2005)

3. THE WASTE ECONOMY AS THE PRECONDITION OF THE ENVIRONMENT PROTECTION

The waste economy represents the sum of all political, scientific, technical and other measures achieving the reduction of the waste, the use of the waste and the safe disposal, by keeping the existing production and consumption[5].Those goals can be reached only in the market oriented economy and with flexible solutions, taking into consideration:

- Ecological benefits;
- Technical feasibility using the best available techniques;
- Economic feasibility.

Regional and sociological differences in a certain town i.e. region affect the amount of the generated waste and its make up where the setting of waste economy is being carried out such as village regions, town regions, agricultural and industrial zones of the area. These reasons, for the setting of the integral waste management system-waste economy, require detailed work on the following data:

- *Population*: number and structure of the population, the surface of the region, the density of population;
- *Settlement*: towns, villages, number of flats, number of the individual houses (with the number of the household members);
- *Industry*: number of the companies, number of the employed, number of the hostels;
- *Surrounding*: geological conditions, hydro-geological conditions, topography of the terrain and so on.

Cooperation with the public

The goal of cooperation with the public is informing the citizens on systems and installations for collection, processing, use and disposal of waste in towns and regions. Cooperation with public stimulates citizens, producers and vendors on reduction of waste and avoidance of waste production.

Avoiding waste

One of the principal goals of the integral waste production system- the waste economy is to avoid waste generating. Direct influence on avoiding waste and production of certain products in trade and industry is limited. That is why avoiding must be done indirectly by stimulating the citizens, producers and vendors with following measures:

- *Cooperation with the public:* the goal is stimulation of citizens and industrial-trade organizations to avoid waste, for example, they shouldn't use products with little packaging but they should use multiuse products, etc.;
- *Legal regulations:* the legal acts on connecting municipal waste companies in regional level, introduction of the cycle for useful waste components, etc.

The use of waste

a) Material use of the useful waste components– the goal is to use components from waste as useful material. In order to use useful components as material from waste, the market of waste must be established for glass, paper, cardboards, construction waste, plastic mass, woods and organic waste. Material use of the useful waste components is possible to achieve by the building installations for separation, installation for composting, installations for the recycling of the construction material and waste from the street reconstruction, installation for sludge reconstruction.

b) Thermal exploitation– primary reason for thermal waste processing is separation of harmful substances and reduction of the waste amount for disposal as well as the use of waste with high thermal power. Achieving these goals can be reached only by building installations for waste combustion, pyrolysis, combustion of waste, and so on.

4. THE AIMS AND DIRECTIONS FOR THE ENVIRONMENT PROTECTION

In order to protect the ecosphere, i.e. all environmental components (water, soil, air, flora and fauna, landscapes and constructed surrounding), the environment protection policy in the Republic of Srpska (BiH) is based on the international conventions from that area:

- Reduction in use, prevention of burdening and polluting environment, prevention of damaging, as well as improving and the remediation of the damaged environment;
- Human health protection and improving conditions for the life quality;
- Safe keeping and protection of natural resources, rational use of resources and the economy manner to ensure the renewal of resources,
- Coordination of other interests and entities with the demands for the environment protection;
- International cooperation in the environment protection;
- Initiatives by the public and participation of the public in the activities aiming for the environment protection;
- Coordination of economy and integrating of the social and economic development according to the requests for the environment protection;
- Setting of and development of the institutions for development and saving the environment.

Achieving the goals to protect the environment from the hazardous waste should be done to prevent the pollution and reduce consequences for the human health and the environment. The following measures can reach those goals [6]:

- Reduction in generating of waste to minimum, by reducing to minimum hazardous characteristics in particular;
- Reducing the amount of the waste taking into consideration special and hazardous waste;
- By processing waste and recovering useful materials from it;
- Combustion and disposal of waste which cannot be recovered, reused or used for the production of the energy in the manner acceptable for the environment.

The processing and disposing of waste should be carried out in the manner that is not endangering human health and without producing the harmful consequences or significant risk for the main components of the environment (Figure 2), in particular [7]:

- Without risk for the water, air, soil, flora and fauna;
- Without making hindrances via noises or unpleasant smells,
- Without harmful influences/ affects on nature or on the location of the special interest.

Carrying out these goals for protection and following all stated demands, is a very complex project. This project needs to be resolved by parallel researches and development of the waste economy (is yet to be formed in the Republic of Srpska (BiH)).

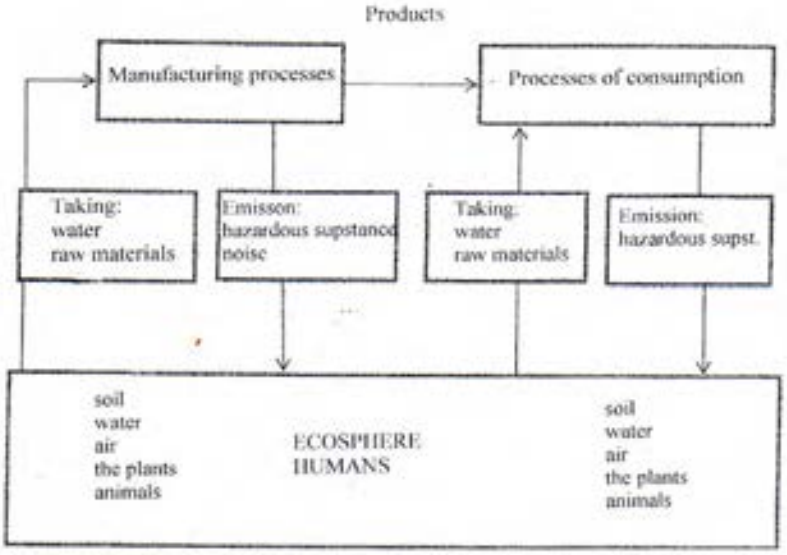

Figure 2. Man's influence on the environment (Source:BMU,2005)

With the idea on forming of a new product all relevant factors that could affect its final form should be taken into consideration (Table 1)[9]. Also, input- output analysis is often used when we choose the optimal choice (Figure 3)[1]which is a detailed image of material and energy flows. The basic for this analysis is the principle by which the materials and energy that enter the process of "transformation" are not lost but only their forms are changed.

Table 1. Factors affecting the choice of a new product (Source:Abfallwirtschat-journal,1995)

Number	Description
1.	Choosing the basic materials with low amount of the harmful components
2.	Minimizing the use of materials
3.	Extending the life time of the product
4.	Possibility of dissembling
5.	Unification of the integral parts
6.	The possibility to re-use the integral parts
7.	Reduction of the integral parts
8.	Unification of the basic parts
9.	The possibility of the material re-cycling
10.	Minimizing of the material
11.	Using the material for packaging which can be recycled or biologically decomposed

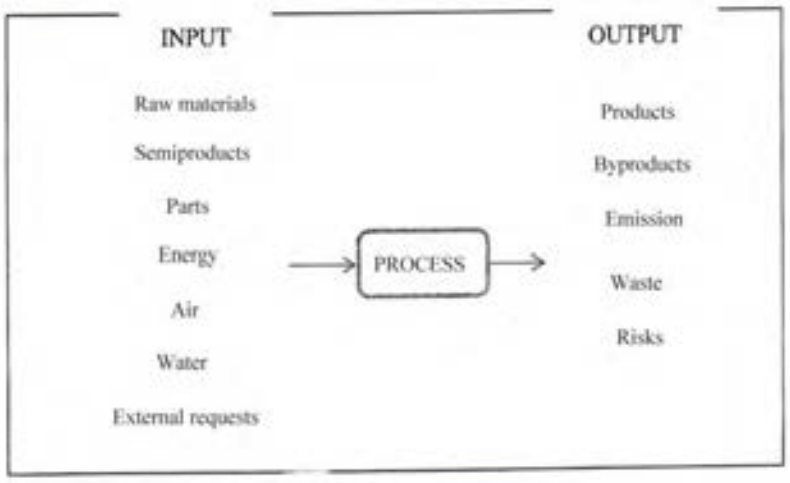

Figure 3. Input-Output Analysis (Source:Đukić,2008)

5. CONCLUSION

Waste production in real life is inevitable. Man produces and creates a lot, entailing some undesirable phenomena such as the production of waste. Waste cannot be completely removed but it can be reduced to an acceptable measure, which can be achieved only if we all become a part of its reduction. We achieve that primarily by education and raising public awareness in whole society.

The general ecological advantages by setting the whole waste management system are: reduction in the amount of waste being disposed at dumps, conditioning the reduction in the dump gas production, dump filtrate and many other harmful substances which are negatively affecting the basic elements of the environment i.e. directly or indirectly on human health, reduction in the total amount of waste would provide conditions for better use of existing waste dumps and a series of all other advantages.

The general economic advantages are: separation of all useful components from the waste (paper, glass, plastic, wood and other) and their use in the technological production processes of the same or the similar products or producing of the energy, saving non renewable raw-materials for the future generations, saving in the use of energy and other components during the production of certain products by using the secondary materials, creating new jobs.

Reaching the goals for protecting the environment from hazardous waste needs to be conducted to prevent pollution and reduce the consequences on the human health and the environment.

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Importance of the Marine Science and Charting about Environmental Planning, Management and Policies at the Turkish Straits

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Abstract

The Turkey is in a good position which has covered by water and also has the gate that connected the asian and europe continental. The Turkish Straits sea area is consist of Strait of the Istanbul (Bosphorus), Strait of the Canakkale (Dardanelle) and also Sea of Marmara. The Straits of Istanbul and Strait of Canakkale are connecting the Black Sea with the Aegean Sea through by Sea of Marmara. The Turkısh Straits has a really importance from the history because of the geopolitics, strategic and geographic situations. These importance, espacially strategic one is that the only water route between the Mediterranean Sea and the Black Sea, so the Turkish Strait sea area has been the site of significant settlement area and also city of Istanbul for a long time in the past. The Turkish Straits have been governed by the Montreux convention, since the 1936. From past to recent years this gate is the most important trade way of the world cause of the oil and oil products. These economic, strategic and also trade considerations have high level risk management about maritime transportation at the Turkish Straits. For these circumstances, need to deeply survey at the Turkish Strait about marine science, find all the risk factors at the end need to shown by the charts on the bridge of the ships and coastal facility for use all the mariners. These results could have chance to make environmental planning, management and their policies for maritime transportation, decrease marine pollution and protect all the straits shoreline by the regulations which aimed at the minimising shipping accident, avoiding collisions and protecting marine environment. With this working, try to explain the marine science and their surveys importance for environmental management, planning at the Turkish Strait.

Keywords: Turkish Straits, Environment, Chart.

1. TURKISH STRAITS SEA AREA OVERVIEW

The Turkey is in a good position which has covered by water and also has the gate that connected the asian and europe continental. The Turkish Straits sea area is consist of Strait of the Istanbul (Bosphorus), Strait of the Canakkale (Dardanelle) and also Sea of Marmara. The Straits of Istanbul and Strait of Canakkale are connecting the Black Sea with the Aegean Sea through by Sea of Marmara. The Turkish Straits has a really importance from the history because of the geopolitics, strategic and geographic situations. These importance, espacially strategic one is that the only water route between the Mediterranean Sea and the Black Sea, so the Turkish Strait sea area has been the site of significant settlement area and also city of Istanbul for a long time in the past. All part of the sovereign sea territory of Turkey and subject to the regime of internal waters. The Turkish Straits have been governed by the Montreux convention, since the 1936. Turkey, due to

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its treaty obligations under the Montreux Convention, first gave annual reports to the League of Nations Secretary-General and, since 1945, has given these to the United Nations Secretary-General. These reports, which also go to the High Contracting Parties, are entitled,'Rapport Annuel sur le Mouvement des Navires a Travers les Detroits Turcs' (Annual Report Concerning the Movement of Ships through the Turkish Straits). Another important point in favour of using the expression the 'Turkish Straits' comes from a UN document. This is the 'Third United Nations Conference on the Standardisation of Geographical Names', held at Athens, in 1977, and attended by 152 participants representing 59 countries, with observers from 11 non-governmental and international scientific organisations. The basic aim of the Conference was to use national names to standardise the names of geographical locations. The Conference resolutions empower Turkey in the use of the name 'Turkish Straits'.[1] This document's title is evidence of the international credence of the expression 'Turkish Straits'. [2] From past to recent years this gate is the most important trade way of the world cause of the oil and oil products. Throughout the history, this situation due to the geographical location, has lead to conflicts between Turkey and the countries both coasting and not coasting the Black Sea in terms of political, economic and strategic interests. Straits seperating Turkey's land into two as Asian side and European side resulted in the facts that Turkey's territorial integrity and independence are directly related to the legal regime which the straits are subject to. [3] In Montreux Conference, representative of Romania, Nicolae Titulescu's expression "Straits are the hearts of Turkey, but also lungs of Romania" affirms the importance of the Straits.[4] The Turkish Straits sea area has very special ecological conditions in terms of marine environment which includes atmospheric and oceanographic conditions, plant and animal diversity and also terrestrial environment. Besides strategic,economic and geologic situations, this area also has roles as biological corridor and biological barrier between the Mediterranean Sea and the Black Sea and form an acclimatization zone for migrating species. Due to being the only maritime access for the neighboring Black Sea states and the Central Asian Turki Republics, the İstanbul Strait has been exposed to dense marine traffic for centuries and substantial increase has occurred in size and tonnage of the ships passing through the Strait with hazardous cargo varieties and amounts they carry. Increase in the number of vessels that navigates on the Strait and being on the transportation way of hazardous and dangerous materials pose serious environmental and safety hazards for the İstanbul Strait, Marmara Sea and the surrounding residential areas. Geographic and oceanographic features of the İstanbul Strait makes the navigation on the Strait rather difficult and consequently the Strait has faced many casualties that caused severe environmental problems due to thousands tons of oil spill occurring in recent decades. [5]

Figure 15. Turkish Straits Sea Area Scheme

1.1. İstanbul Strait (Bosphorus)

Istanbul Strait is important narrow waterway of the world.It is also linking Black Sea with the Agean Sea by The Marmara Sea and also separates European and Asian continentals. Istanbul Strait is one of the most important routes of oil transportation, as it connects the Black Sea and the Mediterranean. Also it has most busy and dangerous maritime traffic line like the Malaka Strait. It has really different and special geographic, hydrographic,oceoangraphic and meteorologic conditions. It is not only important narrowest straits of the

world but also has sharp turns more than 10 times. 17 Nm length of the Istanbul Strait's european coastline is nearly 55 km, anatolian coastline is 35 km. Istanbul Strait sea bottom topography reveals many banks, holes, shallows and also sinks. In according to the Maritime Ministry Database, there are 26606 vessel with totally 329.121.399 Gross tones, passed through to strait, 14082 of them used pilot help, 15198 of them passed strait as transit vessel, 2390 of them bigger than 200 meters, 678 of them bigger than 500 Gross tones, 5327 of them tanker vessel at 2014.

Figure 2. Istanbul Strait Overview

1.2. Çanakkale Strait (Dardanelle)

The Strait of Çanakkale is about 37 nautical miles long and is generally straightforward, with the exception of two significant turns, near the City of Çanakkale, where the Strait reaches its narrowest width about 1,300 metres. Navigation is less dangerous than in the Strait of Istanbul, although strong currents numerous eddies and counter currents are experienced throughout the strait. A limited number of passenger and car ferries run daily between Çanakkale on the Asian side and Eceabat and Kilitbahir on the European side. In according to the Maritime Ministry Database, there are 25.551 vessel with totally 428.721.565 Gross tones, passed through to strait, 11114 of them used pilot help, 15240 of them passed strait as transit vessel, 3280 of them bigger than 200 meters, 316 of them bigger than 500 Gross tones, 5606 of them tanker vessel at 2014.

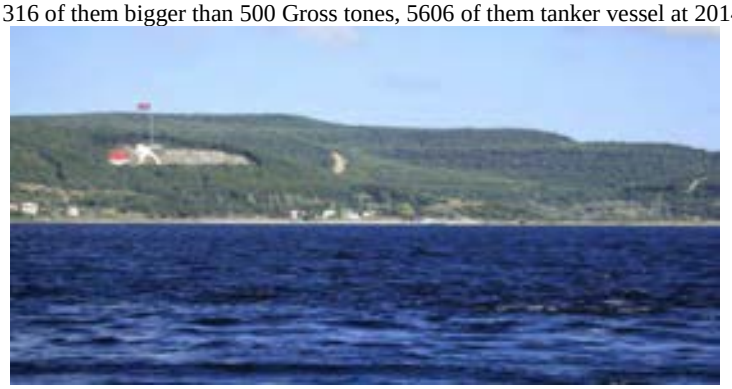

Figure 3. Canakkale Strait Overview

1.3. The Marmara Sea

It is very clear that, The Marmara Sea joins the Istanbul Straits to the Çanakkale Straits and sea area distance is about 110 miles, and does not pose any significant navigational hazards to vessels. It approaches to the two straits tend to be more congested than the open sea approaches. The approach to Çanakkale Strait has limited anchorage space, and that space is close to the traffic lanes. The Marmara Sea is an intracontinental basin 275 km long and 80 km wide formed as a result of pull-apart tectonics along the North Anatolia Fault.[6]

2. IMPORTANCE OF MARINE SCIENCE

The Marine Science has internationally importance about the sea and environmental research of the world. Also it has got many sub-divisions like hyodrography, oceanography, meteorology, climatology, marine geology and geophysics etc. This is the first question when someone hear something the marine sciences, ''What is working for?''. Surely the answer is following, measure and describe bodies of sea by use all sub-divisions. All these sub-divisions measures gains are as following, depth of sea, seabed profile, current, velocity, salinity, ecosystem, environment dynamics, pollutions etc. Apparently, marine sciences are

important parts of the maritime and environment. Some marine science disciplines should be known for all mariners and also environmental specialist.

2.1. Hydrography

Hydrography is the science that measures and describes the physical features of bodies of sea and the land areas adjacent to those bodies of sea. In according to International Hydrographic Organization-IHO definition, Hydrography is the branch of applied sciences which deals with the measurement and description of the physical features of oceans, seas, coastal areas, lakes and rivers, as well as with the prediction of their change over time, for the primary purpose of safety of navigation and in support of all other marine activities, including economic development, security and defense, scientific research, and environmental protection. [7] Hydrographers conducts hydrographic surveys to measure the depth and bottom configuration. All hydrographic datas are used to update nautical charts and develop hydrographic models; increasingly, are used for multiple purposes, through the integrated seas and coast by eligible programs. The main data type common to all hydrographic surveys is the depth. Of additional concern to many surveys is the nature of the seafloor material like sand, mud, rock due to implications for anchoring, dredging, structure construction, pipeline and cable routing, and fisheries habitat, pollutions and also environmental solutions.

Figure 4. Hydrographic Surveying by research ships

2.2. Oceanography

Oceanography covers a wide range of topics, including marine life and ecosystems, ocean circulation, plate tectonics and the geology of the sea floor, and the chemical and physical properties of the ocean. Just as there are many specialties within the medical field, there are many disciplines within oceanography. [8] Biological oceanography and marine biology study plants and animals in the marine environment. Chemical oceanography and marine chemistry study the composition of seawater, its processes and cycles, and the chemical interaction of seawater with the atmosphere and sea floor. Geological oceanography and marine geology explore the ocean floor and the processes that form its mountains, canyons, and valleys. Physical oceanography study the physical conditions and physical processes within the ocean such as waves, currents, eddies, gyres and tides; the transport of sand on and off beaches; coastal erosion; and the interactions of the atmosphere and the sea.

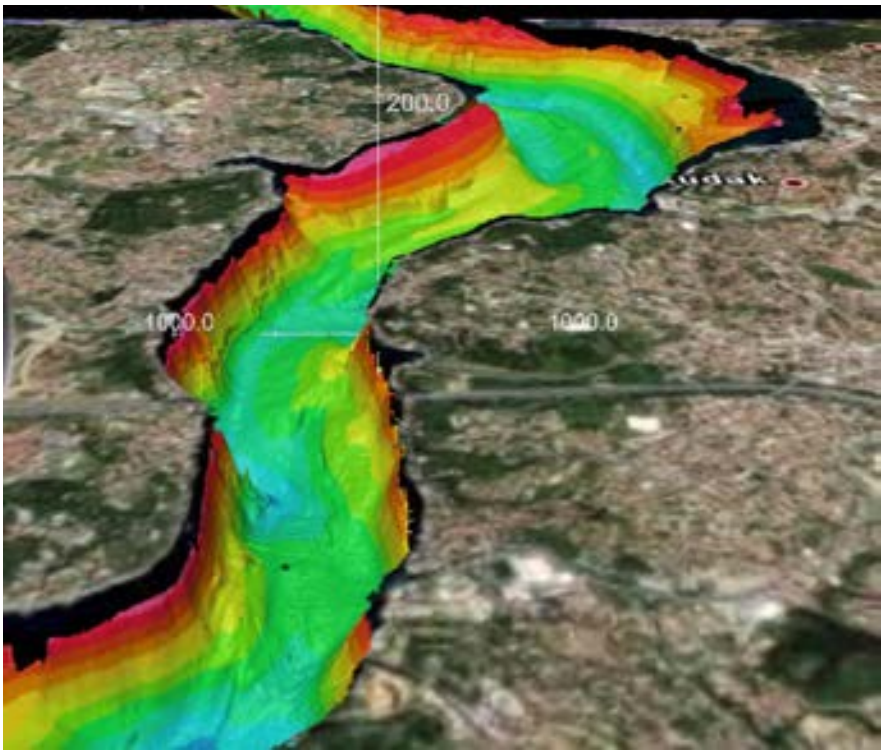

Figure 5. A part of Seabed of the Istanbul Strait

2.3. Meteorology

Meteorology, the study of the earth's atmosphere, is a component of Earth system science. The temperature, wind, and precipitation that we observe and experience impact, and are impacted on by, various scales. Weather, which is at one end of the meteorological spectrum, generally refers to short-term fluctuations which includes less than a couple of weeks, while the climate is characterized by longer time scales from months to years. On short time scales - convection, like cloud cover, humidity, soil moisture, can all impact a forecast while climate is impacted by solar variations, volcanic eruptions, and changes in the sea circulation.

2.4. Coastal Management

Coastal Management integrates the biological, physical, and policy sciences to plan and execute sustainable solutions for environmental challenges where land meets water. The well-created coastal management understands both the science of contemporary issues and the socioeconomic and political complexities facing coastal areas. Nearly 2/3 of the global population living within 100 km of coasts, impacts on the water and land in narrowly concentrated corridors are magnified by the potential for sea level rise and other coastal changes. Coastal Management is particularly applicable to emerging specialities in sustainability, one of the most rapidly growing fields in the 21st century and an inevitable condition for environmental management.

2.5. Environmental Sciences

Environmental science is also defined as the study of the interaction between the biosphere, lithosphere, hydrosphere and atmosphere, and represents a framework for studying problems that fall outside the realm of traditional scientific disciplines. Environmental science is also concerned with the relationship of human activities and the supporting environment. It provides the framework for making rational environmental decisions and solving pollution problems for land and sea.

2.6. Environmental Resource Management

Environmental Resource Management has become an area of national and international significance. Resource managers, typically in the public and private developmental sectors, face increasingly complex technical problems that can cut across several of the more traditional educational disciplines. In addition to

the fundamentals of biological and chemical environmental processes, managers must be knowledgeable in local, region, and global cause and effect relationships of human activities in the development and utilization of environmental resources. Resource managers must also understand the legal and regulatory aspects of resource and environmental impact assessment. Recognizing these multidisciplinary needs, the master's degree program in Environmental Resource is a option in the Environmental Sciences Program at Florida Tech and includes both university course work and an internship with a regulatory agency or private company involved in environmental resource management. Graduates are well prepared to effectively interact with engineers, scientists, managers, and politicians. [9]

2.7. Other Sciences

Marine biogeochemical research of oceans as transporters and processors of chemical elements that are essential to the functioning of the planet, such as carbon, nitrogen, phosphorus, oxygen, sulfur, silicon and iron. Marine biogeochemical is to determine how these elements, which are mobilized by natural and anthropogenic sources, are distributed and flow among the water masses, the seabed, particulate matter, living organisms, and the food webs of which these organisms form part. Particular attention is paid to the processes that occur across the interfaces between compartments which includes are water-particles, water-organisms, water-sediment, water-atmosphere. The environmental conditions of the past are also studied through the geochemical “footprints” stored in the seabed.

Science for the conservation of natural marine resources aims to provide the basic scientific knowledge necessary for the conservation and sustainable management of the marine environment and its natural resources. It therefore assesses the vulnerability of coastal areas and deep-sea ecosystems to human activities which includes fishing, trawling, pollution and changes in coastal and deep-sea morphology and their modulation by natural factors. It also needs to studies the potential of Marine Protected Areas as essential habitats for breeding and protection of endangered species. The research is aimed at improving basic knowledge of the ecology of exploited species and determining the interactions between the components of food webs. In order to assess changes in biodiversity and the exploitation of living resources, research is also aimed at identifying indicators of ecosystem impact and developing and applying models using bioeconomic and ecosystem approaches. Finally, the development of new biotechnological applications is studied in order to move towards an ecologically sustainable and profitable aquaculture.

Structure and dynamics of marine ecosystems research line is to understand the processes that occur in the marine environment and their variability. This will allow to detect the most significant natural changes and to assess their possible implications in the global change. The research aims to determine the main feedback mechanisms between environmental force which include climate, UV radiation, hydrodynamics, etc. and biological processes (reproduction, life cycles, food chains, benthos-plankton coupling) in order to quantify the productivity, diversity and stability of the ecosystems. [10] Physics of the ocean and climate aims are to describe and explain the physical behavior of the ocean and its role in the Earth's climate, using the principles of fluid mechanics and thermodynamics. Variations in temperature and salinity and in the density patterns in the oceans are observed and analyzed in order to develop models to explain the dynamic interaction between climate forcing and the state of the ocean. Researches of water movement means waves and currents, the transfer of energy and momentum between the ocean and the atmosphere, and the special properties of sea water such as the propagation of electromagnetic energy are used to improve knowledge of the physical processes of the ocean. This research also includes technical analyses of oceanic data obtained from space, especially data on surface salinity. At the end, it includes the design of oceanographic instrumentation and the development of advanced numerical models for studying various aspects of ocean dynamics.

Marine geosciences generally research geomorphology, sediment dynamics, geochemical flows, stratigraphy and tectonics of coastal regions, continental margins and ocean basins at all spatial and temporal scales. Marine geosciences also research includes the analysis of present-day sedimentary processes in response to natural and anthropogenic phenomena, the study of the morphology and structure of the seabed, and the assessment of geological hazards in coastal zones, continental margins and basins. In order to improve the general management of the seabed, some applications of this research line address issues such as the vulnerability of coasts, marine pollution, coastal and offshore facilities, oil and gas exploration, geological hazards, climate change and associated changes in sea level.

3. IMPORTANCE OF THE MARINE SCIENCE AND CHARTING ABOUT ENVIRONMENTAL PLANING, MANAGEMENT AND POLICIES AT THE TURKISH STRAITS

As mentioned first part of study that, in 2014, there are 26606 vessel with totally 329.121.399 gross tones, passed through to strait, 14082 of them used pilot help, 15198 of them passed strait as transit vessel, 2390 of them bigger than 200 meters, 678 of them bigger than 500 Gross tones, 5327 of them tanker vessel at Istanbul and 25.551 vessel with totally 428.721.565 gross tones, passed through to strait, 11114 of them used pilot help, 15240 of them passed strait as transit vessel, 3280 of them bigger than 200 meters, 316 of them bigger than 500 gross tones, 5606 of them tanker vessel at Çanakkale. Huge traffic causes many problems. As a result of these problems, some guidelines and regulations have been established for mariners like SOLAS, MARPOL, STCW, SAR etc. International Convention for the Safety of Life at Sea - SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960. The 1974 version includes the tacit acceptance procedure - which provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of Parties. [11] The Convention in force today is sometimes referred to as SOLAS, 1974, as amended.

International Convention for the Prevention of Pollution from Ships which has acronym MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The MARPOL Convention was adopted on 2 November 1973 at IMO. The Protocol of 1978 was adopted in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and a new Annex VI was added which entered into force on 19 May 2005. MARPOL has been updated by amendments through the years. The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes. MARPOL-Annex I is really important for Turkish Straits cause of its content. Annex I, Regulations for the Prevention of Pollution by Oil which entered into force 2 October 1983, covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003. [12]
MARPOL -Annex IV Prevention of Pollution by Sewage from Ships which entered into force 27 September 2003, Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land. MARPOL-Annex VI Prevention of Air Pollution from Ships which entered into force 19 May 2005, sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SOx, NOx and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships.

Also green port projects draws attention to the great importance is given in the last days. Governments and legislators around the world view ports and terminal as critical infrastructure assets. Their ability to ‘go green’ by reducing their carbon footprint, and by being more sensitive to environmental considerations, is vital to future success. GreenPort provides business information on environmental best practice and corporate responsibility centred around marine ports and terminals, including shipping, transport and logistics. [13] In according to Ministry of Environmental and Urbanisation’s policies of Marine and Coastal Area Management show that, there are some procedure and principles concerning the ship-sourced waste notifications. The waste notifications that are required to be made by ships over Ship Waste Tracking System (SWTS-GATS) shall be made by the owner, operator, or authorized agent of the ship to the relevant waste reception obligator and port authority at least 24 hours prior to the arrival of the ship at the port or upon departure from the previous port if the duration of the voyage is less than 24 hours. Any changes that might take place related to the time of arrival at the port or the quantities of waste after the waste notification is made shall again be immediately notified over GATS. The ship master, owner, operator, or authorized agent of the ship shall be obliged to submit the Waste Notification Form contained in Annex-1 of the 2013/12 Circular on the Implementation of Ship Waste Tracking Systems to the relevant waste reception obligator and Port Authority through fax in case of force majeure events, where they cannot access GATS. Services to be rendered by the

waste reception facilities and waste reception ships are performed in return for a fee. The list of fees to be charged to ships are determined by the Ministry of Environment and Urbanization and published in Official Gazette dated 05 June 2009 No: 27249 (Notification Regarding the Fees and Principles to be Implemented Within the Scope of the Regulation on Taking Waste from the Ships and Waste Control). The coastal facility evaluation of the risk and emergency response plan is prepared by Institutions which are authorized by responsible ministry. These institutions are learned from Environment Impact Assessment which is one of responsible ministry's departments. [14] Oil and chemical spillages in accidents that occurred, studies is executed and interfered within the scope of Law no: 5312 "Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances" and Regulation of application of this Law. [14] If the Legal response with chemical-dispersants to oil pollution which is caused by ship wrecked that related with this legislation, in this case, the Ministry's authorization has to be taken to use dispersants. And the use of dispersants without permission from the Ministry is illegal. And environmental law for operation is done to users. [14] The scope of the law No. 5312, Coastal facilities shall be obliged to take financial liability insurance against the damages under this Law. Coastal facilities that fail to comply with the requirement to take insurance shall not be allowed to operate. Coast Facilities Sea Pollution Compulsory Liability Insurance; This insurance provides coverage for legal liability in accordance with the Law No. 5312 dd. 3.3.2005 on the Principles of Responding in Emergencies to Marine Pollution Caused by Petrol and Other Harmful Substances, and Compensation of Damages and Losses, expenses for purification of sea, transportation and removal of collected garbage, claims as a result of death or bodily damage of third parties and loss or damage of private goods arising from pollution or pollution risk in inland waters, coastal waters, continental shelf, exclusive economic zone of Turkey, caused by the coast facility indicated on the policy in respect of General and Special conditions. In this context, to meet the damages, at the initiative of the Ministry, Coast Facilities Sea Pollution Compulsory Liability insurance and Environmental Liability Insurance's general conditions are prepared by Undersecretariat of Treasury. And ships have to have P&I Club Insurance. [14] Below mentioned authorities have the authority to supervise adherence to Environment Law No. 2872 in marine areas under the jurisdiction of the Republic of Turkey and the authority for decision making in the enforcement of administrative sanctions in accordance with Article 24 of the same law: Ministry of Transport, Maritime Affairs and Communications, Coast Guard Command, Boat Commands affiliated with Regional Commands, Istanbul Metropolitan Municipality, Kocaeli Metropolitan Municipality, Antalya Metropolitan Municipality, Mersin Metropolitan Municipality. [14]

Date	Vessel Name and Flag	Accident Area	Accident Type and Oil Spilt
14.12.1960	World Harmony (Greek) v. Peter Zoranic (Yugoslavia)	Kanlica	Collision and fire: 18.000 tons oil spilled
15.09.1964	Norborn (Norwegian) v. wreck of Peter Zoranic	Kanlica	Contact; fire and oil spilled
01.03.1966	Lutsk (Russia) v. Kransky Oktiabr (Russia)	Kızkulesi	Collision and fire: 1.850 tons oil spilled
15.11.1979	Independenta (Romania) v. Evriali (Greek)	-	Collision and fire: 20.000 tons of oil spilled and 30.000 tons of oil burned
09.11.1980	Nordic Faith (British) v. Stavanda (Greek)	-	Collision and fire
29.10.1988	Blustar (Malta) v. Gaziantep (Turkish)	Ahırkapı	Contact: 1.000 tons ammonia spill
25.03.1990	Jambur (Iraqi) v. Da Tung Shan (Chinese)	Sarıyer	Collision: 2.600 tons oil spilled
13.03.1994	Nassia (Philippines) v. Shipbroker	Bebek	Collision and stranding: 22 tons oil spilled
1982	Unirea		66.400 tons oil spilled
07.12.1999	Semele v. Sipka	Yenikapı	Collision: 10 tons oil spilled
29.12.1999	Volganeft 248	Florya	1.500 tons oil spilled
06.10.2002	M.V. Gotia	Emirgan Dock	Stranding: 20 tons oil spilled
10.12.2003	Svyatoy Panteleymon (Georgia)	Anadolu Feneri	Grounding: 230 tons oil spilled

Figure 6. Important Oil Spills in Turkish Straits

Figure 7. 1994 M/T Nassia and M/V Ship Broker's Collision

4. CONCLUSION

The Turkey is on a good position that surrounded by seas on three sides. Also has the Turkish Straits that connects the Black Sea to the Mediterranean Sea by Turkish Strait Sea area which includes Istanbul Strait and Canakkale Strait. Turkish Straits which have an important position in the geographical structure of the natural obstacles to safe navigation and structure is filled with many parameters due to factors because of its strategic importance and geographical political, economic, military, including many areas, The relevant parameters of obstacles to safe navigation and result a negative effect on environmental management undoubtedly the effect of marine Sciences and marine mapping products is very important. The Benefits of marine science to mariners and environment management, have enormous impact in ensuring the safety of all marine habitat. Due to the energy source research especially in the Caspian Sea and the Mediterranean sea, therefore the importance of the use of the Turkish Straits waterways have increased.

In the light of the aforementioned remarks that, the Turkey has great importance about national and international maritime transportation. Marine Science can able to measure all the sea whichs are belong to Turkish territorial sea and the Turkish Straits. Marine science and environmental science are using the formation of hydrography, oceanography, cartography and meteorology, such as more emphasis to the data that are important to the safety of navigation and support to environment management further mapping and marine show needs to be taken. Ultimately, What is importance of Marine Science? cannot be fully answered without considering all sub-divisions, the language of all marine and environmental science.

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Cyclists Approach the Vocational School Student Transportation, Mediterranean University Case

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Abstract

Unfortunately, our country is taken into account only motor vehicle while transportation planning. Biking reach from one place to another is problematic and dangerous. In the city is increasing steadily developing and growing utilization of motor vehicles. (Karaşahin, M., 1999). with this number increasing traffic density leading cause of environmental pollution. To promote bicycle transportation based on human power and to direct people to use environmentally friendly modes of transport and must encourage. Weight is preferred form of transportation in traffic as the use of private vehicles. Increased use of private vehicles is creating air and noise pollution. Transportation evaluate alternative modes of transport in order to solve the problem and society, people need to redirect accordingly. When examined in cars traveling through the city usually possible to see a large number of vehicles that traveled only the driver. Planning for urban transportation makes it impossible just done according to motor vehicle traffic bicycle transportation. Cyclists ride in transport distances, the dominance of motor vehicles on the road, planning to meet the needs of roads and motor vehicle traffic for pedestrians and cyclists is always a negative factor emerges. And leave the bike anywhere for use by drivers in the way they are considered dangerous for cyclists, it becomes difficult and stressful and bicycle use is decreasing.

The view of the bicycle transport is important in planning for the future college students. The advantages and disadvantages of this form of transportation in the investigation were discussed. In order to create awareness of both economic and healthy sporting life it has been shown to be preferred. Bicycle for university students in the city is used as an alternative means of transportation. In many people's leisure time entertainment bike also is a tool used with the purpose of health and social activities. This paper examines the use of a means of transportation in the city with the eyes of the cycling students. These students of environmentally friendly modes of transport and aims to expand the use of bicycles by society.

Keywords: Cycling, Transportation, Traffic, Travel, Transport.

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1. INTRODUCTION

Cycling all over the world, "Transport vehicle" is the status of the state, municipalities, local authorities, construction of bicycle paths is giving more importance in the 21st century. Usually used car on urban transportation in developed countries. People prefer bikes for short and medium distance transportation routes. In these countries, in parallel to the main road it has bike paths. They provide ease of access to the bike path in humans. Most bikes are produced and used in the world is the East Asian continent. China is beginning to take it. China is also close to all of the use of bicycles for transportation. In European countries, particularly the Netherlands, in Denmark and Belgium are very common use as the bicycle for transportation. (Helsinki, Eylül 2007.)

Bike lanes and bike use and dissemination arrangements within the traffic is encouraged. The whole world is trying to be avoided, especially energy derived from oil and solid fuel in European countries, it is being encouraged to use renewable energy. Wind, solar, wave and energy derived from water power offers a cleaner greener life. Cycling is a serious energy source, ie zero cost free, also no petrol, no diesel, no cost, no pollution, no noise, as people are very important for the health and fitness benefits. (İyinam, Ş., İyinam, A. F., 1999.)

Turkey is also often used for entertainment in the bike road trip. Transport use in daily life, especially in big cities for bicycle transport is seen a 100% risk. They are consistent with your particular bike is no urban. In our country, because it is in the status of cyclist's 3rd class car traffic, cyclists are confronted with responses. Giving peace to the bike it is necessary to increase the dissemination and exploitation issues. When the global world also examined statistics on the use of bicycle transportation 70% 29% 1% Trips fun and are being used for bicycle racing. (Yeşil Bisiklet, Temmuz, 2015.)

2. MATERIALS AND METHODS

Research group; Akdeniz University Vocational School of Technical Sciences is composed of students. The questionnaire used as data collection tool; with personal information, transport information, transport choices, causes, it consisted of 15 questions about opinions and habits of observation. Survey questions have been utilized in the preparation of questionnaires that were previously made. The survey is applied by students and instructors, after giving information about access to college student questionnaire was filled out. Answering the survey reflect the thought unique to people, especially during otherwise stated. Surveyed the audience while having no idea they quote are highlighted and influence. The results of the analysis of the data obtained were interpreted as frequency and percentage distributions. (Florida D.O.T., 2000)

3. FINDINGS

Although 30% of the arithmetic average age of 40.6 students in the study group were found to be between 40-48 years of age. The research group is to intensity as a student for 1-2 years. When the male and female students distribution is observed that 84% of boys and 16% girls.

Table 2. Gender Distribution of Surveyed students Audiences

Male	Female	Total
771	147	918
0,84	0,16	1

The research group is a young group density. The average age of male students and 21, the youngest 18, it was understood that the largest age group of 55 and the most in 19.

Table 3. Age Distribution of Surveyed students Audiences

Mean Age	Minimum	Maximum	Most
21	18	55	19

Research group of students usually 85% domestic, 13% prefer to stay at home and 02% at the hotel.

Tablo 4. Where to stay Mass of Students Surveyed

Home	Dormitories	Hotel	Total
776	121	21	918
0,85	0,13	0,02	1

Survey administration Yagil the students closest to 1 kilometer, 11 kilometers away, and the average distance is determined to come 4kilometr way.

Tablo 5. Distances Trip

Mean Distance	Minimum	Maximum	Most	Mod
4	1	11	2	2,75

3.1. Regarding the students' journey Preferences Tools

At the beginning of our country, and most preferred type of traveler Antalya bus ride to come. This made the students usually sit around close to the university and the study therefore seems to provide the most walk transportation. Healthy day by day in our country, cultural and economic reasons to prefer environmental transport is increasing. Users choose according to their preferred modes of transport for the next sets of advantages and disadvantages which will continue in the mode of transportation. Because of the climatic conditions of eligibility of Antalya, as seen in this study is mostly clear that pedestrian access is preferred. Ranked second bus, minibus third row, fourth bike, is in fifth place in service preferences. As this implies 1.6% of bicycle transport was determined to be used in a very small proportion.

Table 6. Their preferred mode of travel for the trip and Percentage of Students

R.N.	Pedestrian	Bus	Minibus	Bicycle	Car	Service	Free	Total
1	392	372	47	15	86	6	0	918
2	26	84	58	14	71	3	662	918
3	4	4	31	6	18	2	853	918

3.2. Student's Opinions about Public Transport

Participants in the survey "Urban Transit What is your satisfaction from the system?" He was asked, 45% of public transport "Dissatisfied" option has come to the fore. A large segment of 65% is certainly not satisfied with the public transport. If satisfied that a cut of 20% in the medium level, while the remaining 15% stated that they have satisfied part.

Table 7. Survey participants were asked from the Public Transport Satisfaction Rating

Very Satisfied	Satisfied	Mid	Not Satisfied	Not Pleased At All	Average	Total
46	57	221	185	409	2,07	918
0,05	0,06	0,24	0,2	0,45	0	1

Respondents to the study "Satisfaction of Transportation What is your fee?" He was asked, 54% of the public transport fare "Dissatisfied" option has come to the fore. 73'lik% from a large part of public transport fees are not absolutely delighted. If a cut is pleased 14'lik% moderate, stated that the remaining part 13'lik% satisfied.

Table 8. Participants in the survey were asked Public Transport Fare Satisfaction.

Very Satisfied	Satisfied	Mid	Not Satisfied	Not Pleased At All	Average	Total
64	53	127	176	498	1,92	918
0,07	0,06	0,14	0,19	0,54	0	1

3.3. Student's Thoughts about the Bike

When asked to ride a bike it is understood that the respondents did not know know and use the bike, a whopping 92%. 8% of the population does not know how to use the bike. Less widespread use despite knowing the use of bicycles as a mode of transport a large portion of the population shows that there is a conscious audience.

Table 9. Bicycle User Number and Percentage connoisseurs

Can Use Bicycles	Can Not Use Bicycles	Total
849	69	918
0,92	0,08	1

Think about bike users were asked of respondents. Is a game Bicycle tool? Whether transport? They tried to determine what they see as. Only a game tool, not just a means of transportation and transportation as well as the survey revealed seen as game tool. It is understood that such a large proportion of the 52% seen in bicycle transportation. The 44% cut of the cycling community sees as the only game in the vehicle. The percentage of bicycle transport as well as game and who was determined to be 4%.

Table 10. What do you think about the bike?

Recreational Vehicle	Transportation Vehicle	Recreational and Transportation Vehicle	Total
408	473	37	918
0,44	0,52	0,04	1

To determine how long the cycle repeats in use "The last time you ride your bike?" It was posed as questions. No riding bicycles except they constitute 26% of the childhood population. 1 year, 41% of which are used in bicycles, bicycle use between 1 and 4 years and 4 years more than 18% to 15% while those who use bicycles.

Table 11. Latest Cycling When did you get in?

Never	1 Year	1-4 Year	Than More 4 Year	Total
242	375	164	137	918
0,26	0,41	0,18	0,15	1

Bicycle transportation purposes to determine the percentage of users "You have been in transport ear bike ever?" The question was posed. A majority of 62% of users stated that they use for transportation. It is seen that when I was little use for transport by 22%. An important part of the bike, such as user generally is understood that 84% of the total valued transportation. Cutting 16% of the student population are using bicycles for transportation.

Table 12. You have been ear as transport bike ever?

Yes	No	when I was younger	Total
573	146	199	918
0,62	0,16	0,22	1

3.4. Bicycle Transportation Student's Perspective

When the factors that influence the use of bicycles on transport students asked what is emerging as a major factor to be suitable for road bikes. However, the lack of appropriate weather conditions, the distance is long for bicycle transportation is not suitable as three important factors in the forefront of traffic safety. As well as the society's point of view to the use of bicycles, the cost of a safe and available bikes, it is not pleasant bicycle use and socially not met appropriate, to be safe in terms of public security and personal as due to factors such as human self-reproach of it is considered to be preferable to use a bicycle.

Table 13. What do you think about the main obstacles to access by bike to school?

R.N.	Obstacles That Causes	1. Factor	2. Factor	3. Factor
1	Distance Away	141	37	17
2	Roads Not SUITABLE	269	18	4
3	Not Part of Me	52	12	9
4	Weather Conditions	138	97	12
5	Traffic Safety	124	93	63
6	Security Public Order	3	7	8
7	The Roads are so Inclined	2	14	3
8	Close	0	0	0
9	People Would Tease Me	40	10	4
10	Bicycle Purchase Costs	135	7	2
11	No Reason	14	623	796
***	Total	918	918	918

Table 14. Do you think the use of bicycles as a mode of transport in the event of very increase in transportation costs?

Yes	No	Total
618	300	918
0,67	0,33	1

Students expensive bike transportation fee if there is thought of as an alternative means of transportation. However, it is understood that transport as a mode of transportation definitely look expensive, even if the bike.

Table 15. If you were given free bike bike you come to school?

Yes	No	Sometimes	Total
472	200	246	918
0,51	0,22	0,27	1

Consider the case of 51% of the students can be given bicycles free bicycles as an alternative mode of transport, 22% and 27% is seen sometimes be used, but will definitely consider. When the rate of bicycle use as money in the transport sector almost half of the rental fee as 46%, but the reality shows that cost is an important factor to be used is free of charge.

Table 16. Daily bike rental fee if you use the maximum amount while cycling to school?

Rent Cost 5 TL	Rent Cost 3 TL	Rent Cost 1 TL	Rent Cost 0	Total
162	32	302	422	918
0,18	0,03	0,33	0,46	1
Media bike rental fee was calculated as 3,07 TL.				

Table 17. What is your total monthly expenses?

<400	400-700	700-1000	>1000	TOPLAM
353	315	150	100	918
0,38	0,34	0,16	0,11	1
Monthly environment seems to be spending between 400-700 TL.				

Table 18. What is your total monthly expenditure transportation?

<40	40-70	70-100	>1000	TOPLAM
326	274	168	150	918
0,36	0,3	0,18	0,16	1
Monthly environment seems to be spending between 40-70 TL.				

Average monthly transportation costs of students with average monthly cost of expenditure when it is observed that about 10% for transport. Accordingly, it said to be an economical means of transport if provided the use in continuous transport way as the transport costs beyond the initial purchase cost of investment and maintenance costs of the bicycle, depending on the additional cost of default and use the number and period.

4. CONTENT

This study and the bicycle as a mode of transport in Turkey is seen as a result of our research are widely used by university students. The use of bicycles in Turkey, students are referred to as a lower than 1.6%. In this case, we will talk about the reasons that first come to mind and revealing survey of the cities we live in that we are a major factor designed to remove the motor vehicle to the forefront of urban transport infrastructure is not suitable for bicycle transportation. But this issue of bicycle transport infrastructure investment planned by

local governments with regard to tourism and student potential still to be brought up is a major deficiency for a highly Antalya city.

The lack of private roads for cyclists, the recognition possibilities to carry bikes with public transport, bicycle parking spaces in the absence of such infrastructure issues as well as people's behavior patterns is also one of the reasons that prevent the widespread use of bicycles. While the car will come to mind first urban transport options, where everyday life often can not go beyond our lives bicycle and play a rationing tool gift to be given to children. Cycling in the absence of an accepted means of transportation within the city, as well as the use is not at the level required cycling as a sport and a hobby.

Geographical features also become more favorable, consisting of cyclists culture of life since the city in the old ones, and thanks to the support that is ongoing and is to provide local governments in the substantial number of people cycling is foreseen that can be used both as a means of transportation. In case of favorable conditions to ensure that our collective is clearly considered as an alternative means of transportation and may be preferred.

To sum up in one area of the bike lives if necessary, in a community, a city or an adoption and acceptance in the country, one of the design of the starting city of behavioral habits, geographical conditions of perception and is influenced by many factors that are up to the attitude of those who rule the country.

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Semi-Analytic Solution for the MHD Two Dimensional Stagnation-Point Flow of a Newtonian Fluid Towards a Uniformly Heated and Moving Vertical Plate

Serdar Barış[1], Mehmet Ş. Demir[2]

Abstract

We consider the application of a new Mathematica package BVPh 2.0 based on the homotopy analysis method (HAM) to the solution of a nonlinear ordinary differential equation system. The BVPh 2.0 is successfully applied to solve the stagnation flow of an electrically conducting incompressible viscous fluid towards a moving vertical plate in the presence of a transverse uniform magnetic field and the results are compared to results of the MATLAB routine BVP4c. The results reveal that the BVPh 2.0 can easly achieve good results in predicting the solutions of such problems.

Keywords: Homotopy analysis method (HAM), Magnetohydrodynamics (MHD), Newtonian fluid, Semi-analytic solution, Stagnation point.

1. INTRODUCTION

The incompressible viscous fluid flow and heat transfer phenomena over a flat surface is one of the most applicable cases in various branches of science, engineering, and technology. These analyses is usually encountered in the practical situations of many manufacturing processes such as the boundary layer along material handling conveyers, the aerodynamic extrusion of plastic sheet, the cooling of an infinite metallic plate in a cooling bath, and many others.

The classical two-dimensional stagnation point flow towards a rigid horizontal plane were pioneered by Hiemenz [1]. The corresponding temperature distribution studied by Goldstein [2]. Stagnation point flows on moving plates have been extensively studied by several authors and discussed in some articles: [3]-[7], etc. Convection in a boundary layer flow was first considered by Sparrow et al. [8]. They obtained similarity solutions for the combined forced and free convection flow and heat transfer about a non-isothermal body subjected to a non-uniform free stream velocity. Lloyd and Sparrow [9] investigated mixed convection flow along an isothermal vertical surface with the method of local similarity. Two-dimensional stagnation point flow and heat transfer problem toward a vertical plate was first investigated by Wang [10]. He obtained similarity solutions for the case of tilted two-dimensional stagnation point flow towards an isothermal vertical plate. Mixed convection in two- dimensional stagnation point flow was studied by Ramachandran et al. [11]. They obtained similarity solutions under the conditions of an arbitrary wall temperature and arbitrary surface heat flux. The effects of uniform suction or injection on the two-dimensional stagnation point flow towards a stretching horizontal plate with heat generation was given by Attia and Seddeek [12]. Recently, Wang and Ng

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[13] presented the solutions for the two-dimensional and axisymmetric stagnation flow toward a heated vertical plate with Navier's slip condition.

Magnetohydrodynamic flow and heat transfer process are now an important research area due to their industrial applications such as cooling of electronic devices by fans, heat exchanger design, MHD accelerators, and many others. Accordingly, a considerable amount of research has been accomplished on the effects of electrically conducting fluids. The study of the hydromagnetic interaction of an electrically conducting viscous fluid with an applied magnetic field in stagnation-point flow was initiated by Neuringer and Mcllroy [14]. In their subsequent study [15], they considered the heat transfer aspect of the same problem. Ariel [16] reexamined the Hiemenz flow in hydromagnetics. Chamkha [17] considered the problem of steady forced convection flow of an electrically conducting and heat generating/absorbing fluid near a stagnation point. Hiemenz magnetic flow and heat transfer problem on a permeable surface were considered by Attia [18] in the presence of uniform suction or injection. Two-dimensional MHD stagnation point flow towards a stretching sheet with variable surface temperature was studied by Ishak et al. [19]. Javed et al. [20] investigated the development of stagnation flow of an incompressible viscous fluid over a moving plate with partial slip. Abbasbandy and Hayat [21] developed the homotopy analysis solution for the problem of steady forced convection flow of an electrically conducting and heat generating/absorbing fluid near a stagnation point. Recently, Demir and Barış [22] obtained the numerical solutions for the two-dimensional and axisymmetric stagnation-point flow of an electrically conducting incompressible viscous fluid towards a moving vertical plate in the presence of a transverse uniform magnetic field by using MATLAB routine BVP4c.

Most fluid mechanic problems are inherently nonlinear and excepting a limited number of these problems, most do not have analytical solutions. Therefore, these nonlinear equations should be solved using other methods. In this study the HAM is applied to the two-dimensional stagnation-point flow of an electrically conducting incompressible viscous fluid towards a moving vertical plate in the presence of a transverse uniform magnetic field. The HAM was first introduced by Liao [23] as an analytic technique for strongly nonlinear problems. After his pioneering work, the HAM has been widely applied to solving the nonlinear problems [24]–[30]. We refer the reader to the books of Liao [24, 31] regarding the historical development of the method and detailed applications of various problems.

We consider the two-dimensional stagnation-point flow of an incompressible viscous fluid towards a moving vertical plate investigated by Demir and Barış [22]. The flow is illustrated in Figure 1. The velocity components corresponding to the *x*-, *y*- and *z*- directions are respectively denoted by u , v and w . Far from the plate, as z tends to infinity, the velocity components denoted by u_∞ , v_∞ and w_∞ . a is a physical constant, depending on the velocity in potential motion, T_w the temperature of the plate, T_∞ the temperature far from the surface, g the gravitational acceleration, V_0 the constant plate velocity in the *y*- direction and B_0 the external uniform magnetic field applied in the *z*- direction.

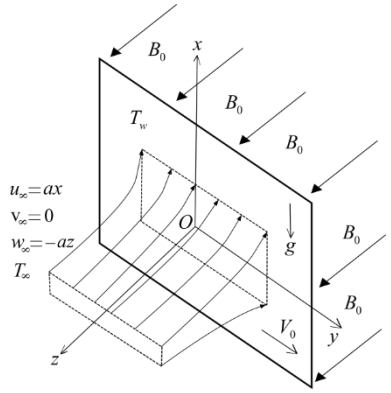

Figure 16. Physical model and coordinate system

Under the following assumptions:

(i) All the fluid properties are constant.

(ii) The flow is steady and laminar.

(iii) The plate is electrically non-conducting.

(iv) The magnetic Reynolds number is so small that the induced magnetic field produced by motion of fluid can be ignored in comparison to the applied one. In addition, the imposed and induced electrical fields are assumed to be negligible.

(v) The effects of viscous dissipation, Ohmic heating and Hall current are not included in the analysis, since they are generally small in the stagnation-point region. Also, the radiant heating is neglected.

The flow is governed by the following four dimensionless ordinary differential equations [22]:

$$\mathcal{N}_1[\mathrm{F}] = \mathrm{F}''' + \mathrm{F}\mathrm{F}'' - (\mathrm{F}')^2 + \mathrm{Ha}\,(1 - \mathrm{F}') + 1 = 0 \tag{1}$$

$$\mathcal{N}_2[\mathrm{F},\mathrm{H}] = \mathrm{H}'' + \mathrm{F}\mathrm{H}' - \mathrm{Ha}\,\mathrm{H} = 0 \tag{2}$$

$$\mathcal{N}_3[\mathrm{F},\mathrm{M},\theta] = \mathrm{M}'' + \mathrm{F}\mathrm{M}' - \mathrm{M}\mathrm{F}' - \mathrm{Ha}\,\mathrm{M} + \lambda\theta = 0 \tag{3}$$

$$\mathcal{N}_4[\mathrm{F},\theta] = \theta'' + \mathrm{Pr}\,\mathrm{F}\,\theta' + \alpha\,\mathrm{Pr}\,\theta = 0 \tag{4}$$

with the following boundary conditions:

$$\begin{aligned} &\eta = 0: \quad \mathrm{F}(0) = 0, \quad \mathrm{F}'(0) = 0, \quad \mathrm{H}(0) = 1, \quad \mathrm{M}(0) = 0, \quad \theta(0) = 1 \\ &\eta \to \infty: \quad \mathrm{F}'(\infty) = 1, \quad \mathrm{H}(\infty) = 0, \quad \mathrm{M}(\infty) = 0, \quad \theta(\infty) \to 0. \end{aligned} \tag{5}$$

where $\mathrm{F}(\eta), \mathrm{M}(\eta), \mathrm{H}(\eta)$ and $\theta(\eta)$ are the similarity functions and the prime denotes the differentiation with respect to similarity variable η. $\mathcal{N}_1[\mathrm{F}], \mathcal{N}_2[\mathrm{F},\mathrm{M},\theta], \mathcal{N}_3[\mathrm{F},\mathrm{H}]$ and $\mathcal{N}_4[\mathrm{F},\theta]$ are nonlinear differential operators. Ha is the non-dimensional magnetic parameter, λ the non-dimensional convection parameter, Pr the Prandtl number and α is the non-dimensional heat generation parameter and they are defined as:

$$\mathrm{Ha} = \frac{\sigma_0 B_0^2}{\rho a}, \quad \lambda = \frac{g\beta(T_w - T_\infty)\sqrt{\rho}}{a\sqrt{\mu a}}, \quad \mathrm{Pr} = \frac{\mu c_p}{k}, \quad \alpha = \frac{Q_0}{\rho c_p a}. \tag{6}$$

where σ_0 is the electrical conductivity, ρ the density, β the coefficient of thermal expansion, μ the dynamic viscosity, c_p the specific heat at constant pressure, k the thermal conductivity and Q_0 is the volumetric rate of heat generation. The dimensionless expressions for the velocity components, shear stress on the plate in the *x* and *y* directions and the heat transfer rate per unit area on the plate are given through the following equations [22]:

$$\frac{u}{ax} = \frac{1}{x}\sqrt{\frac{\mu}{\rho a}}\mathrm{M}(\eta) + \mathrm{F}'(\eta), \quad \frac{\mathrm{v}}{V_0} = \mathrm{H}(\eta), \quad \frac{\mathrm{w}}{-\sqrt{\mu a/\rho}} = \mathrm{F}(\eta) \tag{7}$$

$$\tau_{wx} = -\frac{1}{\mu a}t_{xz}\Big|_{z=0} = -\mathrm{M}'(0) - x\sqrt{\frac{\rho a}{\mu}}\,\mathrm{F}''(0), \qquad \tau_{wy} = -\frac{1}{V_0\sqrt{\mu\rho a}}t_{yz}\Big|_{z=0} = -\mathrm{H}'(0) \tag{8}$$

$$q_w = -k\frac{\partial T}{\partial z}\Big|_{z=0} = -k\sqrt{\frac{\rho a}{\mu}}(T_w - T_\infty)\,\theta'(0). \tag{9}$$

In this paper, the nonlinear equations of the problem under consideration are solved through the Mathematica package BVPh 2.0 and compared with the results obtained by the numerical method MATLAB routine BVP4c. Some plots and tables are presented to show the reliability and simplicity of the method. A good agreement of the present results with existing results of Demir and Barış [22] has been shown.

2. SOLUTION WITH BVPH 2.0

In this section we discuss application of the BVPh 2.0 [24] to solve the system of the coupled nonlinear ordinary differential equations (1)-(4) under the boundary conditions (5). To obtain the series solutions of the problem under consideration, the governing equations, boundary conditions, a proper initial guess for each unknown function, an auxiliary linear operator and an auxiliary function for each governing equation should be defined as inputs. We have great freedom to choose initial guesses, linear operators and auxiliary

functions. But it should be noted that to choose these parameters plays an important role in the frame of the HAM. As long as they are so properly chosen that the solution series converges to the exact solution of the problem under consideration [24]. Thus, we start with to express solution series by the set of base functions

$$\left\{\eta^m, \mathrm{e}^{-n\eta}\middle|\quad n\geq 0, \mathrm{m}\geq 0\right\}. \tag{10}$$

in the form:

$$\begin{aligned} &\mathrm{F}(\eta)=\sum_{m=0}^{\infty}\sum_{n=0}^{\infty}a_{m,n}\eta^m\,\mathrm{e}^{-n\eta}, \quad \mathrm{H}(\eta)=\sum_{m=0}^{\infty}\sum_{n=0}^{\infty}b_{m,n}\eta^m\,\mathrm{e}^{-n\eta},\\ &\mathrm{M}(\eta)=\sum_{m=0}^{\infty}\sum_{n=0}^{\infty}c_{m,n}\eta^m\,\mathrm{e}^{-n\eta}, \quad \theta(\eta)=\sum_{m=0}^{\infty}\sum_{n=0}^{\infty}d_{m,n}\eta^m\,\mathrm{e}^{-n\eta}. \end{aligned} \tag{11}$$

where $a_{m,n}, b_{m,n}, b_{m,n}$ and $d_{m,n}$ are constant coefficients to be determined by the BVPh 2.0. Eq. (11) is called 'solution expressions', which provide us a guide to choose the initial guesses, auxiliary linear operators and auxiliary functions. According to the boundary conditions (5) and, the solution expressions (11) we choose the following initial guesses:

$$\mathrm{F}_0(\eta)=\eta+\mathrm{e}^{-\eta}-1, \quad \mathrm{H}_0(\eta)=\mathrm{e}^{-\eta}, \quad \mathrm{M}_0(\eta)=0, \quad \theta_0(\eta)=\mathrm{e}^{-\eta}. \tag{12}$$

We select the auxiliary linear operators

$$\mathcal{L}_1=\frac{\partial^3}{\partial\eta^3}+\frac{\partial^2}{\partial\eta^2}, \quad \mathcal{L}_2=\mathcal{L}_3=\mathcal{L}_4=\frac{\partial^2}{\partial\eta^2}+\frac{\partial}{\partial\eta} \tag{13}$$

with the properties

$$\begin{aligned} &\mathcal{L}_1[\mathrm{C}_1+C_2\eta+C_3\,\mathrm{e}^{-\eta}]=0, \qquad \mathcal{L}_2[\mathrm{C}_4+C_5\,\mathrm{e}^{-\eta}]=0,\\ &\mathcal{L}_3[\mathrm{C}_6+C_7\,\mathrm{e}^{-\eta}]=0, \qquad \mathcal{L}_4[\mathrm{C}_8+C_9\,\mathrm{e}^{-\eta}]=0 \end{aligned} \tag{14}$$

where $C_1, C_2, \ldots C_9$ are constants to be determined by the boundary conditions. The auxiliary functions may be written as:

$$H_1(\eta)=H_2(\eta)=H_3(\eta)=H_4(\eta)=\mathrm{e}^{-\eta} \tag{15}$$

With the inputs (1)-(5) and (12)-(15), series solutions of the similarity functions at any order $\mathrm{F}(\eta), \mathrm{M}(\eta), \mathrm{H}(\eta)$ and $\theta(\eta)$ are gained automatically by the BVPh 2.0. For further details, refer to the user's guide of the BVPh 2.0 online (http://numericaltank.sjtu.edu.cn/BVPh.htm). For example, the 1th- order of approximations can be written as follows:

$$\begin{aligned} &\mathrm{F}(\eta)=-1-0.25\,c_{01}(1+\mathrm{Ha})+\eta+\mathrm{e}^{-\eta}+0.75c_{01}\mathrm{e}^{-\eta}+0.5\,c_{01}\,\mathrm{Ha}\,\mathrm{e}^{-\eta}\\ &-0.5c_{01}\mathrm{e}^{-2\eta}-0.25\,c_{01}\,\mathrm{Ha}\,\mathrm{e}^{-2\eta}-0.25\,c_{01}\eta\,\mathrm{e}^{-2\eta} \end{aligned} \tag{16}$$

$$\begin{aligned} &\mathrm{H}(\eta)=\mathrm{e}^{-\eta}-0.083c_{02}\mathrm{e}^{-\eta}+0.5\,c_{02}\,\mathrm{Ha}\,\mathrm{e}^{-\eta}+0.25c_{02}\mathrm{e}^{-2\eta}\\ &-0.5\,c_{02}\,\mathrm{Ha}\,\mathrm{e}^{-2\eta}-0.5\,c_{02}\eta\,\mathrm{e}^{-2\eta}-0.167\,c_{02}\mathrm{e}^{-3\eta} \end{aligned} \tag{17}$$

$$\mathrm{M}(\eta) = -0.5 c_{03} \lambda \mathrm{e}^{-\eta} + 0.5\, c_{03} \lambda\, \mathrm{e}^{-2\eta} \tag{18}$$

$$\begin{aligned} \theta(\eta) &= \mathrm{e}^{-\eta} - 0.5 c_{04} \mathrm{e}^{-\eta} + 0.417\, c_{04}\, \mathrm{Pr}\, \mathrm{e}^{-\eta} - 0.5\, c_{04}\, \alpha\, \mathrm{Pr}\, \mathrm{e}^{-\eta} + 0.5 c_{04} \mathrm{e}^{-2\eta} \\ &-0.25 c_{04}\, \mathrm{Pr}\, \mathrm{e}^{-2\eta} + 0.5\, c_{04}\, \alpha\, \mathrm{Pr}\, \mathrm{e}^{-2\eta} - 0.5\, c_{04}\, \mathrm{Pr}\, \eta\, \mathrm{e}^{-2\eta} - 0.167\, c_{04}\, \mathrm{Pr}\, \mathrm{e}^{-3\eta} \end{aligned} \tag{19}$$

where c_{01}, c_{02}, c_{03} and c_{04} are convergence-control parameters provides us to adjust and control convergence regions of solution series. The optimal values of convergence-control parameters are determined automatically by by the minimum of the total error with using the **'GetOptiVar'** command of the BVPh 2.0. The total error at the kth-order of approximation defined as follow [31]:

$$E_n^{(t)}(c_{01}, c_{02}, c_{03}, c_{04}) = E_n^{(1)} + E_n^{(2)} + E_n^{(3)} + E_n^{(4)} \tag{20}$$

where

$$\begin{aligned} E_n^{(1)} &= \frac{1}{1+N} \sum_{j=0}^{N} \left\{ \mathcal{N}_1 \left(\sum_{i=0}^{k} \mathrm{F}_i \right) \Big|_{\eta = j\delta\eta} \right\}^2, \quad E_n^{(2)} = \frac{1}{1+N} \sum_{j=0}^{N} \left\{ \mathcal{N}_2 \left(\sum_{i=0}^{k} \mathrm{F}_i, \sum_{i=0}^{k} \mathrm{M}_i, \sum_{i=0}^{k} \theta_i \right) \Big|_{\eta = j\delta\eta} \right\}^2 \\ E_n^{(3)} &= \frac{1}{1+N} \sum_{j=0}^{N} \left\{ \mathcal{N}_2 \left(\sum_{i=0}^{k} \mathrm{F}_i, \sum_{i=0}^{k} \mathrm{H}_i \right) \Big|_{\eta = j\delta\eta} \right\}^2, \quad E_n^{(4)} = \frac{1}{1+N} \sum_{j=0}^{N} \left\{ \mathcal{N}_2 \left(\sum_{i=0}^{k} \mathrm{F}_i, \sum_{i=0}^{k} \theta_i \right) \Big|_{\eta = j\delta\eta} \right\}^2 \end{aligned} \tag{21}$$

are the average residual error at the kth-order of approximation for the original governing equations, respectively.

3. RESULTS AND DISCUSSION

In this section we compare the results obtained by BVPh 2.0 for the two-dimensional stagnation-point flow on a moving vertical plate in the presence of a transverse uniform magnetic field with the existing numerical results of Demir and Barış [22]. These numerical solutions were obtained using the Matlab solver boundary value problem (BVP4c) designed for the solution of two point boundary value problems. The code is based on a collocation formula. We refer the reader to the book by Shampine et al. [32] for details about how to solve boundary value problems with BVP4c.

The value of η_∞ , which correspond to $\eta = \infty$, was approximated to be equal to 12. This value was found to be large enough to give consistent results. The optimal values of convergence-control parameters change with the change of parameters entering into the problem. The optimal values of c_{01}, c_{02}, c_{03} and c_{04} are gained with BVPh 2.0 at the 5th-order of approximation by setting $N = 100$ and listed in Table 1 for different values of Ha, λ, Pr and α .

Figure 2 shows the total error at the nth-order of approximation for $\mathrm{Ha} = 1,\ \lambda = 0.5,\ \mathrm{Pr} = 0.7,\ \alpha = 0.2$. It is apparent that an increase of the order of approximation leads to a decrease of the total error. In this way, we can gain more accurate results for the considered problem. It should be noted that increasing of the order of approximation increases the computational time.

Table 1. The optimal values of convergence-control parameters

Ha	λ	α	Pr	c_{01}	c_{02}	c_{03}	c_{04}
1	0.5	0.2	0.7	-1.09282	-1.55106	-1.34435	-1.36072
			7	-0.18518	-1.44909	-1.33304	-0.30910
		0.4	0.7	-1.05601	-1.53757	-1.34993	-1.37924
			7	-0.15542	-1.44909	-1.34392	-0.34858
	1	0.2	0.7	-1.06950	-1.54234	-1.34165	-1.35906
			7	-0.18524	-1.44909	-1.33299	-0.30869
		0.4	0.7	-1.14446	-1.57246	-1.35897	-1.37794
			7	-0.15570	-1.44909	-1.34906	-0.34747
3	0.5	0.2	0.7	-0.82109	-1.05711	-1.01218	-1.35278

		7	-1.00009	-1.00415	-0.95480	-0.23861
	0.4	0.7	-0.81933	-1.05618	-1.01147	-1.36687
		7	-1.03383	-1.19491	-0.96557	-0.26856
	0.2	0.7	-0.81641	-1.05464	-1.17289	-1.35332
1		7	-0.99981	-1.17227	-0.95496	-0.23852
	0.4	0.7	-0.81370	-1.05323	-1.17548	-1.36758
		7	-1.03360	-1.19476	-0.96562	-0.26837

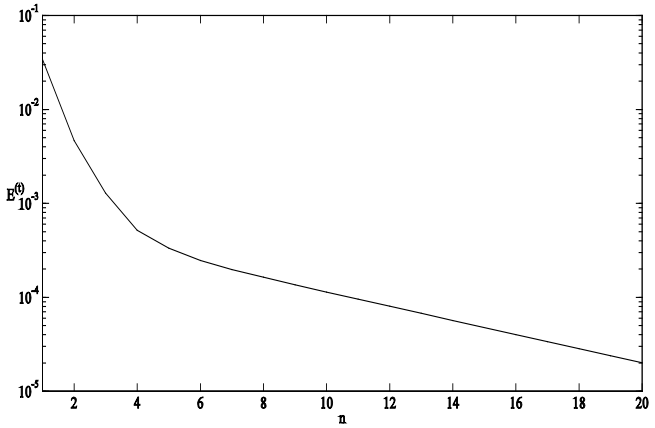

Figure 2. The total error at the nth-order of approximation ($\mathrm{Ha} = 1,\ \lambda = 0.5,\ \mathrm{Pr} = 0.7,\ \alpha = 0.2$ *)*

Figure 3 shows comparison of velocity and temperature profiles obtained with BVP4c [22] and the HAM solutions at the 10th and 20th-order of approximation. The comparison of the values of tangential shear stress $-\tau_{wx}$ on the plate is tabulated in Table 2 for different values of the non-dimensional parameters. Comparison of the shear stress τ_{wy} and the values of temperature gradient $-\theta'(0)$ on the plate are listed in Table 3 and Table 4, respectively. We conclude from these figures and tables that the BVPh 2.0 is able to give results which are accurate and uniformly valid for all values of η .

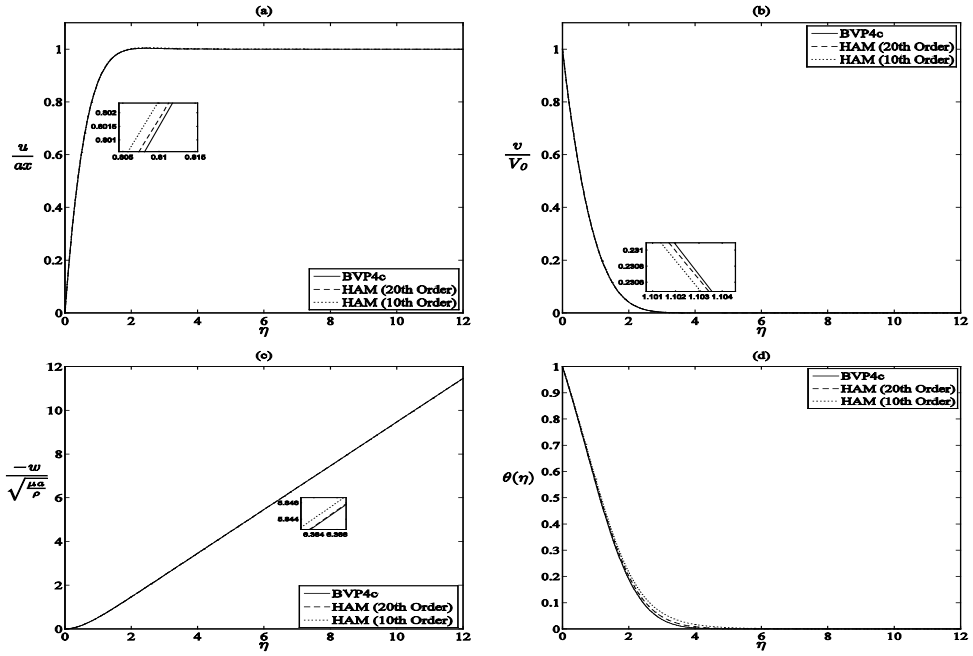

Figure 3. Comparison of velocity and temperature profiles $\mathrm{Ha} = 1,\ \lambda = 0.5,\ \mathrm{Pr} = 0.7,\ \alpha = 0.2,\ \sqrt{\mu/\rho a\, x^2} = 0.4$

Table 2. Comparison of the tangential shear stress $-\tau_{wx}$ *on the plate* ($\sqrt{\rho a x^2/\mu} = 0.4$)

Ha	λ	α	BVP4c		10th Order HAM		20th Order HAM	
			Pr = 0.7	Pr = 7	Pr = 0.7	Pr = 7	Pr = 0.7	Pr = 7
		0.2	0.894020	0.806396	0.898150	0.789090	0.895833	0.810154
	0.5	0.4	0.909225	0.831980	0.915076	0.822630	0.912627	0.821522
1		0.2	1.153908	0.978660	1.162236	0.953864	1.157543	0.985001
	1	0.4	1.184317	1.029827	1.195958	1.011272	1.191123	1.007469
		0.2	1.048941	0.989780	1.051511	0.987712	1.049720	0.990550
	0.5	0.4	1.057998	1.005965	1.061571	0.996422	1.059542	1.010326
3		0.2	1.248587	1.130263	1.253117	1.127113	1.250144	1.131511
	1	0.4	1.266699	1.162634	1.273267	1.151368	1.269787	1.166291

Table .3 Comparison of the shear stress τ_{wy} *on the plate* (Pr = 7, $\alpha = 0.4$, $\lambda = 1$)

Ha	BVP4c	10th Order HAM	20th Order HAM
1	1.112340	1.108034	1.112166
3	1.788563	1.790860	1.788148

Table 4. Comparison of the temperature gradient $-\theta'(0)$ *on the plate (* $\lambda = 1$ *)*

Ha	α	BVP4c		10th Order HAM		20th Order HAM	
		Pr = 0.7	Pr = 7	Pr = 0.7	Pr = 7	Pr = 0.7	Pr = 7
	0.2	0.400810	0.774613	0.384781	0.801580	0.393842	0.765715
1	0.4	0.267068	0.157239	0.243144	0.085677	0.253109	0.277218
	0.2	0.427653	0.896983	0.411394	0.965300	0.421675	0.889137
3	0.4	0.299721	0.343883	0.274684	0.428247	0.287430	0.355195

4. CONCLUSIONS

In this paper, we investigated the application of the Mathematica package BVPh 2.0 based on the HAM in the solution of hydromagnetic two-dimensional stagnation-point flow against a moving vertical plate that is described by systems of coupled nonlinear ordinary differential equations as described by Demir and Barış [22]. The accuracy of the computed BVPh 2.0 approximate results was confirmed against numerical results obtained by using the popular MATLAB routine BVP4c. The graphical and tabular presentation of the results shows that the BVPh 2.0 can easily achieve good results in predicting the solutions of systems of coupled nonlinear ordinary differential equations.

ACKNOWLEDGMENT

This work was supported by Scientific Research Projects Coordination Unit of Istanbul University. Project number 56523.

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Estimating of Kinematic Viscosity of Alternative Fuels by Using ANN

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Abstract

It is known that viscosity is an important parameter for the fuels obtained from vegetable oils. In this study, kinematic viscosities of bioethanol, biodiesel -bioethanol blends and biodiesel produced from safflower oil have been investigated. Kinematic viscosities of bioethanol, fuel blends and biodiesels have been measured between 293-341 K with intervals of 3 K. Viscosity values of fuels have been modelled with nonlinear regression method at Arrhenius equations, in addition, they also have been modelled with artificial neural networks (ANN) method. By comparing ANN model obtained with nonlinear regression models, it has been determined which model is best.

Keywords: ANN, Biodiesel, Bioethanol, Regression, Viscosity.

1. INTRODUCTION

Energy requirement related with increasing of population, economic development and technological improvement is very important parameter for social and economic development [1, 2]. Energy resource separated two main parts as renewable and non-renewable. Renewable energy resources are hydro, solar, wind and biomass, also non-renewable energy sources are fossil energy resources [3].

Vegetable oils are obtained from renewable plants such as canola, rapeseed, soybean, flax, sunflower seeds, safflower and corn. Vegetable oils are considered as a source of alternative energy due to their advantages such that they contain lesser amounts of sulfur, oxygen is present in their structure, their cetane numbers are high, and they have less harmful emissions as a result of burning. In addition, a higher flash point and better lubricating property are among the positive characteristics of vegetable oils. Vegetable oils have high viscosity and low volatility. High viscosity leads to clogging of engine fuel system and filter, rising of injector opening pressure, bad atomization, and longer combustion duration in comparison to the petroleum-based fuels. Therefore, vegetable oils are not directly used and pre-treatment processes lowering the high viscosity are applied. For this purpose, vegetable oils are used after blending with diesel fuel at certain proportions, heating, or producing biodiesel [4].

Biodiesel is the mono-alkyl esters of long-chain fatty acid derivatives in vegetable and fats. This event which occurs as a result of the reaction of fatty acids with alcohols is referred to as transesterification or alcoholysis.

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Transesterification is a chemical reaction used to lower the viscosity of oils. In these reactions, vegetable or animal oils react with a mono-alcohol such as methanol in the presence of a catalyst [5].

Many studies have been conducted on dynamic and kinematic viscosity changes of biodiesels. Clements (1996) the equations have been proposed for estimating the density, viscosity, cetane number, clouding point and heating value of biodiesel. Average typical error in this analysis is calculated to be 10% [6]. Tat and Van Gerpen (1999) have measured kinematic viscosities of a commercial soybean oil and its blends with No. 1 and No. 2 diesel fuels at 75%, 50%, and 20% biodiesel between -20 - 100 °C. They have estimated the viscosities of biodiesel blends by using a blend rule defined by Grunberg and Nissan and proposed by Arrhenius [7]. Tate et al. (2006) have designed a modified saybolt viscometer to measure kinematic viscosities of canola, soybean methyl esters and fish oil ethyl esters. They have measured the viscosities at 20-300 °C with 20 °C intervals. They have estimated the kinematic viscosities of canola, soybean methyl esters and fish oil ethyl esters using Andrade equation [8]. Kerschbaum and Rinke have measured dynamic viscosities of four different biodiesels at 258-303 K. They have estimated the viscosities between 273K to303 K using an exponential equation [9]. Aksoy et al. (2010) have measured the dynamic viscosities of soybean and sunflower oil methyl esters between 0-100 °C at 10 °C intervals. They have indicated that dynamic viscosity decreased with increasing temperature and diesel concentration [10]. Geacei et al. (2015) have measured the kinematic viscosities of the blend of biodiesel-diesel, biodiesel-benzene and biodiesel-toluene between 293.15 K and 323.15 K with intervals of 5 K. they have predicted kinematic viscosities with temperature and fuel composition values by using Grunberg–Nissan, McAllister and Wilke Equations [11]. Valdes et al. (2015) improved a novel ANN model which could estimate the dynamic viscosity, density, and cetane number of biodiesel fuels. Temperature, methyl ester composition, the numbers of carbon and hydrogen atoms entered to ANN system as input values. They obtained R2 values of correlations between 0.91946 and 0.99401 [12].Yang and Li (2015) improved a novel method for prediction of viscosity values of fluid fuels. They have derived an equation contain viscosity values which corresponding to temperature values. The viscosity decreased with increasing of temperature. However, the viscosity increased at high temperature region. They obtained the good results from the derived equation compared with viscosity values in the literature [13].

In this study conducted, kinematic viscosities of biodiesel, biodiesel-diesel blend and biodiesel-diesel-bioethanol blend are measured in the interval of 3 K between 293 K and 341 K. Experimental data are fitted with six equations that are used in viscosity estimation and correlation coefficients are determined. Viscosity estimations are also conducted using artificial neural networks and the results are compared to the most appropriate equation.

2. MATERIAL AND METHODS

2.1. Biodiesel Production Procedure

Safflower vegetable oil was taken from oil plant. Biodiesels was produced by means of transesterification process. Potassium hydroxide as catalyst was used in the transesterification process. Methanol is used to produce biodiesel because of low cost, physical and chemical advantages. The biodiesel reactor was used for biodiesel production. After 16 l. methyl alcohol and 280 g potassium hydroxide was mixed at 40 °C temperature, this solution was added in to 80 l. vegetable oils at 55 °C temperature. This mixture heated at 55°C with stirring at 80 rpm for one hour. The mixture consists two layers which are glycerin and methyl ester. The glycerin was separated from methyl ester. it was washed with the pure water due to remove soap and residual alcohol. Then Biodiesel was separated from the mixture and evaporated to remove residual water. Table 1 are shown properties of biodiesel and diesel fuel.

Table 1. Properties of Fules

Fuel	Density kg/m3	Flash Point ° C	Heating value kJ/kg	Pour Point ° C
No.2 diesel fuel	815	58	43350	-33
Biodiesel	885.6	156.5	43140	-4

2.2. Non-Linear Regression and ANN

Kinematic viscosities of biodiesel, biodiesel-diesel blend and biodiesel-diesel-bioethanol blend obtained from safflower oil measured as experimentally. The purpose of choosing the most appropriate equation for

prediction of viscosity values obtained as results of experiments used empiric formula given in the literature [7, 10, 14].

$$ln\mu = a + blnT \quad ...(1)$$

$$ln\mu = a + b/T \quad ...(2)$$

$$ln\mu = a + b/(T + c) \quad ...(3)$$

$$ln\mu = a + \frac{b}{T} + \frac{c}{T^2} \quad ...(4)$$

$$ln\mu = a + \frac{b}{T} + cT \quad ...(5)$$

$$ln\mu = a + bT + cT^2 \quad ...(6)$$

Coefficients of equation obtained with non-linear regression method by using SPSS statistical analysis program. The R^2 obtained from results of statistical analysis shows that how successful of modelling technic. If the R^2 value close to 1, the predicted model is well. The MSE is a statistical criterion using how close to predicted or computed data to real data. The MSE is stated as mathematically in equation 7. In this study, the RMSE square root of MSE and more favored as statistically used instead of MSE.

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(Y_e - Y_m)^2 \quad ...(7)$$

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(Y_e - Y_m)^2} \quad ...(8)$$

The modelling for biodiesel and biodiesel blends experimental values of kinematic viscosities used non-linear regression and ANN method. The ANN analysis performed in Matlab environment. The obtained models from both ANN and non-linear regression compared according to the R^2 and RMSE criterions and decided the best model. The number of neurons in ANN's hidden layer determined as empirical and the optimum results observed for the number of neurons layers is 5 (Figure 1).

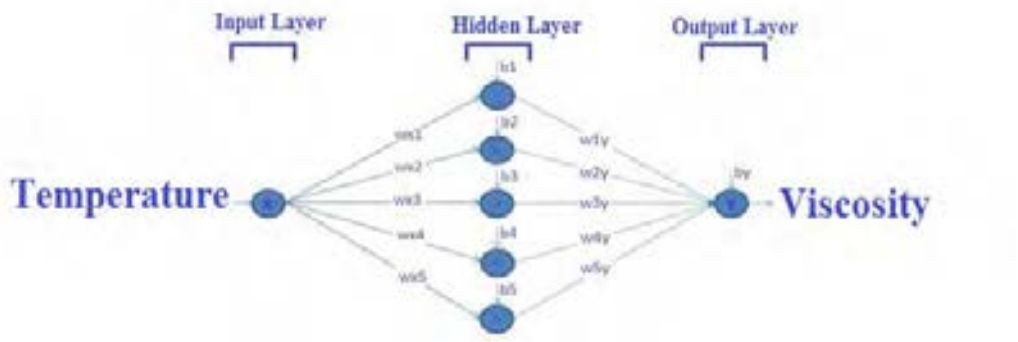

Figure 17. The ANN Scheme

3. RESULTS AND DISCUSSION

The measurement of kinematic viscosity was performed by fully automatic viscosity measurement device and experiments achieved between 293 K and 341 K with intervals 3K. As seen in Figure 2 the viscosities of the fuels were decreased with increasing of fuel temperature. Also, when biodiesel blended with diesel and bioethanol viscosities of the fuel was decrease. Standard diesel fuel (D100) kinematic viscosity values measured as a reference for experimental results. The kinematic viscosities of biodiesel produced from safflower oil (B100), the blend of %50 standard diesel fuel and %50 biodiesel (D50B50), the blend of %45 standard diesel fuel %50 biodiesel and %5 bioethanol (D45B50E5), the blend of %40 standard diesel fuel %50 biodiesel and %10 bioethanol (D40B50E10) and only bioethanol (E100) measured.

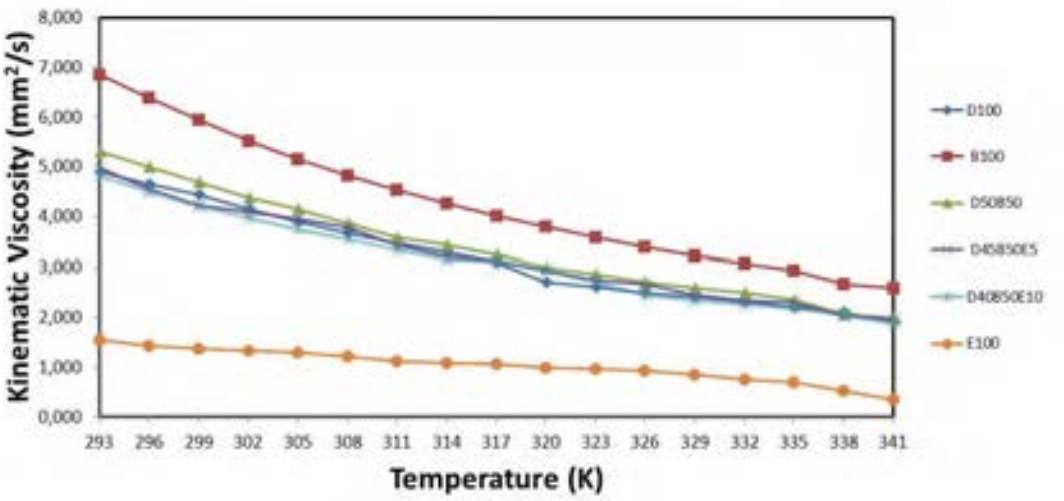

Figure 2. The Kinematic Viscosity Values Depend on Temperature

As a result of Non-linear Regression analysis on the basis of the equation which generally used in the literature Equations 5 and 6 determined as most appropriate formulas for prediction of kinematic viscosities. Coefficients, R^2 and RMSE values of all equations are given in Table 1.

As seen in Table 1 R^2 values of all predictions and ANN very closed to 1 and this situation shows that predictions appropriate for determine to kinematic viscosity values of fuels. The kinematic viscosity values obtained from Equation 5 and ANN method separately compared with experimental results. As shown in the Figure 3 clearly, ANN results obtained all most the same to non-linear regression analysis results and experimental results.

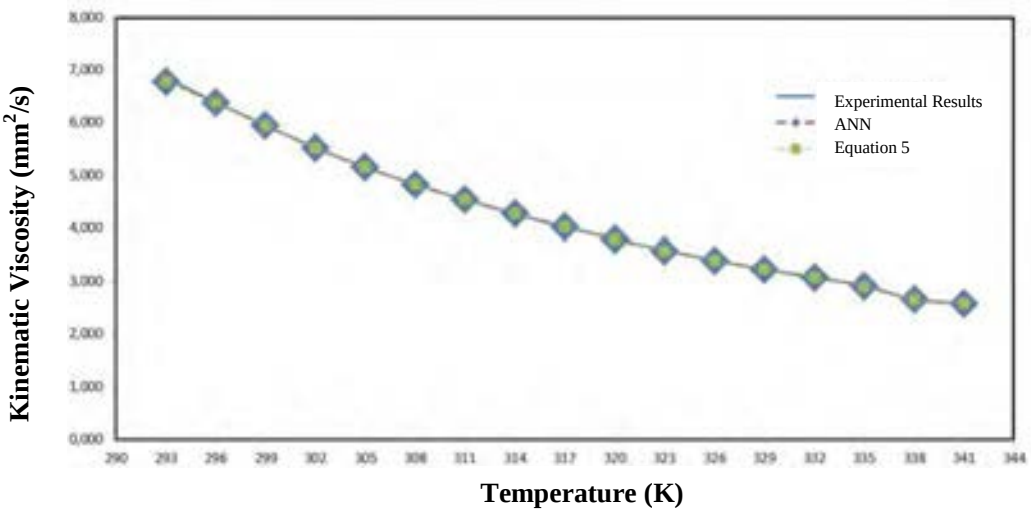

Figure 18. Comparing of the Experimental Results and ANN Modelling (B100)

Table 2. The Results of Non-Linear Regression Analysis and ANN

Sample	Data	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6	ANN
B100	R^2	0,99829	0,99929	0,99954	0,99954	0,99954	0,99946	0,99996
	RMSE	0,05637	0,03616	0,03041	0,02774	0,02815	0,02980	0,00796
	Coefficient (a, b, c)	38,72 -6,48	-4,996 2026	-3,169 1045 -87,91	-2,51593 475,37451 242011,44188	-9,74986 2768,78952 0,00759	16,63776 -0,07612 0,0000884193	
D40B50E10	R^2	0,99660	0,99582	0,99558	0,99665	0,99673	0,99673	0,99962
	RMSE	0,05393	0,05976	0,06364	0,05027	0,04986	0,04999	0,01693
	Coefficient (a, b, c)	35,44 -5,964	-4,793 1865	-16,19 16390 630,8	-9,117 4571,571 -422723,494	4,04374 483,67714 -0,01410	8,53365 -0,02796 0,00001423	
D45B50E5	R^2	0,99484	0,99383	0,99498	0,99506	0,99513	0,99513	0,99984
	RMSE	0,06776	0,07414	0,06281	0,06237	0,06203	0,06193	0,01119
	Coefficient (a, b, c)	35,040 -5,889	-4,687 1842	-14,86372 13720,02438 540,88104	-9,89112 5099,81586 -508947,94653	5,83453 196,71277 -0,01679	0,59132 741,79181 -1,79009	
D50B50	R^2	0,99807	0,99764	0,99683	0,99804	0,99810	0,99804	0,99952
	RMSE	0,04654	0,05151	0,06185	0,04382	0,04366	0,04382	0.02165
	Coefficient (a, b, c)	37,540 -6,315	-5,060 1974	-9,241 5666 226,8	-8,33395 4022,32794 -319725,37049	1,52183 945,78315 -0.01051	10,50405 -0,03891 0,000029883	
D100	R^2	0,99523	0,99459	0,99426	0,99459	0,99526	0,99519	0,99908
	RMSE	0,06799	0,07242	0,07716	0,07496	0,06379	0,06397	0,02793
	Coefficient (a, b, c)	36,91 -6,216	-5,019 1942	-11,87 8889 367,1	-531 1942 526	2,93332 700,27124 -0,0127	-1,13607 1134,07775 -0,0000131905	
E100	R^2	0,92068	0,91286	0,92448	0,95693	0,95988	0,96224	0,99918
	RMSE	0,09468	0,09924	0,08689	0,06536	0,06326	0,06147	0,00903
	Coefficient (a, b, c)	35,34 -6,138	-6,055 1914	-24,12476 29809,53979 919,19124	-40,79152 23665,06877 -3398421,18405	64,92354 -9184,94602 -0,11326	-23,90762 0,17275 -0,00030655	

4. CONCLUSIONS

Kinematic viscosity values of produced samples obtained as experimentally. On the basis of experimental results non-linear regression analysis was performed by using Arrhenius Equations. As a result of regression Analysis obtained R^2=0.99 approximately for all equations. According to regression analysis the closest predictions to experimental results computed by using Equations 5 and 6. Additionally, another modelling was estimated by using ANN method. R^2 values obtained from ANN provided higher than regression analysis results. Consequently, it's shown that, the modelling of kinematic viscosities of biodiesels by using ANN method has been more effective than non-linear regression Analysis.

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Discussion and Evaluation on the Environmental Effects of Periodically Measured High-Frequency Electromagnetic Field and Climatic Changes in 3 Year-Period

Teoman Karadağ[1], Veysel Gögebakan[2], Teymuraz Abbasov[1]

Abstract

In this study, the values of electric field intensity were continuously measured a metropolis in the city center in February for three years (2013-2015). These measurements with 0.5 second-periods are 100 KHz-8GHz frequency range. The measurements were done by the help of continuous electromagnetic field measurement station MonitEM. Continuous measurement results were gained with 24-hour periods. The minimum average and maximum values of electromagnetic field changes were observed and evaluated. It is observed the electromagnetic field having changes in different times in different a day changes depending on mobile communication traffic. However, the values have generally similarities on the same days of week. Also, the electromagnetic field changes in different times in a day have active values in different time periods. Hence, different strategies can be used in different times in a day to evaluate environmental factors of electromagnetic field changes. Moreover it is observed electromagnetic field actively changes depending on some environmental factors such as temperature, humidity and solar radiation. The potential temperature, humidity and solar radiation causing electric field intensity spread the environment were measured in the area of the measurements. Considering the all measurement results in the environment, the change of electric field intensity value comprehensively evaluated and presented.

Keywords: Electromagnetic Field, Monitoring Electromagnetic Field, Continuous Measurement, Climatic Change, Environmental Health.

1. INTRODUCTION

With the rapid development of technology during the last decade, the number of wireless apparatus, equipment and systems, and the amount of electromagnetic field density they emit into the environment have increased quickly as well. Effective use of 3G and 4G new generation communication systems during the recent years, increasing number of Wi-Fi hot points, increasing coverage of homes, offices, buildings and the cities by base stations cause momentary changes in electromagnetic field levels in the environment. The change in electromagnetic field values is in an increasing tendency in consequent years with the increase in the period of use of mobile systems and the number of mobile devices used. Over the years, physical and biological effects the

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fields that have a frequency spectrum changing from MHz frequency levels to the multiples of GHz on humans, animals and the environment frequently occupy the agenda [1 – 3]. Especially the RF electromagnetic fields in GSM, 3G, LTE, 4G emitted by base stations became a serious concern about public health among people. With the popular use of 3G and 4G mobile communications services during recent years, discussion on the possible increasing effects of electromagnetic fields has reached serious dimensions. The concerns about possible carcinogen effects of mobile communications systems that work on an approximate microwave oven frequency (2.45GHz) in humans, with increasing use tendencies of the subscribers due to its wide spectrum of services (fast data access) increase every day. Furthermore, increasing number of in vivo and in vitro studies' results demonstrated direct relationship between the effects of high frequency electromagnetic fields and formation of cancer types [4 – 7]. However, there are also considerable number of studies that arrived at contradicting results with these [8]. Studies have been continued for use of MonitEM system, which would enable the continuous measurement and monitoring of electromagnetic fields that are emitted in broadband and GSM, 3G, and LTE frequencies since 2012 [10 – 12]. Electromagnetic field measurements are conducted in the broadband (100kHz – 8GHz) since November 2012. In the study, high frequency electromagnetic wave values are measured at the same point in a metropolitan center during one month for a period of consecutive three years and the changes in electromagnetic fields within the years were evaluated along with environmental temperature, humidity and solar radiation values and presented in this article.

2. MATERIALS AND METHODS

Continuous electromagnetic fields measurement and monitoring station MonitEM could take 24h/385 measurements within the 100kHz – 8GHz frequency spectrum. General and internal structure of the station is displayed in Figure 1. The measurement probe continuously measures the RMS values of electromagnetic fields in an isotropic manner. Furthermore, by changing the probe of the station, measurements could be conducted at GSM, 3G and LTE frequencies. Measurements taken at half-second intervals conforming to international standards perform lossless data calculations with Sliding Windows Average method for half-hour periods. The measurements are then sent to the server using on-board GPRS or 3G modem. The station is designed to perform measurements in all seasons. It is protected against precipitation (rain, snow), dust or humidity in accordance with the Environmental Protection IP65 standard, and it could function under all weather conditions. Fastening base used during set-up is produced with non-magnetic fiberglass material.

Figure 1. A General View of Continuous Electromagnetic Fields Measurement Station

The station that was conducting measurements within 100kHz – 8 GHz frequency range was set-up at the same point in the center of a metropolitan city during the months of February in 2013, 2014, and 2015, and electric field strength values were measured continuously. In the assessment of the measurements, the variables induced by changes in climate such as temperature, humidity and solar radiation were considered. Seasonal values were obtained from the regional meteorological station operated by the General Directorate of Meteorology of Turkey.

3. RESULT AND DISCUSSION

The data obtained at the station that conducted continuous electromagnetic field measurements in the 100kHz – 8GHz frequency spectrum within a period of three years were compiled for half-hour periods. The findings demonstrated surges in electric field strength values measured. The main reasons for these surges were the number of subscribers that connect to the base stations that were located in the measurement area and broadcast in high frequencies, and the communications traffic that includes the duration of the communications. The electric field strength value findings obtained from these measurements are displayed in Figure 2a.

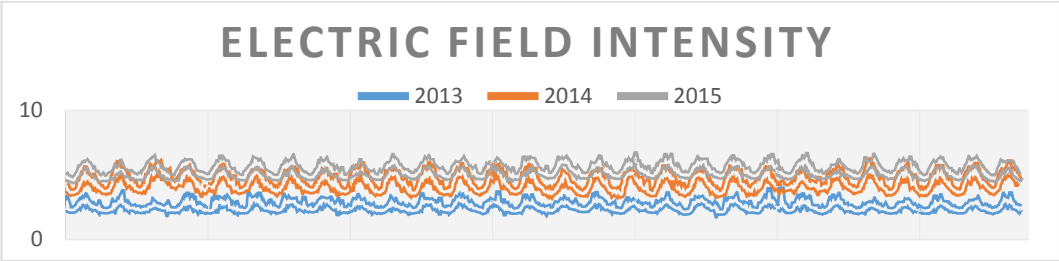

Figure 2.(a) The change graphic in time of electrical field violence values continuous measured in the 2013-2015.

Figure 2a demonstrates that the level of electromagnetic field for the area of measurement within the three-year period continuously increased. The highest value of the electromagnetic field strength increased 178%, the lowest value increased 214% and the mean value increased 208%. This change and increase is presented in Table 1. Furthermore, the temperature, humidity and solar radiation values of the environment demonstrated significant changes during the period of investigation. Figure 2b, c, and d shows the climate changes graphically based on each variable of change. For instance, it was observed that as the humidity in the environment increased, electromagnetic field levels in the environment decreased. And as the temperature increased, the electromagnetic field levels in the environment increased as well.

Table 1. The highest, lowest and average electrical field violence changes measured in the 2013-2015.

[V/m]	E_{max}	E_{min}	$E_{avrg.}$
2013	3,5	2,14	2,566
2014	5,79	3,48	4,408
2015	6,23	4,6	5,349

However, it has been observed electromagnetic field pollution has increased in time despite all the climatic changes. The main reason for this situation is that the use of base stations and other high frequenced electromagnetic field sources in and near the research area has increased. Hence it is clearly seen that the main reason for electromagnetic pollution is high frequenced communication sources although the climatic changes affect the electromagnetic field pollution. So, while evaluating the effects of electromagnetic field on biological structures, this point must be considered. For determining the level of electromagnetic field more clearly, the field levels spread by electromagnetic field sources and climatic changes must be compared permanently. This is possible just by utilizing the measurement systems of electromagnetic fields[13].

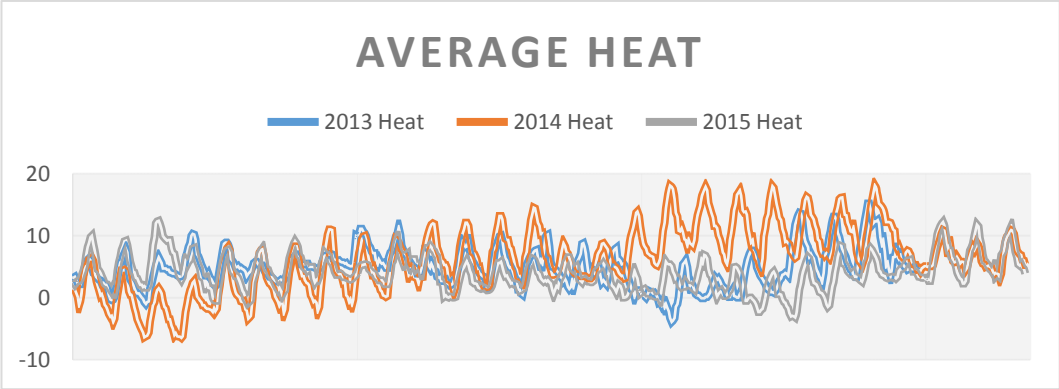

Figure 2.(b) The temperature changes measured in the period of 2013-2015.

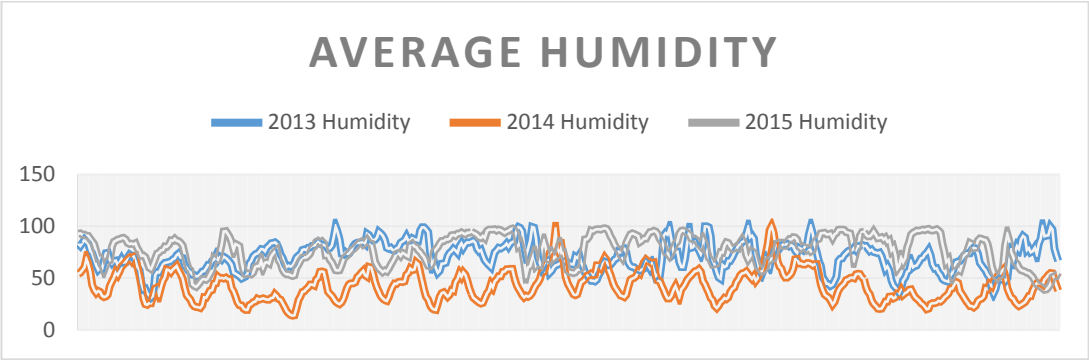

Figure 2.(c) The humidity changes measured in the period of 2013-2015.

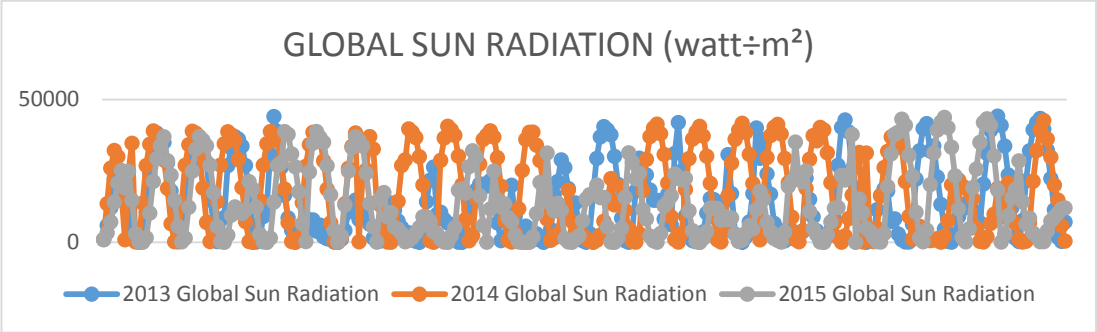

Figure 2.(d) The global sun radiaion in environment changes measured in the period of 2013-2015.

4. CONCLUSION

Today, an important part of the environmental problems are due to electromagnetic field pollution sources. Long term (for instance 3 years) electromagnetic field level measurements demonstrated that this pollution level increased at least 178%. However, levels of electromagnetic field pollution are based on other parameters as well. Some of the significant reasons for this are the climate variability (humidity, temperature, solar radiation) and communications traffic. Considering the tendency of the electromagnetic field levels to increase in the future, it is obvious that the effects of electromagnetic field levels, as well as the climate change would be determinant on the health of human and other living beings.

Considering all these cases, it is vital to have educative and infirmative implementations in universities and other units about electromagnetic ecology to create awareness in public.

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An Example of Finding both Economic and Environmental Friendly Energy Source

***Mine Sertsöz*[1]**

Abstract

Energy efficiency in a short definition is minimizing the energy used without reducing efficiency and amount in generation. To think energy efficiency only in economical dimension would be wrong while environmental pollution gives big alarms in recent years. Because reduction of energy used means to be one step closer to a clean environment.

In this study firstly nine different energy sources are analyzed as economic to supply energy requirement for 1000 houses town for 30 years. Than the economical five sources (Solar, Coal, Hydroelectric, Wind and Naturalgas) are analyzed as environmental. In this way the best solution is found both economical and environmental for supplying energy requirement.

Keywords: Energy, Renewable Energy, Clean Energy, Energy Sources, Electrical Energy.

1. INTRODUCTION

One of the negative impacts of the industrial revolution, which began in the eighteenth century, is the environmental effects (the global temperature increase in atmosphere and in oceans, decreased longevity, increased mortality, etc.), and was observed since the end of the nineteenth century. At the end of the twentieth century, the sources of these negative environmental impacts have been examined and then many studies have been conducted on the measures for precaution, in many fields. The reasons of environmental problems and the solutions to these problems, which passed local borders, were taken as agenda by the conference of Unite Nations Human and Environment Conference in Stockholm in 1972. 20 years after Stockholm Conference, United Nations Convention to Combat Desertification (UNCCD), United Nations Convention on Biological Diversity (UNCBD), and United Nations Framework Convention on Climate Change (UNFCCC) legalized concepts of "sustainable development." Besides the other universal contracts, UNFCCC, accepted in 1994, is the most known contract that emerges radical transformation in order to prevent the green-house effects, based on human, energy, industry, transportation, agriculture, waste, and forestry. Kyoto Contract, which was accepted in 1997 and gained validity in 2005, supports strong and reformist sanctions to prevent climate changes [1]. Many studies have been applied in the transport sector. According to reports of Organization for Economic Co-operation and Development (OECD) countries, the share of the transport sector, in total energy demand, was 24 % in 1971, where this ratio is estimated to reach 37 % by 2020. For this reason, studies, conducted on energy efficiency and environmental impact issues in the transport industry, will be even more important [2]. To increase the consumption of energy per capita, developed with a measure of development of countries for many years, the efficient use of energy has been important. In the open literature about energy economics, the methods of Granger [3] and Sims [4] have been

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constantly used in the causality relationship analysis between energy consumption and economic growth. This relationship was firstly discussed by Kraft and Kraft [5], who demonstrated that this is a one-way causality from economic growth to energy consumption based on the US data for the 1947–1974 periods. After this study, many researchers [6–13] have used the same methods in their studies.

In addition to the studies on energy economy, the studies have been guided to monitor and measure CO_2, caused by energy consumption. When CO_2 emission, varied with the total energy demand (the CO_2 share of the transport sector in total energy demand), was 19 % in 1971, this value is approximately estimated to reach 30 % by 2020 [2]. This result clearly shows the importance of the global warming and other environmental impact analyses.

This study aims to calculate the CO_2 emissions with different sources for to supply electrical energy. Methods which are used in calculations take too long time so they are done by MATLAB.

2. ENERGY EFFICIENCY

In the twenty-first century, the two indicators, concepts of energy efficiency (producing much) and less energy consumption (reducing the energy intensity), are used in the agenda (Fig. 1).
Today, the oil and gas supply strategies are important milestones in both the development of countries and their foreign policies because of the increasingly strategic role of these resources as an energy source in world politics.
Despite all the efforts on the search and technology development for alternative energy sources, it is expected to increase energy demand. Increasing energy demand will largely be met by oil and natural gas again in the coming years, to scientific estimates. In the last decades, while the worldwide oil reserves have been determined to be 156.7 billion tons, which will run out in 41 years, natural gas reserves have been determined to be 175.8 trillion m3, which will run out in 67 years. So for today,depletion of oil and natural gas will be between 32 and 56 years, respectively [1]. While the world economy grows 3 % per year, the energy intensity decreases1 % per year by means of the energy efficiency. If the average increase is 2 % per year in the world energy consumption, this value will reach 12.3 billion TEP in 2015 and 15.1 billion TEP in 2025.

The world oil demand is expected to increase by 1.6 % per year in the next 30-year period. And the most important factor is expected to increase transport demand because of this increase. Currently, 47 % of the total oil consumption is originated from the transport industry, and this ratio will reach to 55 % by 2030. About two of the three are expected to be originated from the non-OECD countries [1]. Because of increasing energy demand, more reserves should be found and trillions of dollars should be invested for usability of these resources. For instance, in 2001, the world production of conventional oil was 72 million barrels/day and it is estimated to be 120 million barrels/day in 2030. And also, the natural gas demand was 2.5 billion m3 in 2000, and it is expected to be doubled to reach 5 trillion m3 in 2030. And the average annual demand growth will be 2.4 % [1].

The primary energy supply has been 99,840 million TEP, and the primary energy production has been 26,779 million TEP in Turkey since 2006 and 73 % of its energy needs are met by imported energy. In 2006, total energy consumption of world was 11.4 billion TEP, and share of Turkey in this consumption was 0.8 %. Ninety-three percent of the crude oil demand and 97 % of the natural gas have been currently provided with imports. If the necessity is not supplied by local sources, these demand rates will increase to 99 and 100 %, respectively, in 2020 [1].

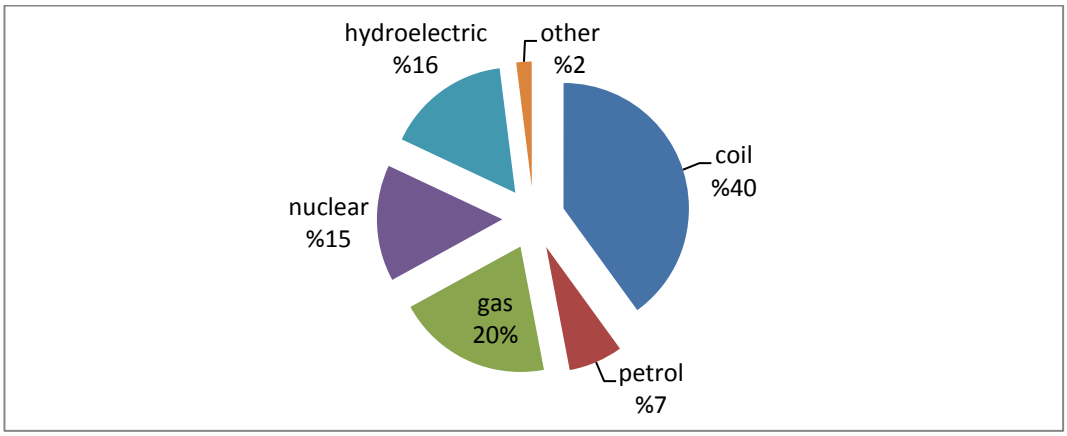

Figure 1. Electrical energy production proportions according to sources [modified from ref. 15]

3. COST ANALYSES OF ENERGY PRODUCTION CENTRALS

When cost elements are evaluated in energy centers it usually must be taken into account first investment cost and unit energy production cost. Unit energy production cost covers all spendings (first investment cost, operating/maintenancing cost). And also it is economical criterion for to express the essential cost for to supply unit energy from the center. The factors which effect to electrical energy production in energy centers are first investment cost and operating/maintenancing cost[16].

Table 1. Enegy Central Cost [17]

CENTRAL TYPE	FİRST INVESTMENT COST($/kW)	FIXED OPERATING COST($/kW-yıl)	VARIABLE OPERATING COST ($/MWh)
Wind Turbine (sea)	6230	74	-
Nuclear	5530	93,28	2.14
Jeothermal	4362	100	-
Biomass	4114	105,63	5.26
Solar	3873	24,69	-
Coil	3246	37,8	4.47
Hydroelectric	2936	14,13	-
Wind Turbine (land)	2213	39,55	-
Naturalgas	917	13,17	3.6

4. METHODS

In this study firstly nine different energy sources are analyzed as economical to supply energy requirement for 1000 houses town for 30 years. Than the economical five sources (Solar, Coal, Hydroelectric, Wind and Naturalgas) are analyzed as enviromental. In this way the best solution is found both economical and enviromental for supplying energy requirement. For to calculate costs more easily MATLAB is used.

Than these five sources is compared according to CO_2 emmision.

1. Wind (sea): (6230+74X)YZ
2. Nuclear: (5530+93.28X+2.14)YZ
3. Geothermal: (4362+100X)YZ
4. Biomass: (4114+105.33X+5.26)YZ
5. Solar: (3873+24.69X)YZ
6. Coil: (3246+37.8X+4.47)YZ
7. Hydroelectric: (2936+14.13X)YZ
8. Wind (land): (2213+39.55X)YZ
9. Gas: (917+13.17X+3.6)YZ

X: Year (Avarage 30 years is the best life value in centrals)
Y: Installed Power (for one house is 12000kW)
Z: House Numbers in the Village (for this study is 1000)

The best five economic sources:

1. Naturalgas is 1.578 $*10^{10}$ $
2. Hydroelectric is 4.031 $*10^{10}$$
3. Wind (land) is 4.079 $*10^{10}$$
4. Coil is 5.261$*10^{10}$ $
5. Solar is 5.536 $*10^{10}$$

Table 2. CO_2 Emmision of these sources (kg/MWh)

	Coil	**Naturalgas**	**Solar**	**Wind**	**Hydroelectric**
CRIEPI, Japon[18]	990	653	59	37	18
Paul Scherr Inst.[19]	949	485	79	14	3
IAEA[20]	968	440	100	9 - 36	4 - 23
Vattenfall AB[21]	980	450	50	6	3
Avarage	**971**	**507**	**72**	**20**	**10**

5. CONCLUSION

It can be seen easily the best economic source is naturalgas. But if it is compared according to the CO_2 emmisions the best source is hydroelectric. When electrical energy will be supplied from these five sources also economical way and CO_2 emmision quantity must be taken into account.

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ICOEST 1st INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND TECHNOLOGY
SARAJEVO
9 - 13th September 2015

Investigating the Radiation Absorption and Thermal Properties of Composite Materials Incorporating Waste Eggshell, Waste Sawdust and Pumice

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Abstract

Radiation is widely used in the field of medicine, energy, and military. The most effective way for protection from the negative effects of radiation is shielding the places. Concrete is the most common shielding material for buildings. It is well known that the major component of concrete is cement and cement plants have some harmful environmental impacts at all stages of the production process. In this study, composite materials produced incorporating waste eggshell, waste sawdust and pumice at different amounts with epoxy as binder material as an alternative to other shielding materials which are produced by using cement. Shielding properties of composites at 17, 26 and 59.6 keV were investigated. Unit weight, thermal conductivity coefficient, ultrasonic sound velocity and linear radiation absorption coefficient values of the composite materials were obtained and compared with the classic mortar samples. As a result, it is presented that linear radiation absorption coefficient was increased with the increase of waste eggshell amount. Besides, increasing amount of sawdust affected the thermal and acoustic properties positively.

Keywords: Eggshell, Pumice, Radiation Shielding, Sawdust, Thermal Conduction.

1. INTRODUCTION

The term “radiation” is used to describe the transportation of mass and energy through space. The realization of importance of radiation gave an important role in technological developments in various fields. We all enjoy the benefits of radiation in medical diagnostics and treatment. On the other hand, there are many hazards of radiation is known such as atomic explosions and radiation exposure [1]. The nuclear fuel cycle, phosphate rock extraction, coal power plants and even oil and gas extraction are some of the man-made sources of air and waterborne radionuclide releases to the environment [2]. For example the nuclear power generation when compared with other systems based on fossil fuels, more clean and has low cost. Nevertheless, radiation leakage from nuclear power plants makes huge causalities, financial and environmental damages [3]. Therefore many researchers in recent years have focused on safety and environment protection against nuclear damages.

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The nuclear energy can scatter as wave, particle or energy packages called photons [4]. For being protected from the harmful effects of radiation, attention should be paid for three basic issues which are time, distance and shielding. Radiation dose will increase due to duration of radiation exposure or distance to radiation source. Radiation emitting of some radionuclides are so strong that it can be exposed for miles distant. It can be prevented by shielding from such strong radioactive materials. Various radiation types may occur both naturally or artificially, also various effects may occur due to type of radiation. Selection of structural material and design of radiation shield varies due to radiation type which radiation source emitted [5].

Today, lead is commonly used as gamma radiation shield but it is not possible to use it on large scales due to its cost and high density. Thus, researchers have studied on different materials for shielding of gamma radiations [6]. One of these materials is cement based compounds containing concretes and different types of heavy concretes, with or without lead. These cement compounds shield nuclear radiations mainly through moderating neutrons and blocking their pathways. But the heavyweight and the large volume of these materials cause problems in the course of production, transportation and construction [7].

To overcome these problems and developing efficient and low density materials, certain researchers have been focused on using several polymer composites as an alternative radiation protection material. Most of these composites produced using polymers with boron. It is reported that these composites not only effective radiation shields but also are safe and convenient for construction, dismantlement and reintegration [7]. In these studies polyethylene (PE) and high-density polyethylene (HDPE) used as polymers to make composites. These materials have high content of hydrogen atoms and their large scattering power used as neutron moderator [8, 9]. It can be seen in the literature that other polymers such as low-density PE (LDPE), epoxy, polystyrene, polyamide and poly (4-methyl-1-pentene) were also used as nuclear protective matrices [8-10].

Rapidly growing world and industrials developments lead to environmental problems and day by day it is becoming increasingly unavoidable. Within this scope, in recent years evaluating waste materials gain importance and many scientific studies have been done. Some of those studies are about evaluating waste materials for producing shield materials against radiation which has huge damages on environment and human health [11-13].

It is known that as a waste of catering factories and patisseries, eggshells causes environmental pollution [14]. Eggshells generally don't have commercial importance. Eggshell disposal is also a serious problem for egg processing industries due to stricter environmental regulations and high landfill costs [15]. The chemical composition of eggshells approximately 94% $CaCO_3$ (calcium carbonate), 1% $MgCO_3$ (magnesium carbonate), 1% $Ca_3(PO_4)_2$ (calcium phosphate) and 4% organic matter [16]. According to Turkish Statistical Institute data of July 2011, annual number of egg production in Turkey is 1.05 billion. Average weight of an egg is 50 – 60 g and according to size of egg, eggshell constitutes 7.8 – 13.6% of a hen egg. As a result 4500 – 7850 tons of eggshells have been disposed as waste annually [12]. Some researchers reported that eggshell wastes can be used as dyestuff [17] and heavy metal [15] removal.

Generally natural fiber used for reinforcing plastics due to natural fibers are strong, light, non-abrasive, non-hazardous, abundant and cheap [18]. Natural fibers with natural fillers have been used for improving the physical and mechanical properties of wood-plastic composites. It is known that sawdust has been used as filler and improving material for plastic based composites. It is also used for developing insulation bricks and materials. [19].

In this study; utility of waste eggshells and sawdust is invetigated to produce a composite material which has lightweight, low thermal conducting and available for radiation shielding.

2. MATERIALS AND METHODS

2.1. Materials

One set of mortar samples produced for comparison the radiation shielding and thermal conductivity properties with the composite material. As cement and aggregate for mortar sample, CEM I 42.5 ordinary Portland cement and Rilem – Cembureau standard sand used, which are up to Turkish Standards TS EN 197-1 and TS EN 196-1 respectively. Standard sand is a product of Limak Trakya Cement Inc. Chemical and physical analysis of cement and sieve analysis of standard sand is given in Table 1 and 2 respectively.

Table 1. Chemical and physical properties of cement

Chemical analysis results	
Compounds	**%**
SiO_2	*18.85*
Al_2O_3	*4.80*
Fe_2O_3	*2.40*
CaO	*62.80*
MgO	*2.50*
Na_2O+K_2O	*1.14*
SO_3	*3.69*
Free CaO	*0.90*
Loss of ignition	*3.5*
Physical analysis results	
Specific gravity (g/cm^3)	3.12
Specific surface (cm^2/g)	3250
Fineness	
On sieve 200 μ (%)	0
On sieve 90 μ (%)	2.5

Table 2. Sieve analysis of CEN standard sand

Square-mesh size (mm)	Cumulative residue (%)
2.00	0
1.60	7 ± 5
1.00	33 ± 5
0.50	67 ± 5
0.16	87 ± 5
0.08	99 ± 1

Waste eggshells provided from patisserie and crushed to 0-1 mm size. Chemical composition of eggshell is given in Table 3.

Table 3. Chemical composition of eggshell

Compounds	(%)
$CaCO_3$	94 - 97
$MgCO_3$	0.2 – 1.0
$Ca_3(PO_4)_2$	0.2 – 1.0
Organic matter	2 – 3.3
Other (Na, K, Fe, Cu, Mn)	0.1

The wood sawdust was obtained from the waste of a carpenter's shop sawmill in Kahramanmaraş, Turkey. The epoxy used in this study is a two-component epoxy. It is a type of resin which is used for binding element for many mixtures. Epoxy is the general name of organic compounds which an oxygen atom bonds to two carbon atoms and makes a triangle protrusion out of chain. Epoxy has an important role on polymer composites. That is because of the high strength and adhesion of epoxy resin. Epoxy resin has an increasingly consumption in the field of engineering because of very good mechanical and chemical features such as high adhesion strength, low shrinkage, thermal stability, low curing time and safe usage immediately after application [12].

In the study, for providing thermal and acoustic insulation 0-1 mm size pumice was used. Pumice is widely used in construction industry both in Turkey and worldwide. The most important reason is low bulk density, high thermal and sound insulation, acclimatization properties, easy plastering, perfect acoustic features, elastic behavior under load and earthquake and low cost in comparison with alternatives [20]. Pumice used in this study obtained from Kayseri region and has grain size of 0 – 1 mm.

2.2. Methods

2.2.1. Composite Production

Components and mixture design of composite materials produced given in Table 4.

Table 4. Components and mixture design of composite materials

Sample Code	Compounds of Composite								
	Sawdust (g)	**Eggshell (g)**	**Pumice (g)**	**Epoksy (g)**	**Cement (g)**	**Sand (g)**	**Water (g)**	**Sample Size (mm)**	**Thickness (mm)**
R	-	-	-	-	450	1350	225	160x140	20.0
S	100	-	-	100	-	-	-	160x140	24.7
1	100	50	-	100	-	-	-	160x140	26.9
2	100	100	-	100	-	-	-	160x140	28.2
3	100	150	-	100	-	-	-	160x140	30.3
4	100	200	-	100	-	-	-	160x140	19.3
5	100	-	50	100	-	-	-	160x140	24.1
6	100	50	50	100	-	-	-	160x140	23.6
7	100	100	50	100	-	-	-	160x140	26.9
8	100	-	100	100	-	-	-	160x140	28.2
9	100	50	100	100	-	-	-	160x140	24.5

Sawdust, eggshell and epoxy compounds mixed in a cement mixer. Mixed materials placed in to moulds as layers and compressed under 10 bars, then wait in drying oven at 125 ºC for 1 hour. Material design illustrated in Figure 1.

Figure 1. Laminated Composite Designs

2.2.2. Unit Weight Per Volume

The weight of the plate sample after dried recorded as g_1 and volume of the sample calculated by measuring the outer sizes, recorded as V. Unit weight of samples calculated as follows,

$$B= g_1/V \quad (1)$$

2.2.3. Coefficient of Thermal Conductivity

Coefficient of thermal conductivity was determined due to ASTM C 1113-09 (2004) – Hot Wire Method. 140x160x20 mm size samples used for thermal conductivity test. Samples acclimatized under 20±2 °C temperature and 65±5% relative humidity conditions. Tests were performed with Quick Thermal Conductivity Meter (QTM) 500 Kyoto device at Kahramanmaras Sutcu Imam University USKIM laboratories. Thermal conductivity coefficients of samples tested and results recorded as W/m°K.

Thermal conductivity coefficient was calculated by the following formula;

$$\lambda= \frac{q.\ln (t2+t1)}{4\pi(T2-T1)} \ (W/m^oK) \quad (2)$$

Which;

λ : Coefficient of thermal conductivity (W/m^oK)

q: Hear passing through the material (cal)

T_2-T_1: Temperature difference of surfaces (^oC)

t_2+t_1: Time interval of measurement (s)

2.2.4. Ultrasonic Sound Velocity

There is a relationship between the velocity of an ultrasonic sound passing through a section and the density of materials. Velocity of ultrasonic sounds became lower with increasing pore amount of material. After determining the passing time of an ultrasonic wave sent in from one surface of the material to other surface, wave velocity can be calculated as follows;

$$V = (S / t)*10^6 \quad (3)$$

Which;

V = P wave velocity (km/s)

S= Distance between the surface which ultrasound sent in and the surface which ultrasound taken (km),

t = Elapsed time of P wave passing through the material (microsecond)

Ultrasonic sound test were performed for all the samples and velocity of P wave determined.

2.2.5. Linear Absorption Determination

Linear absorption test experimental set up is given in. 120x120x20 mm samples produced for tests. Each sample weight with 0.1 g sensitivity and dimensions measured and given in Table 4. An Am 241 (59.60 KeV) gamma ray radioisotope source used for tests in the Laboratuary of Phisics Department in Kahramanmaras Sutcu Imam University. The experimental system also comprised a Si(Li) semiconductor solid state detector which its resolution is 155 eV at 5.96 KeV. Spectrums occurred after counting determined with S 100 card.

Si (Li) semiconductor solid state detector is a detector which has a semiconductor silicon crystal lattice with diffusion lithium atoms 2 mm thick, with 12.5 mm2 active area, and it is fed with reverse supply voltage of 500 volts under vacuum. The Am-241 radioisotope source produces 59.60 keV gamma X-rays. The preamplifier converts the characteristic X-rays which reach the detectors to a few milivolt electrical pulses. Then, the electrical pulse is increased to 0-10 volts level by the amplifier. The electrical pulses are converted to numeric values by the ADC (Analog Digital Converter). In accordance with these values, the energy of the pulses generates peaks at appropriate channels on the 4096 channel screen. Thus, different values and energy pulses give the characteristic X-ray spectrums of the samples on the screen.

In this way, linear absorption coefficients which means what percentage of radioactive rays passes through and what percentage absorbed by material.

3. RESULTS AND DISCUSSION

3.1. Unit Weight Results

Unit weights per volume of composites determined and given in Table 5.

Table 5. Unit weights per volume of Composites

Samples	Unit Weights Per Volume (kg/m^3)
R	2.32
S	0.30
1	0.43
2	0.55
3	0.69
4	0.82
5	0.34
6	0.46
7	0.51
8	0.42
9	0.48

Unit weight results shows that all of the composite materials' unit weights are lower than the reference sample which is produced with cement. These materials can be used as interior wall or partition wall element. Thus,

building weight can be lowered. This minimizes the earthquake force due to Newton's famous law, force equals mass times acceleration. Light weight buildings take smaller earthquake forces than heavier buildings under the same earthquake acceleration.

It is seen from the results, sawdust and pumice lightens the samples but unit weights were increased with the increasing amount of eggshell. This is because eggshell has a density of 2.45 g/cm^3, higher than both of pumice and sawdust.

3.2. Coefficient of Thermal Conductivity Results

Coefficient of thermal conductivity results illustrated at Figure 2.

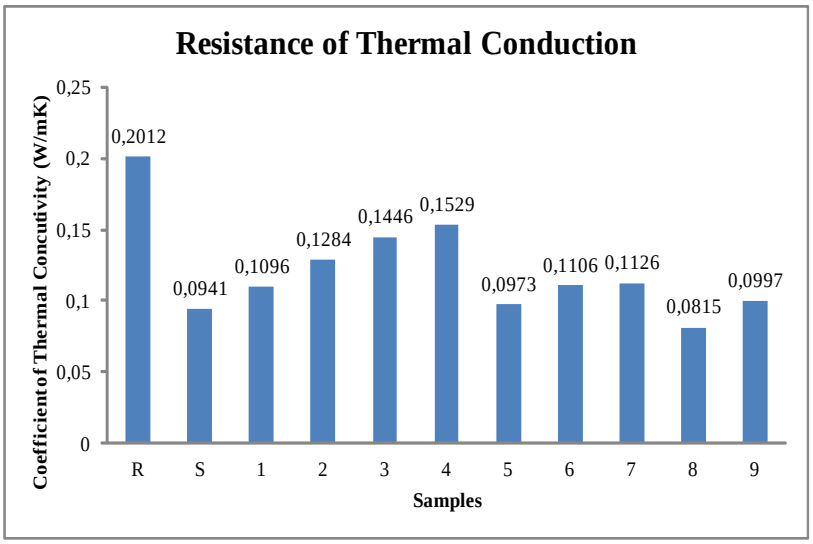

Figure 2. Results of thermal conduction test

According to the results reference sample (R) has the highest thermal conduction coefficient. It is known that mortar samples have higher coefficient of thermal conduction, and not a good thermal insulation material. Increasing the eggshell amount enhances the thermal conduction coefficient. It is associated to density and filler effect of granulated eggshell. Eggshell has higher density than the other materials. This is because eggshell has low porosity. Also granulated eggshell fills the pores between other materials which constitute the composite samples. This creates a denser structure. Pumice added samples has lower thermal conductivity coefficient. Sample 8 has the lowest, because it has highest amount of pumice. Pumice has a porous structure and acts as a thermal insulation material. This sample has a thermal conduction coefficient approximately 60% lower than mortar sample.

3.3. Ultrasonic Sound Velocity Results

Ultrasonic sound velocity results are illustrated at Figure 3.

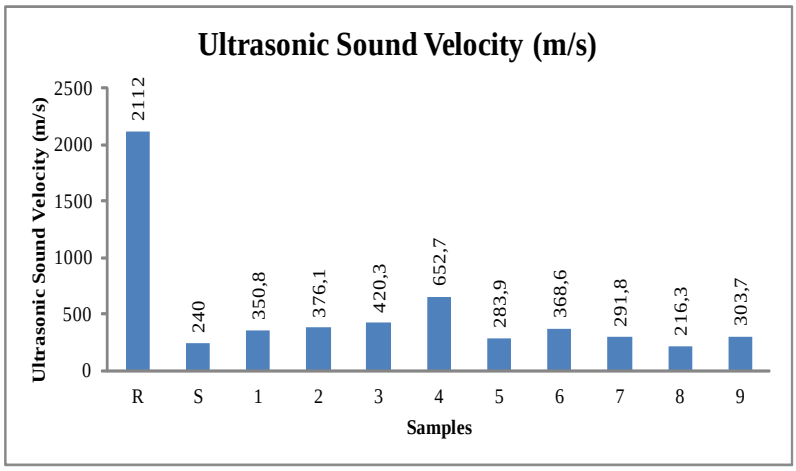

Figure 3. Ultrasonic sound velocity test results

The ultrasonic sound velocity test showed very similar results with thermal conduction coefficient test. Because both of these results associated with the density and porosity of material. Reference sample, which is produced with cement and has the higher unit weight, also has the highest ultrasonic sound velocity. Eggshell addition increased the ultrasonic sound velocity of composites due to creating a dense and compact structure. Pumice addition make the velocity values lower, because it acts as an insulating material due to porous structure. According to these results sample number 8 has the lowest ultrasonic sound velocity value. This sample approximately has 90% better results than the reference mortar sample.

3.4. Linear Radiation Absorption Coefficient and Radioparency Results

Linear radiation absorption coefficient and radioparency results are illustrated at Table 6. and Figure 4 respectively.

Table 6. Linear absorption results

Sample	59.6 keV	26 keV	17 keV
R	0,07	Absorbed	Absorbed
S	0,06	0,12	0,45
1	0,19	0,72	Absorbed
2	0,24	1,37	Absorbed
3	0,27	1,74	Absorbed
4	0,31	Absorbed	Absorbed
5	0,05	0,09	0,69
6	0,15	0,54	Absorbed
7	0,20	0,78	Absorbed
8	0,04	0,05	0,92
9	0,14	0,50	Absorbed

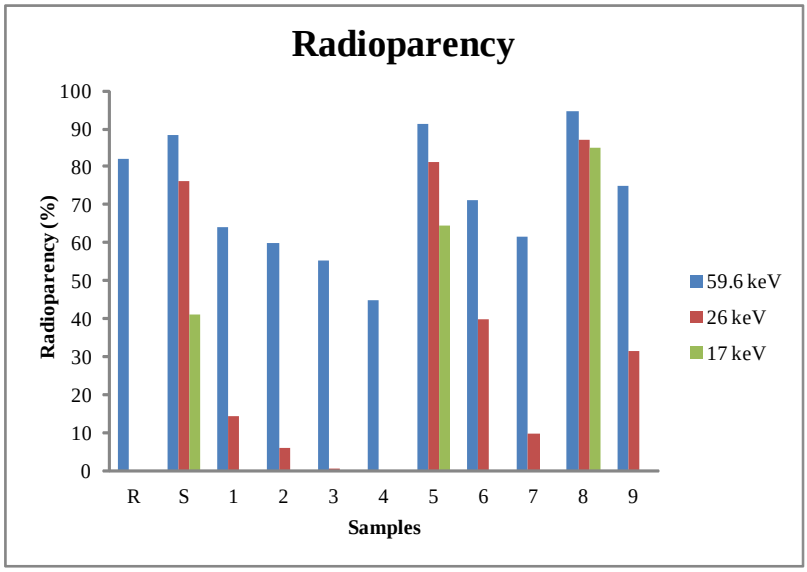

Figure 4. Radioparency Results

All the samples except S, 5 and 8 totally absorbed 17 keV energized rays. It is seen that 26 and 59.6 energized rays absorbed by sample 4 at most. It is seen that sample 4 is the most waste eggshell incorporating sample. Using waste eggshell is effective on radiation absorption. Radioparency of sample 8 under 59.6 keV energized rays is 95% and it is 44% at sample 4. This difference between two samples based on sample 8 is pumice based composite and it has higher porosity than other samples. Sample 4 could be used as a radiation shielding material at this thickness because average radiation energy of the devices used at health sector is lover than 70 keV. This material can be used at higher radiation energy levels by increasing the eggshell amount and the thickness. It is thought that high level of calcium carbonate ($CaCO_3$) in the eggshell is effective on radiation absorption.

4. CONCLUSIONS

- Is is seen that thermal conduction coefficient and ultrasonic sound velocity values negatively affected by the increasing of eggshell amount. These values can be enhanced by using pumice and sawdust, where thermal and acoustic properties are at the forefront;
- It is seen that the unit weight values of composites are lower than the conventional cement based materials. Therefore, building weights can be lowered by using these composite materials as separation element. Thus, this will provide minimizing the cross-sections of bearing elements;
- Radiation absorption values affected positively by increasing waste eggshell amount. Lead or high thickness concrete is generally used for radiation shielding. But lead is expensive and bad for health and it is know that cement, which is main element of concrete, has harmful effects for environment at the production process. By using waste eggshells as a waste and natural material, it will provide environmental protection effects and a new economic product will be produced.

As a result of the study, it is seen that composite materials incorporating waste eggshell could be used at hospitals, military and industrial facilities and shelters which are under radiation hazard. Thermal and acoustic properties could be increased by producing with pumice and sawdust. But it is known that these materials have high water absorption because of having so many pores. Water absorption properties needed to be considered in further studies for producing more qualified composite materials.

ACKNOWLEDGEMENT

The radiation absorption properties of samples were determined by the help of Prof. Dr. Adnan KÜÇÜKÖNDER from Kahramanmaraş Sütçü İmam University, Department of Physics.

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SARAJEVO
9 - 13th September 2015

Feasibility Assessment of Small Hydropower Projects by RETScreen

M. Ishak Yuce[1], Simal Yuce[2]

Abstract

The most favorable renewable energy production method is hydropower, including the small-scale plants. The main parameters need to be determined in small-scale hydropower plants (SHP) are the installed capacity and the cost, which are effected by the design flow, net head, turbines, tunnels, canals, penstocks and the other variables. All of these variables are analyzed in the feasibility studies in order to find the optimum installed capacity and the cost of the plant. RETScreen is a computer program, which is capable of estimating the amount of the energy to be generated, the investment and the maintenance costs for small-scale hydropower projects. In this paper the feasibility studies of nine different SHPs, which were obtained from DSI (the States Hydraulic Works, Turkey), were compared with the results computed by the RETScreen. The results achieved by the RETScreen were noticed to be compatible with the results of DSI feasibility studies. The RETScreen was noted to be capable of assessing feasibility studies of SHP within a relatively short period of time, thus minimizing the costs.

Keywords: Small-Scale Hydropower Plants, RETScreen, Feasibility Study, Installed Capacity, Cost Estimation.

1. INTRODUCTION

Hydropower, which is classified as a renewable resource, has been the primary source of energy in the history of man-kind. Mesopotamians had constructed irrigation channels and dams around 6000 BC. Water supply systems had been operated from 3000 BC in Jordan (Korn, 2004; Erdogdu, 2011). Ancient water systems have been found in South America and Asia. Mesopotamian civilizations, ancient Egyptians and Sumerians have captured energy of flowing water by employing wheels to lift water for irrigation purposes. Since the invention of the water turbines in the early 19th century, which can harness energy from falling water, the contemporary dams started to spread all over the world (Sleigh and Jackson, 2004).

As water is stored in dam reservoirs it gains potential energy due to the change in the surface elevation. When it flows through the penstocks the potential energy is converted into kinetic energy, and then into mechanical energy after it hits the turbine blades to turn them. The mechanical energy is transmitted to the generator by a shaft before it is converted into electric energy. This is known as hydroelectric power or hydropower. Hydropower is the most significant and widely used form of renewable energy representing 19% of total world's electricity production (Balat, 2007; Yuksel, 2010; Connolly et al., 2010).

In 2007, around 15.5% of the electricity demand of the world was met by hydropower, which makes over 3000 TW h. Hydropower is a reliable source of energy, since it is predictable, local and cheap to generate. Over 60

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countries produce more that 50% of their electricity demand from hydropower. It is projected that, Turkey has a gross annual hydropower potential of 433 TW h, corresponding to 1% of the total capacity of the world. Its share is around 13.7% of the total capacity of Europe (Table 1). The technically exploitable hydropower capacity of the country is assessed to be around 216 TW h, which accounts for 1.5% of the technically utilizable potential of the world and 17.6% of Europa. Although the economically feasible potential of a country is subjected to the global and local energy and investment prices, the economically viable potential of Turkey is evaluated to be approximately 165 TW h, which is the second largest economic potential in Europe (Table 1).

Table 1. Hydropower potential of Turkey (GW h/year)

	Gross Potential	**Technical Potential**	**Economic Potential**
World	40,150,000	14,060,000	8,905,000
Europe	3,150,000	1,225,000	1,000,000
Turkey	433,000	216,000	140,000

By the end of 2013, the total number of hydropower plants in operation was 458 with an installed capacity of 22.804 MW and the annual generation capacity of 80.060 GW h of electricity, which corresponds to almost 50% of the economically utilizable and 37.1% of the technically feasible potential of the country. The total number of hydropower plants under construction is 165 and 956 of them are planned to be constructed by 2023 (Table 2). The installed hydropower generation capacity matches to 36% of the nation's total installed capacity (Balat, 2007; Yuksel, 2010). In 2013, the hydroelectricity produced was 59.246 MW h corresponding to 24.8% of the total electricity generated by the country. Despite the fact that Turkey uses only 37.1% of its technically viable hydropower potential the USA, Japan, Norway and Canada make use of 86%, 78%, 72% and 56% of their potentials, respectively.

Table 2. The status of hydropower plants in Turkey at the end of 2013

	Total Number	**Installed Capacity (MW)**	**Energy Production (GW h/year)**	**%**
In operation	458	22 804	80 060	49
Under construction	165	8 096	25 342	15
Planned	956	16 624	59 662	36
Total	1579	47 524	165 064	100

The role of the hydropower is significant in Turkey, since the country is unfortunate in fossil fuel resources and has no nuclear power plants generating electricity yet. For the last three decades, the country's demand for electricity has increased with a rate of 7.8% on average. The projections indicate that Turkey will consume around 450 TW h electricity by 2023 (Balat, 2007; Erdogdu 2011; Kucukali and Baris 2009).

2. SMALL HYDROPOWER IN TURKEY

The installed capacity upper limits of small hydropower plants are accepted to be 1.5 MW in some countries, while it is 50 MW for some other countries. Since, there is no globally accepted definition of small hydropower (SHP). Additionally, within the range of small hydropower, they may be named as; mini, micro, and pico hydropower which have an upper limit for installed capacities of 1 MW, 100 kW and 5 kW, respectively (Taylor et al., 2006). Table 3 shows the installed capacity upper limits of small hydropower for different countries. Being used for more than one hundred years, small hydropower plants are consistent source of energy which uses a well-developed technology.

Table 3. Installed Capacity Upper Limits of SHP for Different Countries (TNSHP, 2004)

Country	Upper Limit for SHP (MW)
Portugal, Spain, Greece, Ireland, Belgium	10
Italy	3
Sweden	1.5
France	12
United Kingdom	20
Turkey	50

Turkey has a mountainous terrain with an average elevation of 1132 m, which favors the formation of high gradient river streams suitable for SHP development (Kucukali and Baris, 2009). The country has a large untouched small hydropower potential, it has a gross theoretical potential of 50 000 GW h/year, while 30 000 GW h/year of this potential is technically viable and 20 000 GW h/year is the economically feasible (Balat, 2007; Kucukali and Baris 2009). The SHP potential of Turkey is given in Table 4. Compare to the large scale hydroelectric power plants, SHP impose minimum adverse effects on the environment. The capital investment and the operating costs per kW of electrical energy for SHP are lower than the other renewable energy alternatives in Turkey (Dursun and Gokcol, 2011).

Table 4. Small Hydropower Potential of Turkey (Balat, 2007)

Potential	Generation GWh/year	%	Capacity (MW)
Gross theoretical	50 000	100	16 500
Technically feasible	30 000	60	10 000
Economically feasible	20 000	40	6 500

3. STUDY AREA

A number of small scale hydropower projects which are located in different parts of Turkey are considered in this research. Kale, Gökgedik, Akpınar and Torlar small hydropower plants are located in Kahramanmaras region, while, Çaykara is in Trabzon, Zafer and Damlasu are in Adana, Akıncı is in Ardahan, Alagöl is in Niğde regions. The diversity of sites represents different climate and geographical conditions of the country which are the most suitable regions for SHP development. The outcomes of these feasibility reports, which are endorsed by the State Hydraulic Works (DSI), are compared with the feasibility studies performed by employing the RETScreen. The main characteristics of the all nine SHP are given in Table 5.

Table 5. Main features of the small hydropower projects

SHP	Kale	Gökgedik	Torlar,	Damlasu	Çaykara	Akpınar	Alagöl	Zafer	Akıncı
River basin	Ceyhan	Ceyhan	Ceyhan	Seyhan	-	Ceyhan	Seyhan	Seyhan	Aras
River Name	Körsulu	Körsulu	Körsulu	Körkün	Solaklı	Aksu	Kosk	Karaisalı	Kura
Design Flow (m^3/s)	16	18.58	26.73	7.96	25.41	6.2	11.10	22.7	54.19
Net Head (m)	252	152	66	93	120.34	146.82	113.03	28.6	6.33
Number of Turbines	3	3	3	2	3	2	2	3	2
Turbine Type	Pelton	Francis	Francis	Francis	Francis	Francis	Francis	Kaplan	Kaplan

4. RETSCREEN SOFTWARE

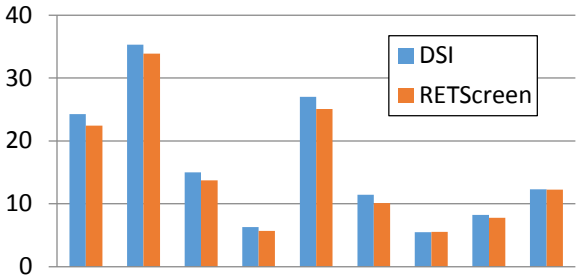
RETScreen is publically available free of charge software developed by Natural Resources CAMNET Energy Technology Centre. It is an excel-based software that allows preliminary estimations of the renewable energy projects, including small scale hydropower plants. The software calculates the potential power capacity, the capital costs, the operating costs, the amount of energy to be generated and the payback period. The user can choose either of two methods existing in the software package. Method1is a less detailed and less accurate analysis choice

that combines limited data entry with default empirical formularies, while Method2 is more detailed and more accurate analysis alternative necessitating increased levels of project site knowledge and more detailed data entry by the user. In Method2 analysis, a standard five-step procedure is followed which contains Energy Model, Cost Analysis, Greenhouse Gas (GHG) Analysis, Financial Summary and Sensitivity and Risk Analysis (Rehman et al.,2007; Kosnik, 2010). RETScreen analyses are considered as pre-feasibility studies. Every single hydropower site is different from another one, the location and the site conditions comprise around 75 percent of the total development cost of a SHP project. The cost of manufacturing the electromechanical equipment covers only about 25% of the total cost, which is reasonably fixed (RETScreen International, 2015). The outcomes of the feasibility studies approved by the DSI and the estimations performed by the RETScreen are presented in Table 6. The results calculated by the RETScreen software were observed to be very close to those of DSI endorsed feasibility reports. Therefore, instead of using cumbersome and time consuming traditional methods, employing the RETScreen software in prefeasibility assessment of SHP is expected to save time, thus money.

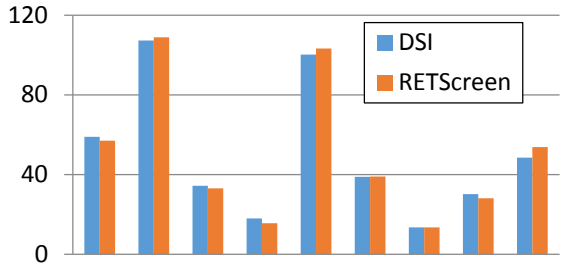
Table 6. Comparison of the results of the feasibility studies

SHP	Installed Power (MW)		Renewable Energy Delivered (GWh)		Total Initial Cost ($)		Benefit Cost Ratio	
	DSI	RETScreen	DSI	RETScreen	DSI	RETScreen	DSI	RETScreen
Gökgedik	24,29	22,45	58,90	57,04	38 701 098	39 037 552	0,68	0,64
Kale	35,33	33,91	107,28	108,83	38 117 497	36 403 337	1,24	1,25
Torlar	15,01	13,75	34,38	32,99	25 010 693	22 389 429	0,62	0,51
Damlasu	6,32	5,69	17,91	15,56	9 273 994	10 200 834	0,97	0,83
Çaykara	27	25.1	100.28	103.32	53 868674	53 663 000	1.28	1.23
Alagöl	11,47	10,1	38,775	39,01	17 174 165	15 085 500	1,76	1,8
Zafer	5,5	5,55	13,39	13,49	8 585 823	9 895 000	1,13	0,92
Akpınar	8.22	7.785	30.2	28.04	16 102 884	16 676 000	1.42	1.18
Akıncı	12.32	12.274	48.5	53.84	27 518 327	36 675 000	1.02	0.98

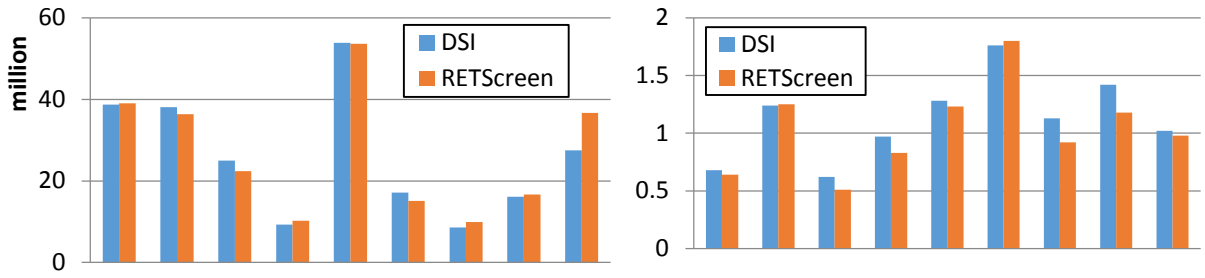
The installed power capacity, renewable energy delivered, total initial cost and benefit cost ratio results achieved by the RETScreen are compared with the outcomes of the feasibility reports approved by DSI for the SHPs studied here (Figures 1a - d). The benefit cost ratios of the projects were witnessed to be slightly under-estimated by the RETScreen. Gökgedik, Torlar and Damlasu SHPs were found to be infeasible projects both by the RETScreen and DSI, since their benefit cost ratios were noted to be under unity (Table 6). Zafer and Akıncı SHPs were found to be feasible by DSI, however the benefit cost ratios for these projects were noted to be 0.92 and 0.98, respectively, faintly under unity. The benefit cost ratio for Kale, Akpınar, Alagöl and Çaykara SHP projects were estimated to be more than unity, 1.25, 1.18, 1.8 and 1.23, respectively, by the RETScreen. While they were noted to be 1.24, 1.42, 1.76 and 1.28, correspondingly, in DSI approved reports. Taking the results tabulated in Table 6 and Figures 1a - d into account one can say that RETScreen can be used in assessment of feasibility studies of SHPs in Turkey. Since the installed power capacities, energy delivered and total initial costs estimated by RETScreen were found to be very close to these found in DSI approved reports.



(a) Installed Power (MW)



(b) Energy Generated (GWh)



(c) Total Initial Cost (Million $) *(d) Benefit Cost Ratio*

Figure 1. Comparison of the results estimated by the RETScreen with the outcomes of the DSI approved feasibility reports (Each pair of columns represents one SHP project)

5. CONCLUSIONS

Small hydropower projects should categorically be dealt with a different approach than large scale hydropower projects, because of the differences between the ways they operate. Rather than optimization of the system, maximization of the delivered energy and the cost effectiveness should be the primary objective. The RETScreen is a decision support tool which is capable of maximizing the delivered energy and minimizing the initial cost of a SHP project within a short period of time, by altering certain variables.

For reservoir and run-off river type of projects, a pre-feasibility report can be prepared in a short time compared to the traditional feasibility studies. In addition, the report can be revised every time when the variables are altered. Therefore, different alternatives can be studied with ease without extensive calculations, which will help designers save time and money. Though, the RETScreen employs Canadian hydrological and meteorological databases, the outcomes of this study has shown that the software can easily be used for SHPs projects in Turkey.

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The Use Of Crumb Rubber Asphalt Concrete And Sustainable Impact On The Environment

Arzu Bodur Er[1], Ahmet Çoşgun[2], Hasan Barış Barut[3],Murat Karacasu[4]

Abstract

Increasing the number of tire production and transportation of the rapid advancement of technology and thus causes an increase in the amount of waste tires. Tires become waste after the end of its life, it has become a major environmental problem that threatens human health. Tires produced from natural and synthetic rubber consisting of durable high molecular polymers for Environment, used and stored after they complete their life force, the growth of harmful bacteria quite as favorable environmental health problems are encountered. Waste materials are tried to be consumed by various methods. Burning waste rubber consumption is one of these methods. Although this is an easy and inexpensive method incineration of waste tires creates a problem in terms of environmental pollution. This method is prohibited in many countries. Research on availability and production as building material recycling waste materials are made in the last thirty years. Waste tires need concrete, as well as widespread use in asphalt concrete pavement. One of the key areas that use recycled scrap tires evaluated in many different areas are also road construction and maintenance works. Recycled scrap vehicle tires, quiet asphalt, porous asphalt, such as asphalt mixtures are used in the production of various high-quality asphalt.

This is a problem all over the world are being tested different methods to reduce partly. The average recycling complete the evaluation of the 30 million tires each year life in Turkey; environment, the natural balance and therefore it is essential to human health. In this study, in today's conditions rapidly depleted of natural resources, waste rubber granules widely used as an alternative to quarried aggregates used in asphalt concrete supplied and performance was examined. Ever tried to use scrap tires in asphalt and produced in a different way from the ground and used methods. Supported in the electron microscope photograph, it has provided a positive contribution to the performance of the mixture through a structure similar to popcorn.

Keywords: Waste tires, rubber, asphalt concrete, environmental.

1. INTRODUCTION

Asphalt is one of the oldest building materials known for 5000 years. Although it used as a coating material or used as mortar providing tightness with asphaltic road material dating back over 100 years. Not to be binding in all those years, it is used to prevent dust has removed the vehicle (www.asmud.org.tr).

The discovery of asphalt from crude oil, refined factors in road construction in the early 1900s and the increase in motor vehicle production increased interest in the asphalt. Today, according to the different types of traffic loads and environmental conditions are maintained asphalt coatings (Tunç, 2007).

The first asphalt practices in Turkey and support from the Ottoman period in the construction of French penetration macadam coating is obtained. Republic, asphalt pavement construction began in 1929, was expanded in 1948 with technical assistance provided by the US Marshall and In 1950 with the establishment of the General Directorate of Highways General Directorate of Highways began continuous development period. Founded in 1950 in the framework of the policies developed by the Highways General Directorate of the asphalt path length of 1289 km in 1967, in 2010 and reached 10781 km.(Tunç, 2007). Road passenger and freight transport in our country has a significant share of 95%. Increasing the proportional impact of the increasing volume of traffic and the population is declining lifetime use of existing asphalt road. It causes deterioration in the increase of the number of vehicles on the road, especially developing industrial zones and axle load. In this regard, engineers and experts for many years, need stability both in terms of superior performance, longer life, lower maintenance and

repair costs in an effort to produce asphalt, asphalt were used in various contributions. In the literature, several studies investigating the different material to replace the paving aggregate, one of the two main ingredients.

Virginia state legislation in 1989 (law) has developed the use of waste tire plan. In 1997, it evaluates the waste tire surface coating. The coating of the contribution of waste tires in the studies had determined that reduce reflection cracks (Maupin and Payne, 1997).

Waste tires in road construction, uses since 1950. Benefits up to the use of natural rubber in bitumen based until 1840, although 1960 is unexplored. Carlson and Zhu, Phoenix into hot asphalt mixture when working cracks to develop methods for the repair of the road, which added shredded tires, have obtained mixtures with different properties by resting for entering the continuous mixing and reacting with different periods, and this product has also asphalt rubber name (Carlson and Zhu, 1999).

In 1999, a study conducted in the state Sakramento rubber-modified mixture effects on the traffic noise was investigated. Waste tires prepared by modifying the asphalt-coated road traffic noise of the field tests, was found to be significantly less than the unmodified coating. (Sacramento County Department, 1999)

Yesilata and friends every year in our country in their study that in 2007, approximately 110,000 tons of waste tire occurs, the potential of these waste tires; damping element energy fuel for recycling, some of the chemicals in the step of obtaining indicated that they are considered as raw materials. (Yeşilata vd., 2007a). Yesilata and friends of that same year they made a rapid increase of the amount of the scrapping waste tires in another study, unlike other waste tires are buried under the ground without passing though no action could not, for years held that they do in the land, the illegal storage conditions, in general, the environmental problems created by this waste threatens human health that gave place (Yesilata vd., 2007b).

Sugözü and Mutlu with the use of waste tires in road paving have suggested the idea to reduce traffic accidents will provide a better grip of the asphalt road (Sugözü ve Mutlu, 2009).

Oregon Department of Transportation (ODOT) said, between 1993-1999 examined the project in 17 separate highway built modified, made the field tests and issued a report, waste rubber additive of flexible coatings produced from bitumen, the control of the ratios that better performing, the waste tire contribution of cracks and asphalt layer reduces the formation of deformation that extend the life and reduce maintenance costs, As well as the reduction of waste tires in recent years as the economy as well as products for use in asphalt technology and environmental pollution because of the contribution it makes in extending the life of the asphalt it has been widely used in America and many countries of the world (Xiao, 2006).

Ensure that the expected increase in asphalt pavement performance and to evaluate environmentally hazardous waste is common in the literature on a wide variety of modified asphalt production. Also included in this study include the use of different sizes and proportions of the car in end of life asphalt tires.

With improving technology in the world and a variety of domestic and industrial waste and the amount is increasing in our country. These fields can be used in evaluating the waste is limited (Karacasu and Bilgiç,2009). One of the areas where the most significant technological developments in transportation. With each passing day, increasing vehicle production and sales, more leads to the production and sale of tires. Therefore, this rapid consumption causes the accumulation of used tires from vehicles. After completing his lifetime uncontrolled release into the environment of these tires become waste; air, water and especially soil pollution causes many environmental problems. (MEB,2011). While on environmentally harmful waste tires that can be recovered by 95% when the appropriate conditions are met. With the increase of people living and consumer understanding of the world's population it is changing. If the needed reduction in the use of natural resources sparingly and even depletion is inevitable. Given the need for nature and natural resources, unconscious consumption being the community should be and must be more sensitive to environmental issues This study tested until now scrap tires to be used in asphalt and milled and produced using a different method from the method used. Supported in the electron microscope photograph, it has contributed to the performance of the mixture through a similar structure to the popcorn.

2. MATERIALS AND METODS

The materials used in highway pavement is divided into two groups, namely general aggregates and binders.

2.1. Aggregate

Aggregate is one of the main materials used in road construction. The stresses created by the traffic load plays an important role in meeting. Asphalt application crushed stone, gravel and aggregates are used to break the composition prepared from them. Our country is usually made from limestone aggregates used in recent years, more durable and rough surfaces far as possible in order to obtain wearing of hard rock (basalt, granite etc.) It is used prepared aggregates.

2.2. Bituminous Binders

Bitumen, to obtain crude oil. The volatile crude oil and light fuel is heavy oil component remaining after refining. The color is black or brown, is a material impermeable to water. 5000 years is a long time bitumen, waterproof, provide all the waterproofing and protective properties thanks to the adhesive or bonding purposes are used. In the mid-19th century, rocks in Europe are known for use as a pavement binder can be obtained from the asphalt deposits (Shell Bitumen Handbook, 2004). Before waterproofing, bitumen used for different purposes such as adhesives are widely used as binders for road surfacing all over the world in the end.

2.3. Asphalt

From dark brown to black color, it can be changed from solid to semi-solid consistency, which can be liquefied with solvent, is called natural asphalt or bituminous material obtained by the distillation of petroleum. History's oldest road-building material.

2.4. Modified Bitumen

Bitumen, although 5-6% by weight of the mixture used in road paving plays an important role on the road performance. Today, many different materials are used as asphalt modifier. The overall objective is to improve the behavior of the use of these substances bitumen and bituminous mixtures (İsfalt, 2001).
CRM-300 and SMR-400 as of end of life tires in general are obtained by grinding with high pressure and friction effects (Figure 1).

20 MPa of high pressure and 10-90 ° degrees relative rubber lysis vulcanization under shear, the CH-CH polymer chains less destruction and chaotic formation of free radicals causes depolymerization and ability reaction of the material as a result of which causes the increase.

Figure 1: Under High Pressure Specially ground Car Tire

Figure 2: Asphalt plant on the site

CRM-300 and in the SMR-400 modified materials, to reduce the viscosity, poly phosphoric and ortho-phosphoric acid, ground EVA production waste to reduce the index of penetration bitumen with rubber surface

between the malt and asphaltene component CH-CH bonds of sulfur to connect in a cross , ground polyurethane production residues, also has zinc oxide as a reaction activator.

The asphalt concrete production plant in asphalt without the need for additional equipment to the construction site (Figure 2) are used. Also the transport of normal asphalt concrete and asphalt produced equipment is used in the laying phase. CRM-300 and SM-400 modified asphalt materials, Highways Specification of wear and binder coating layer to the expected resistance values (KTŞ, 2006) provides. However, they stay with it to contribute to the performance characteristics of the asphalt pavement, CRM-300 in cold climate regions, SMR-400 offers great advantages in the area of hot climates.

Table 2: CRM-300 SMR-400 utilization rates

Special Ground Rubber Modified Asphalt Additive		
Asphalt Type	50-70 asphalt	50-70 asphalt
Modified Asphalt Type	CRM-300	SMR-400
Min. Ground tire Amount (as% of asphalt amount)	% 10	% 15

Jam by swelling at high temperatures in ground rubber additives asphalt concrete under normal conditions while preventing the CRM-300 and SM-400 additive material to win a structure in the form of popcorn because of the production under high pressure and should asphalt, providing a homogeneous distribution in both mixtures (Figure 3,4).

Asphalt Modifier, the dry mixture (mixture of bitumen before joining after the heated bitumen additives excluding all), the wet mixture (hot bitumen) can be applied.

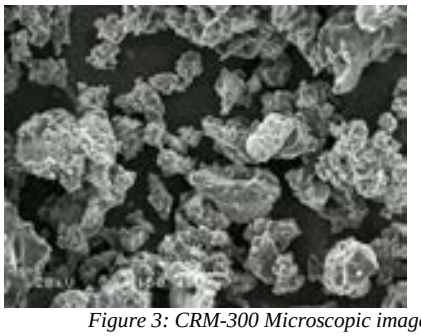

Figure 3: CRM-300 Microscopic image

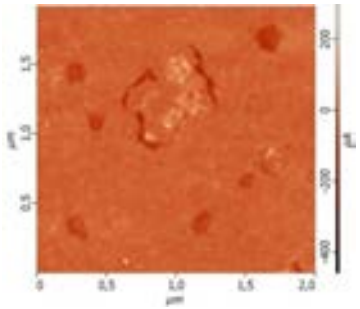

Figure 4: Modified asphalt Specifications

Completing the life recycled to the tire (the recycled elastomer waste) was added to the patented other asphalt modifier additives are obtained CRM-300 and SM-400 modified asphalt material bearing the names. The test results for these materials are given in Table 3 and Table 4.

Table 3. The modified asphalt product (CRM-300)

Sıra No	Experiment Name	Standard Assay		Modified Asphalt
		TS EN	ASTM	CRM-300
1	Penetration (25^0C) 0.1 mm	TS 118 EN 1426	D 5-97	49.1
2	Softening Point (^{0}C)	TS 120 EN 1427	D 36-76	58.5
3	Thin film Heat Loss Test (163^0C, 5 hours) (%)	TS EN 12607-2	D 1754-97	
3.1	Mass Changes (%), mak.			0.13
3.2	Permanent Penetration (%), min.	TS 118 EN 1426		44.5
3.3	Softening Point Reduction (^{0}C), min.	TS 120 EN 1427		2
3.4	Softening Point Elevation (^{0}C), mak.			6
4	Flash Point (^{0}C), min.	TS 123 EN 22592	D 92-02b	295
5	Elastic Return (25^0C), (%)	TS EN 13398		13
6	specific Weight (gr/cm^3)	TS EN 15326		1.03

Table 4. The modified asphalt product (SMR-400)

Sıra No	Experiment Name	Standard Assay		Modified Asphalt
		TS EN	ASTM	SMR-400
1	Penetration (25^0C) 0.1 mm	TS 118 EN 1426	D 5-97	48.1
2	Softening Point (^{0}C)	TS 120 EN 1427	D 36-76	62
3	Thin film Heat Loss Test (163^0C, 5 hours) (%)	TS EN 12607-2	D 1754-97	
3.1	Mass Changes (%), mak.			0.04
3.2	Permanent Penetration (%), min.	TS 118 EN 1426		42.5
3.3	Softening Point Reduction (^{0}C), min.	TS 120 EN 1427		2
3.4	Softening Point Elevation (^{0}C), mak.			6
4	Flash Point (^{0}C), min.	TS 123 EN 22592	D 92-02b	292
5	Elastic Return (25^0C), (%)	TS EN 13398		18
6	specific Weight (gr/cm^3)	TS EN 15326		1.02

2.4.1. Modified asphalt type selection

The use of modified asphalt for application; For cold climate regions CRM-300 (10% private ground rubber additives and other modifying agents patented), SMR-400 for hot climate zones (10% private ground rubber additives and patented other modifying agents) modification is recommended as the asphalt material . Both modified asphalt must also wear material can be used for both the binder.

2.4.2.1. Modifiers CRM-300 and SMR-400 's advantages over other modifiers

CRM-300 and SMR-400 modifier is preferable in many areas compared to other modifiers. Some of these;

- Crack formation, rut formation, resistance to the negative effects of the high water and cold climatic conditions, mineral additives to make long-lasting adhesion is the modifier than others.
- Modifiers CRM-300 and SMR-400 Use of pavement maintenance costs that increase the life of the 25-30% decrease at the same rate.
- Modifiers CRM-300 and SMR-400 when used positively change the characteristics of asphalt concrete, coating and implementation work does not bring any surplus costs.
- According to another modifier, CRM-300 and SM-400 transport and storage is more appropriate.
- The preparation time using modified bituminous binder powders obtained by the present fragmentation method Although 2 hours, this method of preparation time thanks to a modified bituminous binder is reduced to 20 minutes.

- Other fragmentation methods as observed in the piece obtained rubber-based modifier additive segregation and separation of the carbon black is not seen in the CRM-300 and SMR-400 Modifiers.

2.5. Aggregate and bitumen Tests

The results of aggregate and bitumen applied experiments used in the experiments are given in Table 5 and Table 6 as a whole.

Table 5. Aggregate results of batch experiments

Material Properties	**Test Results**			**Related Standards**	**Desired Border**
	Rough	**Fine**	**Filler**		
Specific Weight (gr/cm^3)	2.620	2.622	2.708	ASTM C 127-TSEN 1097/6	---
Water Absorption (%)	0.225	1.040		ASTM C 127-TSEN 1097/6	<2.5
Cramped Unit Weight (kg/m^3)	1911.6			TS 3529	—
Bulk Density (kg/m^3)	1756.4			TS 3529	—
Abrasion Loss (%)	28.912			ASTM C 131-TSEN 1097/2	<30
Flatness Index (%)	15.69			TS 9582	---
Determination of Organic Matter	There is little or no organic matter			TS 3673	---

Table 6. Heating loss test results before and after the bitumen batch experiments

Experiment Name	Test Results						Desired Border
	unadulterated		CRM-300 Additive		SMR-400 Additive		
	pre-Heat loss	Heat loss after	pre-Heat loss	Heat loss after	pre-Heat loss	Heat loss after	
Softening Point (°C)	46.5	52	58.5	59	62	65.5	46-54
Penetration (25 °C, 1/10 mm)	58.5	60.2	49.4	44.5	48.1	40.5	50-70
Ductility (25 °C, 5 cm/dk)	>100		<100		<100		+100
Elastic Return	3.11	2.13	30.52	18.93	36.36	28.64	
Flash Point (°C)	302		335		330		Min. 230
Heat Loss (%)	0.13		0.21		0.06		Maks. 0.50
Specific Weight (gr/cm^3)	1.048		1.037		1.029		1.0-1.1

2.6. Applied Tests Mixture

To evaluate the performance of bituminous mixtures in flexible pavement, formed the base of the bituminous layer and cracking causing pull decline and to design a durable body against the pressure deformation occurs on the bottom floor are experiments to optimize the mix (İsfalt, 2001).

3. *RESULTS AND DISCUSSION*

Experimental studies in 1100 g aggregates received 3.5%, 4, 4.5, 5, 5.5, 6, 6.5 mixture heated mixer with the addition of bitumen in varying proportions. 3 samples were prepared for each rate of bitumen. The mixture temperature 160 0C is. 50 strokes are made on both surfaces of the samples in the Marshall compactor. Practical specific gravity of the prepared mixture, Marshall resistance was obtained with porosity and bitumen-filled porosity values. In addition, CRM-300 and SM-400 separately Marshall Test was applied to doped state. 50-70 penetration test results for samples prepared using bitumen (Table 7) are shown below.

Table 7. The mixture was applied to the test results

Experiment Name		Bitumen Ratio (%)		
		Control	CRM-300	SMR-400
Practical specific gravity (highest)		5.51	6.32	6.00
Marshall Strength (highest)		4.00	3.82	4.41
Void ratio (4%)		4.02	4.46	5.04
Bitumen filled the vacancy rate (70%)		4.04	4.39	4.82
AVERAGE		**4.39**	**4.75**	**5.07**
for Opt. bitumen rate	Practical specific gravity, kg/m^3	2433.48	2413.36	2385.58
	Marshall Strength (highest)	1900.6	1650.0	1515.4
	Void ratio (4%)	2.9	3.2	3.9
	Bitumen filled the vacancy rate (70%)	77.6	76.4	73.5
	Flow, mm	**2.27**	**1.82**	**2.02**

CRM-300 and SM-400 additives that experimental studies to examine the effects of asphalt concrete performance was supported by KGM laboratory studies. Highways 'are to be responsible for the maintenance and repair of Tokat-Turhal State Road' in contribution with 10% private ground crumb rubber asphalt concrete was poured using CRM-300 bitumen. Then, the mixture performance tests on core samples taken from the land, in search of living wheels (TiO) tests were applied (Figure 5). Experiments were carried out separately for pure and spiked samples.

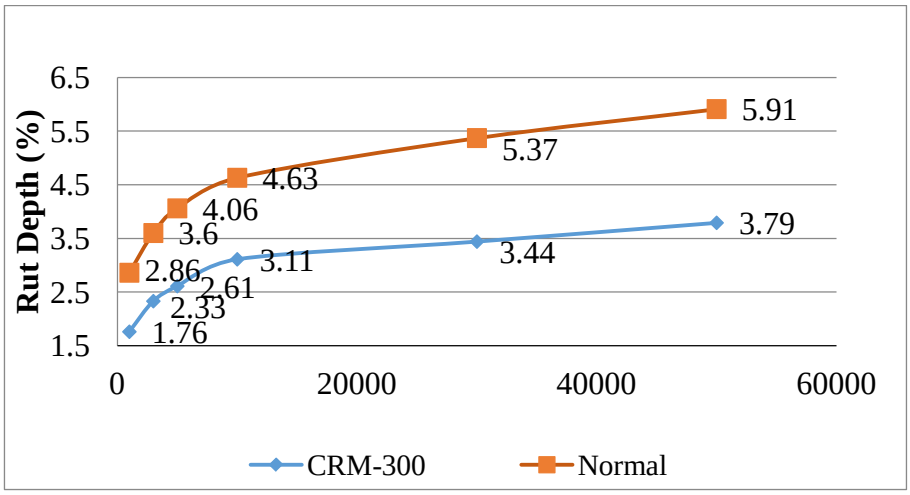

Figure 5. CRM-300 doped and undoped mixture sit in the footsteps wheels

4. CONCLUSIONS

Under normal conditions, ground rubber additives prevent swelling at high temperatures in jam making asphalt concrete. This causes me to fall in a certain amount. CMR-300 additive can prevent that 100uM size and volume increase as more down the owner. CRM-300 or SRM-400 with asphalt concrete formed by the modified asphalt additive, for drawing water into is not affected by freezing. Water forms ice cold air through the forming surface. CRM-300 and SRM-400 doped due to the weight vehicles moving on due contribution rubber used as modifiers in the asphalt, flexing results in the coating layer is crack the ice layer formed on the coating layer is broken and then causes the surface to be excluded. Because there is no need to de- icing surface chemicals and salt, it extends the service life of the pavement. Now losing heat of asphalt concrete containing crumb rubber, the cold weather and the breakdown of this mixture makes it possible to move to a greater distance. Because they also have to absorb the sun's rays in cold climate regions, they are delaying the icing on the pavement (Figure 6).

Figure 6. CRM land application

CRM-300 and SMR-400 additive is obtained in a totally our country sources. This is important for efficient use of national resources. Also in other countries which entered the specifications, used in the manufacture of pavements ground tire has a significant share in the context of environmental and visual pollution prevention.

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Vocational And Technical Education Example A Simulator Training Climate Study For The Development Of Split

Ahmet Çoşgun[1], Erdoğan Şimşek[2], Barış Barut[3], Arzu Er[4]

Abstract

Heating and cooling sector in the world and a surge in energy costs in Turkey, split air conditioning use has brought to the fore. Air conditioning and heating in Turkey in the Aegean and Mediterranean regions, as well as being widely used for cooling purposes. Although newly developed cooling unit for heating and cooling load can be achieved by consuming less energy fluids and air conditioning heating up even at lower ambient temperatures it has been developed. The desired rapid and economical heating and cooling needs of rapid industrial development and housing and businesses that result in Turkey, the split is met by the air conditioning. This widespread use raises the need for qualified people to perform the installation and servicing of air conditioning. For this purpose, Akdeniz University of Technical Sciences in a wall-mounted split air Vocational training simulator has created. Çukurova University, Çukurova Vocational School Climate of previously performed sample split air simulator in cooling labs have tried to make a similar the leader of this study, carried out in this simulator, air conditioning, 220-volt electrical connections, with double head jack cable, have seen that can be done via sockets, the electrical and pressure measurement devices power, current, voltage, values are shown it can be read numerically. Both samples were compared to readings in the simulator, sample split is also discussed what could be done to improve the air conditioning simulator.

Turkey in Higher Education Board affiliated universities Vocational School in the relevant section in the attached vocational education ministries with (in air conditioning and refrigeration field) vocational education and training is still out these examples practical training simulators to gain professional experience of the technical staff in the firm is in service training by expanding available. Use of this practical training simulator, the usual technical elements to come out of the air conditioning was split training method will transform theoretical knowledge into practice, we think it would be provided in addition to receiving practical training. Thus in Turkey Climate better training of qualified technical personnel needed by the cooling market will also be provided. This example is modeled training simulator of Turkey in higher education board connected to the Faculty of Engineering of the Faculty of Technology are available in the Department of Mechanical Engineering and Energy Systems division, Technical Vocational High Schools, the Air Conditioning & Refrigeration Technology Program, National training due to technical and vocational training institutions ministry conditioning and cooling program We opinions be useful to show in practical educational courses.

Keywords: Split air; Training simulators; Electrical circuits; Measuring equipment.

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1. INTRODUCTION

Split air conditioners, day by day, Turkey has also entered a rapid growth trend into the dizzying individual air conditioning systems. Split widespread reduction of the cost of air conditioning is one of the leading actors in this fast-Trent.

Cooling system elements are two or more split air conditioning device formed by placing the name of the body. The dictionary defines the word in Split, are defined as discrete Split air is divided into two fully separated form the middle of the window air conditioners. Refrigeration and heat pump alone as in window-type air conditioner (heat pump) is available in air conditioning. Thanks to the timer opens the requested time and closed position. Moisture position and season passes for cooling without a more comfortable environment comprise only the flexibility to select the installation location during installation taking just moisture, being relatively smaller indoor and quieter operation are outstanding as split the biggest advantages of air conditioning (İsa, 2004).

Wall-mounted split air conditioners, outdoor conditions the temperature of the interior environment without taking into account the variability in, dehumidification, are air movements and by checking with the fresh air intake elements in some models recently developed device that allows the retention of internal environmental conditions required comfort level. They also split air conditioners, with a newly developed filter systems, dust and particles are devices that perfectly filter (Lightning and et all, 2009).

Wall-mounted air conditioning, thanks to the four-way valves are placed on the outside of the indoor unit can transfer heat from the external environment or internal environment from the external environment. This split air conditioners because of its superior characteristics, are most commonly used in air to air heat pumps (Şimşek and et all, 2009).

Plug the plug-in devices, wall-mounted split air conditioner with the group, the indoor heat exchanger makes indoor and outdoor heat exchanger that the outdoor unit installation of the following refrigerant circulation, signal exchange and condensing water out of copper pipe that helps, electric cables and to run with drain pipe installation ready. Air conditioning, heat energy in the indoor unit when used for cooling purposes by obtaining a temperature lower than the indoor temperature on the coil of a fan is transferred to the refrigerant by the ambient air. The temperature of the refrigerant gas in the compressor, the indoor unit is raised above the ambient temperature, the cooling fluid which is transferred by heat energy is discharged into the surrounding medium at a lower temperature than the high temperature of the outdoor unit. If the system is used for heating purposes if the refrigerant is transferred from the external environment through the outdoor heat energy is transferred to the indoor heating is provided by the indoor unit. The refrigerant fluid directed to an internal or external unit is supplied via the four-way valve (Nayar, 2009).

For this purpose, Akdeniz University of Technical Sciences in a wall-mounted split air Vocational training simulator has created. Çukurova University Çukurova Vocational School Climate of previously performed sample split air simulator in cooling labs have tried to make a similar the leader of this study, carried out in this simulator, air conditioning, 220-volt electrical connections, with double head jack cable has been observed that can be done via sockets. Also the electrical power measuring device and pressure , current, voltage values can be read has been identified and quantified. Both samples were compared simulator read the above-mentioned values. Split the most important part of the air conditioning installation, it constitutes the electrical connection. On this simulator , air-conditioning refrigeration air conditioning technician to make the electrical connections are intended to connect properly. It also impacts on the wrong connection on the air conditioning system , as a numerical value gauge , digital thermometer, ammeter , voltmeter and wattmeter ' were also monitored and evaluated the results.

2. MATERIALS AND METODS

Experimental modeling , Akdeniz University of Technical Sciences in a wall-mounted split air Vocational training simulator has created. The study leader , which Cukurova University Vocational School Climate sample made previously held a similar split air conditioner in the cooling lab simulator (Figure 1) .

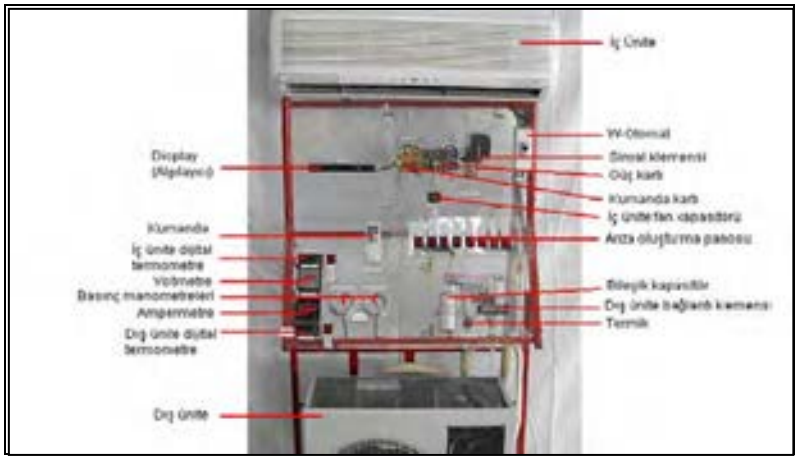


Figure 1. Wall-mounted split air training simulator instance

2.1. *Split Air Fault Simulator*

Akdeniz University of Technical Sciences held in Vocational laboratories and shown systematic in Figure 2 wall mounted split air conditioner internal and external unit created by placing on the same pedestal 3519/3666 W cooling / heating capacity of the wall is made of an air conditioning fault simulator. In this simulator socket electrical connector, the electrical measuring device is formed by gathering together with temperature and pressure measuring instruments and auxiliary elements. Split air conditioning fault simulator, indoor fan motor and fan capacitor 220 Volt power supply, external 220-volt compressor unit and the compressor capacitor, four-way valve, fan motor and fan capacitor consists of electrical connections. Used in experiments considered individually air conditioned and specifications aimed to investigate the effects on the air conditioning system of the electrical current in both provinces the same with the Cukurova University conditioning cooling laboratory olds do like the air conditioning and the like, it is make simulator split. The following specifications of the wall split air conditioner simulator training is given in table 1.

Table 1. Wall-mounted split air conditioner specifications of the training simulator

Specifications	**Coolling**	**Heating**
Capacity	3519 W	3666 W
In the cooling mode Power consumption	1200 W	1270 W
Rated current	5,9 A	5,9 A
Voltaj	220-240 Volt, 50 Hz	
Refrigerant	R22/0,7kg	
Max. Power consumption	1690 W	
Max. Rated current	7,7 A	
Flow	530m^3/h	
Sound power (Indoor / Outdoor unit)	37dB(A)/52dB(A)	
Weight (Indoor /Outdoor unit)	10kg/35kg	

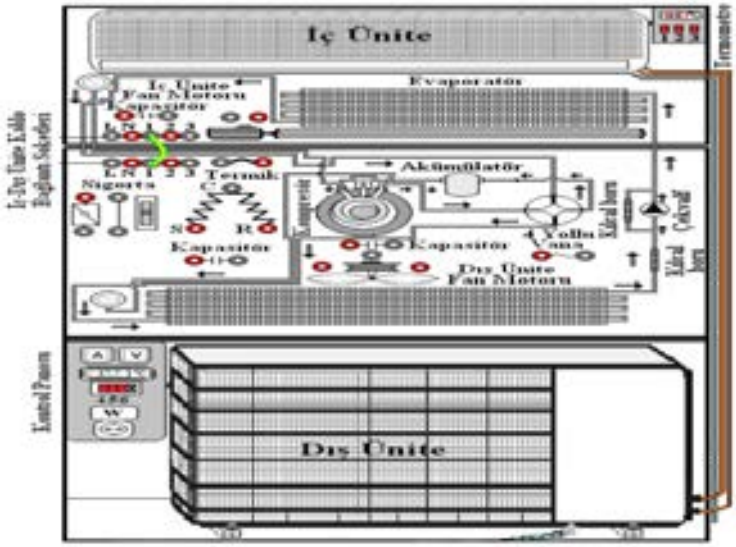


Figure 2. Wall-mounted split air training simulator (Bilgili and et all , 2012)

Wall-mounted split air-conditioning training simulator , indoor and outdoor units made on 40x40 mm square steel profile construction of a carrier body is mounted in opposite ways . Facing the indoor unit between indoor and outdoor units mounted 0.85 mm thick MDF board. Compressor on a sheet , four-way valve, condenser, the outdoor unit fan motor, capillary tubes, non-return valve , the accumulator, the evaporator and the indoor fan motor and the piping connections between those elements have been drawn as above showing in figure 2.

MDF plates on the compressor in the outdoor unit and outdoor unit fan motor of the permanent circuit capacitor , compressor joint ends of the main and auxiliary winding , phase and neutral socket of the four -way valve coil connection. Wall-mounted split air conditioner 's indoor unit , wiring the fan motor and capacitor indoor fan is moved to the socket.

Red socket on MDF panels in accordance with the regulatory norms phase power cord, plug the black sockets are neutral. Two glycerine showing the compressor suction and discharge pressure gauge is connected to the system. Split evaporator refrigerant in the air conditioner's indoor unit; entry point to the respective sensing sensor to measure output and air discharge temperatures are connected. For temperature measurements, electrical connections are made thermometer. Simulator connection of sensors mounted on the split pipe in the air conditioning system was isolated on the pipe. At the same time simulator which split condenser refrigerant in the air conditioner outdoor unit; inputs, outputs and the external unit a second digital thermometer with sensors to measure air blowing temperature and the electrical connections are made. Split air current drawn by the training simulator, the ammeter on the control panel, the system checks the voltage changes from the voltmeter and power is provided to read from the plug-in wattmeter (Bilgili and et all, 2012).

2.2 . Wall Type Split Air Simulator Panel and Electrical Connections Electrical Circuits

2.2.1 . Wall-mounted split air conditioner 's indoor fan motor electrical connection

Wall mounted to measure the force it takes the electrical connections made through training simulator device is bringing to the location wattmetre runs in cooling mode. Indoor fan motor and electrical connection of the first movement as the capacitor shown in Figure 3 below, has been commissioned by making both ends of the fan motor with jack cables. As is known, air conditioner fan motors inside the unit in general asynchronous motors are used in the power range of 10-20 watts. Two braking winding outside of the main and auxiliary windings of the fan motor is also located in the system. The fan motor speed control is provided via the power board. When the wall split energized indoor fan motor of the air conditioning in the digital display and gauge readings are given in Table 2 below. 2 with the same schedule, already prepared, air conditioning simulator is made by the Cukurova University in comparisons.

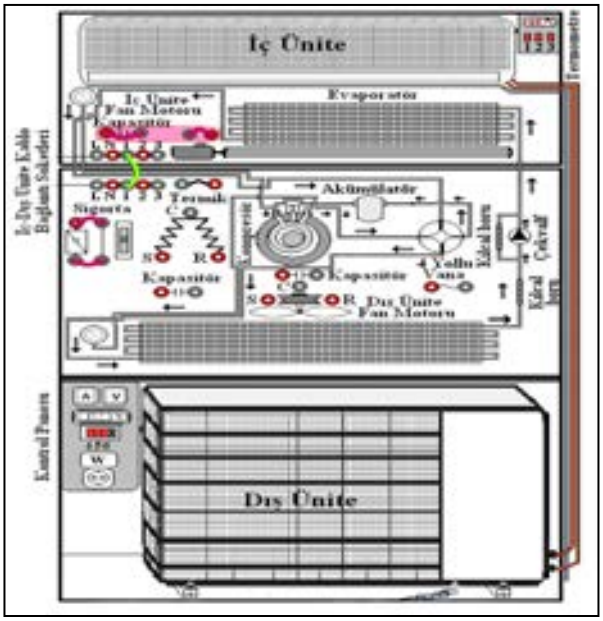


Figure 3. Wall-mounted split air conditioner indoor fan motor and the indoor fan capacitor electrical connection (Bilgili and et all , 2012)

2.2.2 . Outdoor Unit Fan Motor and Capacitor Electrical Connection

Figure 4 below the outdoor unit fan motor and capacitor electrical connections are shown. Outdoor fan motor provides air flow through the condenser coils on the outdoor unit is an asynchronous motor of 80-90 W of power. Outdoor unit air blowing system; Depending on the fan motor and the motor shaft is composed of axial fans. Control card fan relay command from the microprocessor on, check the power circuit when the ignition outdoor fan motor is activated; fan motor is switched by the relay contacts opened exit.

Outdoor fan motor and compressor to the required torque in the continuation of the first movement, and movement is constantly supplied with some air conditioning creates a unified capacitor circuit and phase differences remaining. In some split-type air conditioning fan motor and compressor capacitor is divided. Capacity values of discrete capacitors typically ranged from 0.6-15 μf and 250-450 volts (Bilgili and et all, 2012).

Wall-mounted split air-conditioning training simulator phase difference, 3μf is provided with a 350 volt capacitor. Figure 4 shows the phase in which the fan motor as seen from the number two round sockets, socket completes the circuit by passing through a neutral outdoor fan capacitor. And pressure gauge readings on the digital display when energizing the outdoor fan motor are given in Table 2 below.

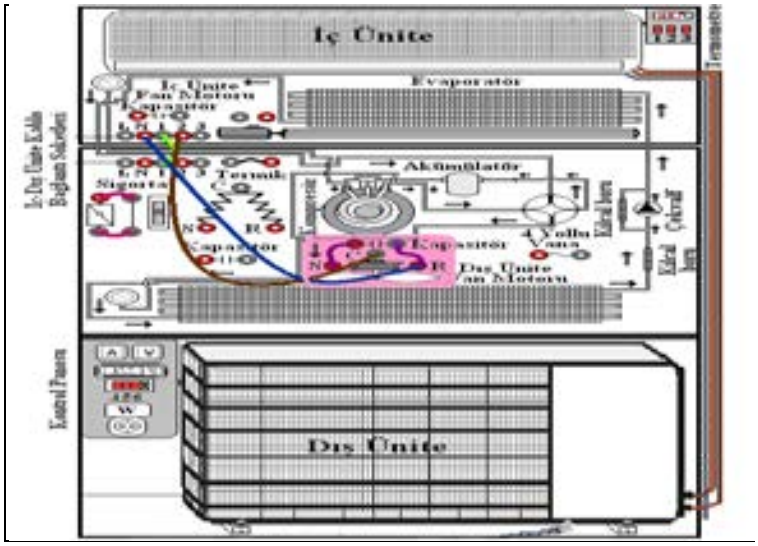


Figure 4. Outdoor Unit Fan Motor Power Connector (Bilgili and et all , 2012)

2.2.3 . Wall split air conditioner compressor simulator Electrical Connection

Split full hermetic rotary compressors used in air conditioning. The electric motor used in the compressor housing, the auxiliary coil is an induction motor. compressors are the most important elements of air-conditioning and cooling systems, increasing the pressure of the refrigerant in the form of low-pressure and superheated steam which is absorbed from the evaporator again to the condenser into superheated steam sender and are devices which convert the electrical energy into mechanical energy. Permanent circuit capacitors used in the compressor can withstand tension between µf be between 15-60 and 250-400 volts. These capacitors provide the necessary momentum in creating a phase difference between the first start of the compressor and continues in the main and auxiliary windings provide a more stable operation (Airfel, 06). (L) round socket from the received phase of the compressor is connected to the thermal input to the jack plug as shown in Figure 5. Phase, is connected by means of plug-in jack on the joint end of the compressor thermal output. Home winding, the main winding end of the capacitor; end of the auxiliary winding is coupled to the auxiliary winding from the neutral terminal and completes the circuit connector. When energized, the compressor and pressure gauge readings on digital indicators are given in Table 2.

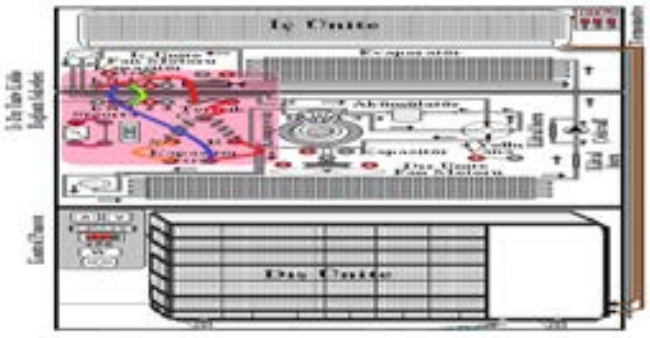
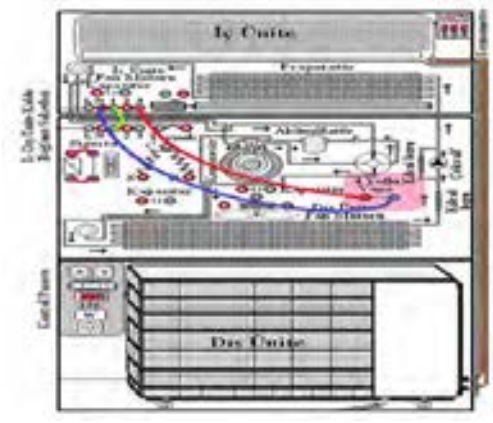


Figure 5. Compressor Electrical Connections

2.2.4 . Wall split air-conditioning four -way valve solenoid coil of electrical connection

Solenoid coil, the magnetic field forming device for the heating coil windings between the signal received from the microprocessor trying to change the location and direction of the refrigerant through the four -way valve (Bilgili, 2010).

Phase number from three circular socket as shown in figure 6. Caution following input socket is connected to the solenoid coil via plug jack. Coil outlet end is connected to a neutral connector jack . Four -way valve system in the digital display of the entire heating system as a result of transition to the solenoid is energized and the gauge readings are given in Table 2 . Complete the electrical connection of the simulator shown in figure 7 below.



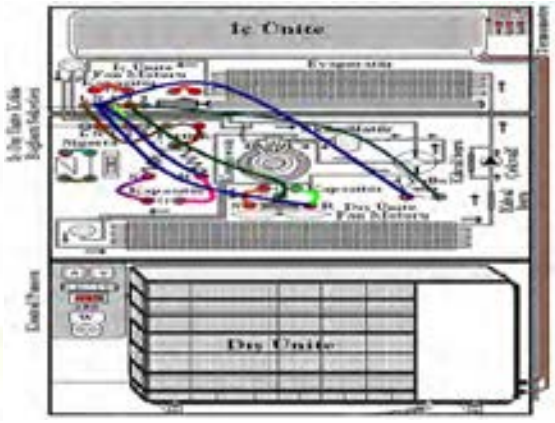


Figure 6. Four -Way Solenoid Valve Electrical Connection Figure 7: Split Air Training Simulator Complete Electrical Wiring Diagram

Table 2. Wall split Cukurova University of measured values when power to the air conditioning components and training simulators in the training simulator to compare Mediterranean University

		Voltmetre (V)	**Ampermetre (A)**	**Wattmetre (W)**	**Alçak Basınç Manometresi (Bar)**	**Yüksek Basınç Manometresi (Bar)**
Çukurova University Çukurova Vocational School program wall mounted split air conditioning cooling measurement values	İç ünite fan motoru	226	0,17	36	9,8	9,8
	Kompresör	214	6,08	1222	2,2	19
	Dış ünite fan motoru	221	0,37	82	10,5	10,5
	Tüm sistem devrede iken ısıtmada alınan değerler	215	6,11	1238	3	20,5
Akdeniz University Vocational School of Technical Sciences wall mounted split air conditioning and refrigeration program measurement values	İç ünite fan motoru	225	0,16	35	9,4	9,3
	Kompresör	215	6	1290	2,4	18
	Dış ünite fan motoru	220	0,35	77	9,6	9,5
	Tüm sistemde iken ısıtmada alınan değerler	216	6,5	1310	3,2	21

Wall type split the measured values when power to the components of the air conditioning training simulator Cukurova University and Mediterranean University volts in comparison measurements in indoor and outdoor units in training simulator has proved to be the difference in wattage amps. These differences, although the same wall split air conditioners used to be due to small differences in the amount of gas used to vary the amount of power drawn reveal the results. Moreover, the result of which vary depending on the amount of gas in the difference in

low and high pressure values. The results differ because of the external weather conditions between the provinces of comparison is an indicator that confirms the emergence of different.

2.2.5. Wall-mounted split air conditioner indoor unit electrical circuit simulator

Wall-mounted split air conditioner indoor unit electrical circuit diagram of a training simulator is shown in Figure 8. Phase from the network, the indoor unit 250 of the compressor relay card entry V - 2 means Amp fuse glass. Insurance card circuit to protect against electrical faults that may occur for any reason. One phase separated in glass fuse output means through indoor fan motor connector on triac. Phase completes the circuit through the neutral line from the output of fan motor connector. A varistor is connected to the circuit to be affected by voltage spikes. The first movement of a capacitor is connected to the indoor fan motor circuit. The other phase in the insurance output divided, four-way valve solenoid valve relay the income and the outdoor unit in the signal terminals energize the gas to change the direction of the indoor unit (3) is connected. The other input of the phase after leaving the fan relay, the indoor signal terminals to activate the fan in the outdoor unit (2) is connected. Phase, is connected to the indoor unit of the compressor relay output signal terminals (1). Neutral line socket via the indoor unit board and card Sign out from the indoor unit to the socket end of the signal neutral terminals (N) are connected. Soil evaporator is determined by a screw to the hair. Indoor unit plug the card sensor board, air routing engine room is connected pipes and thermistors. The simulator is also placed in a test button on the card to the test. The indoor unit from the outdoor unit signal terminals 5x1.5 mm2 multi-stranded thermoplastic insulated signal terminals (TTR) cable connectors by pulling the outdoor unit is connected to the terminal connector to be correct (Basalak, 2010).

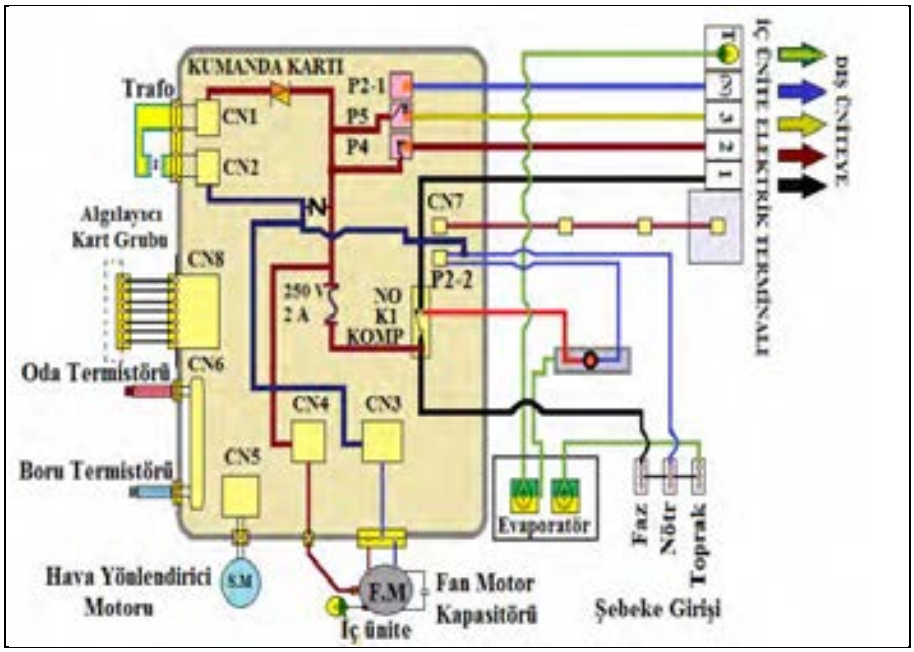


Figure 8. Wall Split indoor unit electrical circuit diagram of the air conditioning system simulator

2.2.6. Outdoor Unit Electrical Circuit Diagram

The outdoor unit to the system circuit diagram shown in Figure 9. Connected to the outdoor unit terminals drawn between internal and external unit 5x1.5 mm2 TTR (thermoplastic insulated stranded) cable's No. 1 end of the phase, the N-terminal neutral, one of the ends of the earth, ends 3 4-way valve, No. 2 ends the outdoor fan motor connection of the ends. As through the relay card with commands given from the microprocessor in the indoor unit from the outdoor unit element is activated. Phase from the compressor relay passes through heat; compressor joint end (C) comes. The main winding is connected to the main input of the capacitor winding. The auxiliary winding is connected to the slave end of the capacitor winding.

Home winding (R), a joint end of the circuit completing the auxiliary winding end of the capacitor continues to complete the circuit of the auxiliary winding connection from the end capacitor. This capacitor will remain switched on permanently in the main and auxiliary movement of the compressor, creating constant phase difference over wrap will provide additional torque.

Fan motors in the outdoor unit, have taken over the fan relay on the main board as phase fan motors gives the joint ends. Home winding capacitor from the joint end (C), auxiliary winding capacitor (F) from the end of the outdoor unit and signal connection terminals on the neutral (N) completes the circuit. The fan motor is running. Fan motor capacitor in the link is continuously activated (Fuji Electric air conditioning, 2)

When the air conditioning control to retreat to the indoor heating mode phase from 4-way valve relay enters the 4-way valve solenoid coil. Solenoid coil, the neutral connection on the outdoor unit signal terminals (N) completes the circuit. Changing the direction of the gas through the gas solenoid coil leads to the indoor unit. Thus, the hot gas will be printed inside the unit. The hot gas temperature, is transferred by the action of the indoor fan motor on the indoor unit (Fuji electric air conditioning, 2).

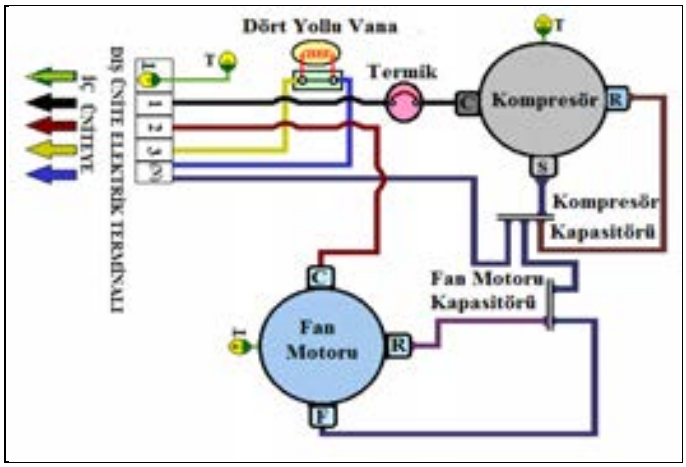


Figure 9. Split (split) outdoor unit of the air conditioning system, electrical circuit diagrams

3. RESULTS AND DISCUSSION

Wall-mounted air conditioning measured values in Turkey when power to the training simulator component Cukurova University and Mediterranean University compared Training simulators split volts facilities of indoor and outdoor units measuring air conditioning, it was observed that there are differences in amperes wattage. These differences, although of the same type and model wall split air conditioners used to be due to small differences in the amount of gas used to vary the amount of power drawn reveal the results. Moreover, the result of which vary depending on the amount of gas in the difference in low and high pressure values. The results differ because of the external weather conditions between the provinces of comparison is an indicator that confirms the emergence of different.

One of the more air conditioning type used in Turkey are split type wall mounted split air conditioner from air conditioning. Split air conditioners, heat pump property type because it has cooling and heating in winter can make. To end the production of the newly developed R22 gas and heating at lower temperatures and can be used with R410A gas that has been promoting the use of air conditioning. Where winters are mild and wet Mediterranean and Aegean regions not only for summer cooling, air conditioners are used for heating in winter. R410a gas in heating and air conditioning in temperatures due to global warming the interior of Anatolia where the summers are very hot it is known to be widely used.

Wall-mounted split air training simulator, technical staff training in vocational and technical training schools, air conditioning found in vocational schools providing training in the laboratory can be used during training in refrigeration technology department. Currently found in existing air-conditioning service, air-conditioning circuit to recognize the technical staff in service training, lack of connections and wrong connection in the practical training necessary to observe the behavior of the system, this can be done through similar training simulators and

bunne. This training simulator through technical elements, wall mounted split air conditioner's power supply, air-conditioning the current drawn by the internal and external unit suction and discharge temperatures, compressor suction and discharge pressures can be read from the system's dashboard and can be seen clearly how to behave devices across the connection deficiency or excess.

Wall-mounted split air training simulators, such as to contribute to the growth of these large housing will be trained on Air Cooling Technician, we also hope to benefit greatly from vocational and technical training in the technical staff have completed their development. This split air training simulator, which eliminates the need for technical personnel in the industry's problems in the electrical connection of the clima to be removed during the service, we opinions.

This example is modeled wall mounted split type training simulator of the Higher Education Council affiliated to the university of Engineering Faculties to present the Technology Faculty of Mechanical Engineering and Energy Systems division, Technical Vocational High Schools, the Air Conditioning & Refrigeration Technology Program, Technical and applied in air conditioning and refrigeration program of vocational training institutions in educational lessons in the laboratory would be beneficial, especially in the current course of the show we opinions.

The establishment of the Air Conditioning and Refrigeration Engineering Turkey, hoping we consider Turkey also will lead to an increase in the practical training in higher education institutions.

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ICOEST 1st INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND TECHNOLOGY
SARAJEVO
9 - 13th September 2015

Essential Elements of Integrated Coastal Zone Management at Istanbul, Turkey

Bedri Alpar[1], Başak Işıl Çetin[2]

Abstract

Coastal areas are transitional areas between the land and sea. These highly productive ecosystems create jobs, and boosts local economic growth with a higher percentage of collective and private enterprises and a larger share of production. Therefore central and governments must adopt an integrated policy and decision making process to promote a balance of uses in coastal areas. Scattered with historical attractions, heritage sites, buzzing cultural scenes and other natural resources, Istanbul is the economic and cultural capital of Turkey. The south of the city, the area at the junction of the Bosphorus Strait with The Sea of Marmara, offers great opportunities and has a vitality fed by widespread economic and cultural factors. The typical landscape of the city, its geomorphic features, oceanographic and hydrodynamic features of its waters, sea bottom characteristics, environmental pollution, make this region a critical marine environment which impacts to economy, environment and community. This panorama becomes much more complex if public organizations have not coped well with unexpected natural disasters, mostly strong earthquakes, moderate tsunamis and even flooding. This study emphasizes the essential elements of integrated coastal zone management, which is a multidisciplinary process to promote sustainable management of coastal zones, at this critical coastal environment, and its probable impacts to economy, environment and community. All objectives and probable impacts must be understood and need to be integrated by collecting information, planning, decision making, management and monitoring of implementation.

Keywords: Integrated coastal zone management, regional targets, national targets, layered flows, sediment transport, hydrodynamic models.

1. INTRODUCTION

Coastal zones are home to a large and growing proportion of the world's population. Even the coastal zones occupy only 15% of the land, these attractive areas are the home to about half of the world population. In national scale approximately 51% of the Turkey's population lives on coastal and shore buffer zones, which are at the disposal of the Turkish government. In fact many productive and valuable coastal zones are the most dynamic places with interactions between land and sea. They serve many important socio-economic functions and therefore receive untreated urban wastes and riverine inputs and concentrate various pollutants coming from inland agricultural and industrial activities. The narrow coastal zone can also be squeezed spatially from the sea side. Therefore such kinds of complex systems are highly vulnerable because they are usually the sink for the hinterlands. All these stresses cause serious environmental problems and will be felt more intensively by the coastal inhabitants in the future. In Turkey, however, the reliability-based risk assessment methodology is only followed in the design stages and application of the coastal structures. In that sense, extreme characteristics of wind waves, tides, storm surges, wave set-up, soil characteristics and the structural system parameters are considered [1].

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All these problems with their probable impacts must be understood and need a challenge of sustainable management. The rational management of the resources of coastal areas is made complex by three essential difficulties [2]. The first problem is the management of these vital resources by various different sectors (e.g. fishing, navigation, mining, oil production, navigation and even land-based activities) which apparently cause many conflicts between them. The second problem is that the jurisdiction over coastal areas falls to different levels of government. Finally, the complexity of dynamic and easily vulnerable coastal systems and intricate relations between them especially under anthropogenic stress, such as building of structures, mining, dredging, etc., causes the third difficulty [3]. Therefore integrated coastal zone management (ICZM) is a dynamic, multidisciplinary and iterative process to promote sustainable management of coastal zones. The core of this concept is to integrate almost all of the objectives and the most of the instruments needed to meet these objectives. This needs to collect information, planning, decision making, management and monitoring of implementation.

In order to provide first steps towards effective national and/or global actions, some regional policies related with the coastal management should be recognized and considered. Gifted with historical attractions, cultural heritage and natural resources, the global city of Istanbul is located at the hearth of transportation network of the whole Marmara Region (Figure 1). Although the province has more than 640 km long coastal line, bordered by two seas and the narrow and meandering Bosphorus Strait connecting these seas, there is not any integrated coastal zone plan prepared for this mega city.

The main scope of the present study is to provide the essential elements related with the coastal management of the Istanbul region. The regional actions can then be related to national policies designed to meet national and global targets of sustainability. In this context, we propose that the most important tool of the multidisciplinary approaches, which are vital for sustainable development, is to combine the spatially-temporally varying essential elements of coastal lands and coastal waters of the target region (coastal-marine spectrum) and then estimate how economic activities affect and are shaped by social processes.

Figure 1. The study area. Coastal data is licensed under the Open Data Commons Open Database License (ODbL) (www.openstreetmap.org/copyright/en)

2. COASTAL – MARINE SPECTRUM OF ISTANBUL

Over the past several decades, the population of Istanbul has increased significantly; in 2014 it has been stated as 14.4 million inhabitants by the National Statistical Institute [4]. High concentration of people and economic resources in coastal areas led to increased development, which led in turn to greater numbers of structures at risk from coastal hazards. The coasts of Istanbul are made up of extremely valuable and extensive ecosystems; a complex interaction of natural and manmade systems. They support a variety of socio-cultural and economic activities; mostly transportation, tourism, recreation and fisheries. According to the laws public benefit is a legal requirement for everybody and every organizations utilizing the coastal zone. But unfortunately coastal urbanization brings with it some damage to coastal ecosystems. Inadequate policies and strategies of central and local governments resulted in with inadequate physical, social and cultural infrastructure. As their environment undergoes severe change, the native inhabitants suffer from overcrowding and other cumulative burden of environmental stress from various activities. The natural coastal system, unfortunately extends tens of kilometers inland, well beyond its maximum limits due to extensive human activities. Therefore inland areas, affect the sea via untreated rivers and non-point sources of pollution. Air, soil and water pollution at overcrowded coastal zones pose greater threats to human health. The coastal waters of Istanbul are characterized by a number of short streams, two natural lagoons (Büyükçekmece and Küçükçekmece), nearshore sandbars and swales, the Bosphorus

canyon carved into the Marmara shelf, and the Golden Horn estuary. The ecological processes occurring in these coastal ecosystem are rather complex as they are interacted with the socio-economic system. Therefore they must be defined comprehensively in order to maintaining coastal activities while preserving the ecological state of the ecosystems.

2.1. Ports and harbors

The very high share (88%) of the maritime transport in foreign trade volume makes the ports and harbors critical in nation's economic development. On the other side, the ports in Istanbul and heavy shipping to relieve the land traffic contribute to the maritime traffic, urbanization and ship-generated marine pollution. The docks for cruise ships at the entrance of the Bosphorus Strait along the European side need to be modernized for modern cruise ship reception. In order to have an effective use of existing ports and their capacities, data envelopment analysis have to be applied. The port of Haydarpaşa, for example, is the biggest container port in the Marmara Region, with an annual cargo volume exceeding 6 million metric tons. Its contribution to the annual income is more than $30 million [5], but port facilities severely affect the land traffic. The Ambarlı is the second big port with full range of services, but limited in space. Therefore the ports and harbors must be carefully analyzed by coastal zone managers due to their vulnerability and their criticality to the economy.

2.2. Waste disposal and wastewater treatment facilities

The rapid growth in population, tourism and industrial activities has surmounted infrastructural capacities to handle liquid and solid wastes. Anthropogenic activity has a negative impact on the coastal ecosystem. As population grows, sewage poses serious threat to the sea. As of today 33 small and big wastewater treatment plants, some with adequate sewage collection systems, operate with different capacities. The primary treatment plants of the Istanbul Metropolitan Municipality (IMM) discharge their partially treated effluents to the marine environment, 1200 m far from the coast [6]. Kadıköy and Yenikapı outfalls are the major contributors of pollution in the Sea of Marmara. The amount of the daily wastewater treatment has increased up to 90% level. For biological treatment and sludge management the existing plants are needed to be extended, so they use larger coastal areas, and must be improved by advanced treatment units.

2.3. Bordering seas, Bosphorus Strait and hydrodynamic conditions

The Black Sea is a dynamic and nutrient-rich ecosystem with a positive freshwater balance. Therefore it is higher than that of the Sea of Marmara Sea by a few ten cm. The Sea of Marmara is a small sea in active exchange with neighboring seas through the Bosphorus Strait in the north and through the Dardanelles Strait in the west. This inland sea is permanently stratified with two distinct water layers with different characteristics. The upper layer reflects the typical properties of the Black Sea whilst the lower layer below 20-to-30 m water depth shows the Mediterranean characteristics. The IMM discharges waste water into the low dissolved-oxygen lower layer which may be effective on benthic communities.

The Bosphorus Strait is a narrow channel and strongly stratified. Its upper layer carries the low salinity outflow from the Black Sea and the highly-saline bottom layer flow from the Mediterranean into the Black Sea. Naturally these two layers mix along the strait and especially at the junction zone between the Bosphorus Strait and the Sea of Marmara. This means that an important part of the lower later flows back to the Sea of Marmara before entering into the Black Sea. This fact is a very important point for the coastal management authorities in their evaluation of appropriate treatment plants instead of present out-of-date deep sea outfalls for wastewater discharges.

In addition to the distinct oceanographic conditions, the southern termination of the Bosphorus Strait extending in the northern shelf of the Sea of Marmara is exposed to relatively rapid interaction of many dominant processes. The most important and critical ones are the intricate sea floor morphology, variable climatic and hydrodynamical features, terrestrial and other sediment input sources and their transportation in the water column and at the sea bottom. The jet-like Bosphorus flow is effective above the lower (Mediterranean) water mass at the southern exit of the Bosphorus Strait, and this outflow interestingly controls the basin-scale anticyclonic gyre in the eastern Sea of Marmara [7]. The deep currents may also be important especially along the slopes of the natural channel of the Bosphorus strait, and therefore they could be definitive on the net sediment transport [8]. The seabed exhibits heterogeneous textural distribution depending on different depositional environments and hydrodynamic processes that control sedimentation [9]. The coastal sediment supply (off-shore transport) is dominant while off-shore sediment transport may be important along the shoreline as sediment is entrained by longshore currents. The longshore drift in the region is most evident in fall and winter, when southerly energy flux is created by wind waves generated by strong sea breezes. Therefore the wind waves also drive the sediment transport, especially

along the coastal spit of the Küçükçekmece lagoon where the Bosphorus-jet is not effective. The swell waves are also important, especially for the Black Sea coast.

2.4. Coastal and marine pollution

There are different types of contaminants that may be effective in marine environment and destroy coastal habitats; inorganic, organic, radioactive and biological. These contaminants also contribute to the loss of the marine fauna on which many people rely for food and income. Marine pollution stems from multiple sources; mostly via the short streams flowing into the Sea of Marmara, the Golden Horn estuary and from the Black Sea via the Bosphorus Strait. In addition to coastal and marine pollution, the lagoons and other small lakes suffer from water and sediment contamination.

The near shore areas of the Istanbul metropolitan region face some challenges because of various pollutants. Marine sediments along the southern coasts retain substantial concentration of heavy metals (Pb, Cr, Cu, Zn and Cd) as a result of waste disposal activities and discharge practices via streams [10]. Sediment transportation models indicated terrestrial inputs in front of the short streams and via the Bosphorus Strait under the control of secondary currents driven by the Bosphorus-jet, and depending on a nearshore sand ridges. The metal concentrations in front of some streams were found that could likely affect marine biota [10]. Nutrient input [11] and petroleum hydrocarbons [12] from the Black Sea are also important. The higher total organic carbon values (>2%) distributed along the southern coastal areas (<20 m deep) indicated terrestrial organic inputs via streams [9]. Therefore controlling of pollution from the land-based sources must be the one of the most important regional activities. The rehabilitation studies in the Golden Horn, for example, improved the biological life in this heavily polluted estuary after the industrialization in 1950s [13].

2.5. Degradation of coastal ecosystems

Population growth and the associated activities degrade coastal and marine ecosystems. Being detrimental to coast or beach replenishment, the coastal constructions need comprehensive approaches to planning, siting, designing, constructing, and maintaining coastal infrastructures. In that sense hazard identification, siting decisions, regulatory requirements, economic implications, and risk management becomes important. Urban transformation and regeneration projects are realized by a government supported organization, called Mass-Housing Authority (TOKI) and by other private companies.

The coastal region of Istanbul has experienced significant coastline changes over the last three decades [14]. Almost 3/8 part of the 160-km-long southern coasts has been filled and 3 km^2 land has been gained (1.2, 0.52 and 0.22 million km^2 at Maltepe, Yenikapı and Tuzla, respectively).

Annually more than 56,000 vessels cross the Bosphorus Strait. According to the 1936 Montreux Convention, Turkey guarantees the free passage of civilian vessels through the Bosphorus Strait in peacetime. A total of 150 million tons of crude oil are carried by 10,000 tankers passing through this narrow and dangerous sea passage. In order to prevent the marine traffic and probable marine pollution due to growing pressure, an artificial sea-level waterway (50 km long, 150 m wide at surface, and 25 m deep) is planned to be constructed in ten years which will bypass the Bosphorus Strait by dissecting the western (Çatalca) peninsula of Istanbul. The construction budget of the project was announced $10 billion at first glance. Various objections come from the economists, politicians, environmental activists and scientists basically on the feasibility and its environmental and ecological damage. Evidently this project will rapidly increase the population which is the most significant reason for environmental decline. It is further argued that, in a decadal timescale after the fresh Black Sea water enters the Sea of Marmara through a new channel, the Sea of Marmara will gradually reach a state of anoxia, which is the end of life in this inland sea [15].

2.6. Hazards and disasters

The region is subject to a range of natural disaster that include strong earthquakes, moderate tsunamis, and occasional riverine flooding and storm surges. Disastrous earthquakes have occurred along the North Anatolian Fault (NAF) cutting through the Sea of Marmara, and regularly devastate the cities along its coasts. The vulnerability and lack of awareness and preparedness of the mega city of Istanbul and all of the Sea of Marmara basin for natural disasters has been demonstrated dramatically by historical and recent earthquakes. More than 30,000 people died during the 1999 Kocaeli earthquake and the damage was estimated at up to $6.5 billion. A seismically dead zone on the NAF, believed not to be a creeper, is located just south of Istanbul. The predictions depending on various stress models range from 35 to 70 percent for the chances of a magnitude +7 earthquake by 2035. The damage was estimated at up to $50 billion, only $11 billion for the total building (structural) damage

[16]. The high-risk regions were mainly concentrated in less-developed regions. The vulnerability is made worse by poor housing conditions. In addition, west side of the Istanbul metropolitan area is prone to some geohazards such as earthquake-induced liquefaction and landslides [17]. An updated seismic hazard model of the region will be imperative.

Tsunamis are unpredictable events and increasing the uncertainty of preventive action. Therefore possible effects of future tsunamis should be assessed in coastal management. The tsunami waves may be destructive at shallow areas (<20 m). The extensive damage to property may be expected if the tsunami amplitude exceeds 2m, especially at harbors or in small semi enclosed basins [1]. The loss of life may also be expected in addition to general loss of property, if the run-up exceeds 2.5 m [18]. On the basis of first generation tsunami inundation maps which consider the probable run-up elevations at the coast as between 2 and 3 m, the inland distance of inundation was apparently greater at some particular areas, such as Çekmece lagoons, Ayamama, Bakırköy, and Zeytinburnu [19]. The tsunami inundation distance have been calculated 200 m inland at Yenikapı where the sea was filled [20]. As these areas are flat coastal plains, the effect of tsunami can be minimized by planting tree belts between shorelines and areas needing protection. The roads along the coast can be designed to allow drivers escape from the tsunamis as fast as they can. In addition, if the tsunami amplitude is more than 2m, the damage of strong sea currents will be extensive to the coastal properties and to the small harbors and marinas [19]. This problems may be solved by constructing breakwaters at harbors entrances and avoiding potential areas for settlement. New updated numerical tsunami models, which estimates that the storms surges simultaneous with tsunami could change the run-up elevation by 1-1.5 m, and then produce updated coastal inundation maps will be logical.

Global climate change and increased sea-level rise is expected to increase extreme weather events, storm surges, flooding events (e.g. Sep. 2009), and coastal erosion. Such kind of disasters cause damage to homes and infrastructure, and endangers critical habitat. In this context, there is always a risk of damage to coastal structures, filling areas, coastal roads, sewer and water systems, port facilities and other infrastructure due to rising sea levels, higher storm surges and more intense southerly storms.

Preparedness studies in Istanbul against frequently repeated disaster events are conducted by the government and IMM. If it is considered that over 4 million students are enrolled in the Istanbul schools, which range from kindergartens to universities, their attempts to address disasters at various levels must be more efficient than ever.

3. SOCIO-ECONOMIC CONTEXT

Because most of the coastal regions, especially those in developing countries, are undergoing environmental decline, the management of coastal resources often needs making hard decisions, especially when there are competing demands. However in most of the cases this is not a simple problem to be solved easily. This is the reason why policymakers and coastal resource managers use economic methods and try to figure out how to get economic benefits of coastal resources while preserving them for next generations. So those authorities can make better-informed decisions about managing the resources only if they apply economics to coastal resource management.

Although economic, social and environmental variables can change; the general benefits of ICZM in terms of socio-economic context are more coherent spatial planning, improved and ethical decision making, achieved agreement on priorities, stronger community feeling, reduced traffic costs, better quality of life, reduction in pollution, and more sustainable tourism, etc. in general [21].

Besides these, one of the most efficient methods is to describe different ways of assigning value to resources in terms of management. An accurate valuation will better illuminate the linkage between regional economic development and conservation of the environment. Then policymakers and coastal resource managers must compare and assess different management alternatives. It's important to see some essential elements of socio-economic aspects.

3.1. Excessive population growth and consumption

Even there are various complex reasons for environmental decline, in our case, the population is the most significant factor. When the new acts came into force in 1982 in order to encourage and increase tourism revenue, this caused the coastal regions to receive most of the investment capital. Istanbul's populations' shares in the Turkey population have been increased year by year despite its surface area. As this mega city has 1/3 share of economic values of the country, Istanbul's population increases by migrations while its own native and natural population growth decreases [22]. Today, approximately 14.4 million people – it is about 1/5 of the Turkey's population - live in the global city of Istanbul [23]. Within the next 30 years, this figure is likely to double.

Therefore the most of the related projects in the Istanbul region are based on a consumption-led approach, with the goal of economic and property development, but ignoring of the impacts on surrounding areas and the people who live in those areas [24]. Due to nonsufficient potable water resources, Istanbul Water and Sewerage Administration (ISKI) diverted the waters from the streams in neighbor cities, causing irrevocable impacts there.

Furthermore, being one of the most important tourism spots in the world, the city attracted about 12 million foreign tourists in 2014. The income generated from Istanbul's tourism is more than $10 billion. The tourism sector of Turkey targets 60 million tourist arrivals and revenues of $80 billion by 2023. The Turkish government spends at least a sum of $33 billion to build the world's largest airport, covering 7,659 hectares construction zone near Lake Terkos, Istanbul's oldest potable water resource. The old open-pit coal mines in this coastal zone, filled with water at present, will be filled up with soil instead of making a national park for citizens. The reduction in these natural ecosystems will cause significant impact on the coastal ecosystem. Starting from 2017 this airport will able to handle 150 million passengers annually. All these factors show that addressing population issues must be the key in achieving the balance between the economic benefits – e.g. urban development, revenue from tourism and transportation links - and the environmental degradation that influences people's lives.

3.2. Economic parameters

Turkey is a bridge between both East-West and North-South axes, thus creating an efficient and cost-effective outlet to major markets. Turkish direct taxation system consists of two main taxes; income tax (15-40%) and corporate tax. The corporate tax, an important source of income for the government, is collected from companies resident in Turkey, and its rate stands at 20%. The sectors which contribute most to the corporate tax income are the construction works, building material, civil engineering and public works (21%), fuel work (5%) and banks (3%). Its economic growth is stable with an average annual real GDP growth rate of 4.7 percent between 2002 and 2014 [23]. With incentives for strategic investments, large-scale investments and regional investments, foreign direct investment in Turkey averaged $13 billion, changing between $22 billion and $2 billion for the last decade [25].

The strategic importance of the economic capital and the pivotal role of IMM in the national economy is very high; it accounts for approximately 22% of Turkey's GDP ($823 billion, 2014) and 54% of Turkey's exports ($14 billion, 2014). Meanwhile, on the other hand, the figures reflect IMM's high and fast growing debt burden [23]. IMM's budget has expanded significantly over the last decade. IMM accounts for approximately 18.5% (14.5 million, 2014) of the nation's population (77.7 million, 2014) and the rate of the tax collected from the city of Istanbul is about %44 of the grand total for Turkey (over $171 billion), while the IMM's budget is about $7 billion.

3.3. Maritime transportation

Travel by crossing the Bosphorus Strait is a quick and calm way for the working population in terms of visual impact and tranquility, especially during the rush hours. This improves work productivity as well. During the last decade the number of peoples who prefers sea transportation increased from 230,000 (2004) to 553,000 (2014), even the new undersea rail transportation system (Marmaray) is an alternative transportation way anymore. Although the share of marine transportation in total public transportation is about 4.4% (2014), the share of the seaway transportation between the coastal residential towns at the European and Asian sides and along the Bosphorus Strait is as high as 20% [26].

3.4. Gentrification and social policy

In socio-economic point of view, urban transformation (gentrification) is one of the most important socio-economic aspects of ICZM in Bosphorus. Gentrification costs may cause difficulties of indigents' access to the coastal zones in terms of ownership and housing. This means move away from the coastal zones for the population with low socio-economic status. Thus, distribution of income may shape the socio-economic map of coastal zones structurally. Policymakers ought to struggle fair distribution of coastal zones' socio-economic benefits for a fair social policy, especially for socially disadvantaged groups.

3.5. Coastal zone plans and municipality unions

In 2014, the Turkish government issued a new regulation for preparing spatial plans. These are the plans prepared with a strategic approach for coastal areas and guide the zoning plans, in which the procedures of the ICZM plans have been described in detail and the hierarchy among plans and organization levels has been defined in order to

eliminate the conflict in the planning system. In addition to national level, provincial administrations and metropolitan municipalities prepare their sectoral spatial plans along the coastal zones.

According to the Article 18 of Municipal Law No 5393, the IMM is a member of the "Union of Municipalities of the Marmara Region", which has been founded by the municipalities lined along the coasts of Sea of Marmara, Bosphorus and Dardanelles [27], and the "Union of Municipalities of the Bosphorus". Under the Montreux Convention of 1936 the Bosphorus Strait serves as an international seaway of economic and strategic importance. Sailing along the Bosphorus Strait needs more than 10 major course alterations and therefore needs utmost vigilance for a safe navigation. The Strait faced more than 210 collisions and 140 groundings since 1950.

Union of Municipalities of the Bosphorus has been founded in 2002. The founders of the Union of Municipalities of the Bosphorus are; IMM, Beyoğlu Municipality, Beşiktaş Municipality, Sarıyer Municipality, Beykoz Municipality, and Üsküdar Municipality. Municipalities of the Bosphorus has taken over some critical projects (city planning, housing, municipal-social-cultural-economic initiatives, education and research services on city planning and municipal work for members) and action plans for reducing environmental (air, water, soil, and sea) pollution. Municipalities of the Bosphorus also aims to cooperate with universities, public institutions and civil institution to protect historical and natural environment, water supplies, and forests, construct new green fields and residential areas, taken action against disasters and dangers caused by vessel traffic, support socio-economic and cultural development, and promote the Bosphorus to the whole world [28].

Both of these unions are important to distribute the environmental costs more fairly to the member municipalities, and gain ability to behave coordinately and gregariously. In order to reinforce the existing regulations of ever increasing shipping traffic along the Bosphorus Strait and its approaches, Turkish Republic installed a Vessel Traffic Management and Information System with 7 radar stations in 2003.

4. CONLUSIONS

Knowledge is the most important aspect to achieve better results in ICZM. Unless government and public organizations take a wide-ranging perspective, attempts to manage coastal zones sustainably will fail and the environmental decline will in turn exacerbate the issues. To take effective national and even global actions, some regional policies related with the sustainable management of coastal areas, e.g. environmental, economic, social and cultural, should be recognized and considered by the users of coastal resources.

The extremely valuable and extensive ecosystems along the coastal-marine regions of the global city of Istanbul, including the Bosphorus Strait, provide numerous tangible and intangible benefits to the public. For a sustainable development and management of coastal areas, continuous spatial spectra of the coastal-marine regions should be taken by multidisciplinary approaches. On the basis of previous studies and the available data collected by various government agencies and academic institutions, the most important factors that should be considered in the coastal-marine spectra of the Istanbul region are typical geomorphic conditions and geological hazards, mostly strong earthquakes and co-seismic tsunamis. Other natural hazards include occasional riverine flooding and storm surges, with increased intensity and decreased return periods due to climate change. Informative data on the regional and temporal multi-scale interactions between hydrographic, oceanographic, bathymetric and biogeochemical features are needed for an effective coastal management, combining all of the environmental, ecological and social problems in the region.

Although most benefits can be valued in monetary terms, coastal resources are finite in physical and spatial terms. Therefore their management often needs making hard decisions using economic methods, but not ignoring to prevent ecological damages which are usually irreversible in long-term. The side effects of inevitable short-term decisions must be minimized to prevent permanent damage to the resources. Scenario analyses and individual case studies will help in reflecting real-life situations, defining regional policies and then taking effective national actions to meet national targets of sustainability.

ACKNOWLEDGMENT

The authors gratefully acknowledge the financial support of the Scientific and Technological Research Council of Turkey-TUBITAK (project 111Y216).

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BIOGRAPHY

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ICOEST 1st INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND TECHNOLOGY
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9 - 13th September 2015

Data Loggıng Card Desıgn to Control Energy Flow in Hybrıd Energy Generatıon System With Using Proteus, Arduıno and Labvıew Program

Tolga Özer[1], Yüksel Oğuz[2], Hasan Çimen[3]

Abstract

As we know energy is the main problem should be resolved in the coming years.So lots of work havebeen about this field. And these works include data which have to be taken from energy sources. Every project host DAQ (Data Acquisition System) inside of its.

In this work a kind of DAQ system is designed. This DAQ system is aimed to use a renewable hybrid power generation system and will be used to take this hybrid power generation data. The aim of taking these data is made the control the energy flow of hybrid system. Every design steps are explained and introduced which kind of components is used. Used programs are introduced and separately each of processing steps ofprograms and software logic are given.

Keywords: Renewable Energy, Energy Flow Control, Arduino, Labview.

1. INTRODUCTION

From past to present one of the biggest problems of the world is an energy.Energy demand is increasing day by day. Also pollution problem is the important problem of our times with energy problem. To overcome of the these problems alternative renewable energy sources must be considered and have to combined different kinds of energy sources .This kinds of systems are named as ahybrid sources. Hybrid energy sources aims to increase the system efficiency and provide the energy to users without interruption.Our hybrid system is composed of solar panels, fuel cells and batteries. There are three kinds of solar panel which are monocrystalline, polycrystalline and black thin film solar panel. This kinds of hybrid systems have to be controlled for handle the more efficiency from the each of energy sources. So this control process is done with a few numerical values which are taken from sensors. So these programs which I used for data logging process will be introduced.

Proteus is an electrical circuit program which is allow to simulate electrical systems [1]. It includes ISIS and ARES. In the ISIS environment, electronic circuit can be stimulated in detail. Also near of the system design simulation this program is gave an opportunity for handling electrical system PCB (Printed Circuit Board) design

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and it is named as ARES. Lots of electrical components are can be find in this program with theirs package. This program can be used for educational or commercial aims [2].

Arduino is an open-source electronics prototyping platform which offers facilities to makes the applicationseasily. It's a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking analog inputs value from switches or sensors, and controlling physical outputs [3]. The Arduino Mega 2560 board is programmed using the Arduino programming language and the Arduino development environment. Arduino can be used for different kinds of projects as a stand-alone or this controller card and programming environment allows communicating with software running on a computer. Arduino has some advantages for educational, inexpensive when we compare to other systems, open source and extensible software and hardware [4].

LabVIEW (short for Laboratory Virtual Instrument Engineering Workbench) is a system-design development environment platform which is allow to visual programming. LabVIEW provides to collect and save data because of this feature this program can be used as a data acquisition program [5]. Analog and digital data can be acquired flexibly with this program. It is made the programming easier through the visual and object based commands. Labview provides Arduino microcontroller interface environment which is named as LIFA (LabVIEW Interface for Arduino).This addition is make easier data acquisition or control process. Visual and graphical features are providing an advantage for viewing of the acquired data.

Arduino and Labview can be used together different kinds of project. Usually Arduino is used for taking analog data and processing these data and give to the digital outputs according to software which is programmed by user. Taken these data are saved and monitored by means of Labview. When we looked to literature there can be seen Arduino and Labview studies. In [6] developed solar tracking system for obtain the maximum efficiency using Arduino Uno and LabVIEW for real time monitoring. [7] controlled the home automation system remotely with using Arduino. Wireless (Zigbee) technology was used for home automation purposes. [8] used various sensors like infrared sensor, light dependent resistors (LDR), analog potentiometer are used and data was gathered using Arduino microcontroller. DC motor was controlled simultaneously using Pulse Width Modulation. [9] presented innovative laboratory methodology for simulation of microcontroller based virtual kits. Simulation platform by Proteus, LabVIEW, MATLAB and Arduino on a computer easily built all kinds of experiment models. [10] designed and implemented a system which can be able to monitor the school timetable's time slots by controlling the school bell. Arduino microcontroller and Zigbee wireless module was used for control the school bell. LIFA was used for acquiring the data to Labview. [11] presented the practical study of converting manually operated impulse generator to automatic generator.Arduino Board which coded such that the operator has to insert desired impulse voltage through the computer and the rest of the process will be done by the system itself. LabView Simulation tool used for coding purpose using with LIFA.

In this paper, hybrid energy generation system sensor cards are designed with Proteus program. Cards prepared for taking voltage and current data from hybrid energy generation system. Arduino program is used for taking data and programmed as a brain of data logged system. The data calculated process is done with Arduino program. Labview program is used for monitorize data on the screen and saving them in a document. These data logging process is explained step by step in this paper. Differently from other studies LIFA is not used in this study. Labview is used for as normally other kinds of microcontroller projects. Serial communication steps are programmedcompletely in the side of Labview.

2. HYBRID SYSTEM OVERVIEW

Hybrid energy generation system composed of three groups power sources. Each of group is consist of solar panel, battery, dc load and fuel cell. Three kinds of solar panel used for system. They are respectively monocrystalline, polycrystalline and black thin film solar panel. These solar panels output voltages, efficiencies are different to each other's. Each of hybrid power system groups has 12 Volt, 85 Ah gel batteries and 12 Volt, 20 Watt DC load. All of solar panels powers are 100 Watt. Fuel cell kind is a PEM (Proton Exchange Membrane) type and system feature is 24 Volt, 500 Watt.

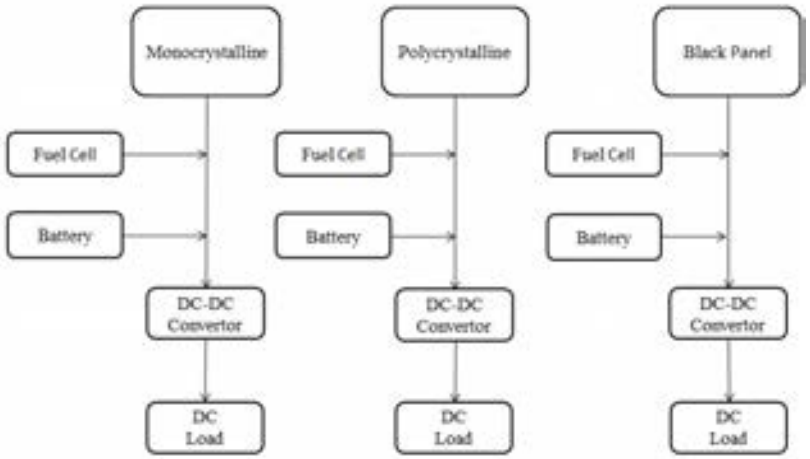

Figure 1. Hybrid Energy Generation System Block Schema

3. DATA ACQUISITION SYSTEM FOR ENERGY FLOW CONTROL

The schematic of the data acquisition system is presented in Figure 2. Considering small scale applications where accuracy and high speed is not so important, industrial scale DAQ's with high price tag is not necessary. But instead a low cost micro controller like Arduino Mega 2560 is enough to meet the requirement. In this section is composed of card design steps, Arduino and Labview programs software explanations.

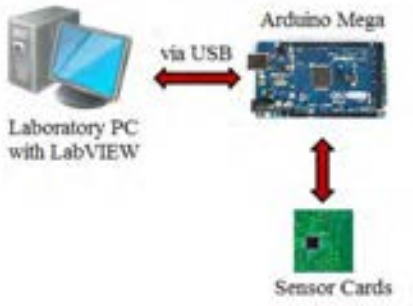

Figure 2. Arduino and Labview Data Acquisition System

3.1. Card Design

In this step electronic circuit cards were designed as a sensor cards. There are three sensor cards and each of card belongs to respectively monocrystalline, polycrystalline and black thin film solar panel hybrid power system groups. Two kinds of sensor were used to sensor cards. They were voltage and current sensors. Voltage sensors were created by voltage divider circuit as shown Figure-3 [12]. Voltage divider is a linear circuit which divides input voltage into an output voltage with a specific ratio. As a current sensor ACS-712 was used for measuring the current.Current sensor working principle is based on Hall Effect event. From -30 A to +30 A current values can be measured with this sensor. Proteus program was used forthese sensor cards design and circuit components placement. Current sensor package was modelled in the Proteus. These cards main purpose is taking the current and voltage measurement values from the sources of hybrid systems by means of Arduino card. There are 16 analog inputs with three sensor cards. There can be seen at Table-1 all sensor cards outputs which are used for what kind of measurement. Sensor Card-1 has six analog inputs as seen at the Table-1. Each one of cards Sensor Card-2 and Sensor Card-3 have five analog inputs. Sensor Card1 Proteus ISIS view is shown in Figure 4. And designed sensor cards can be seen at Figure 5.

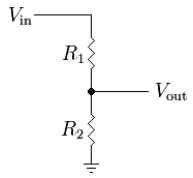

Figure 3. Voltage divider circuit

$$V_{out} = \frac{R_2}{R_1+R_2} V_{in} \quad (1)$$

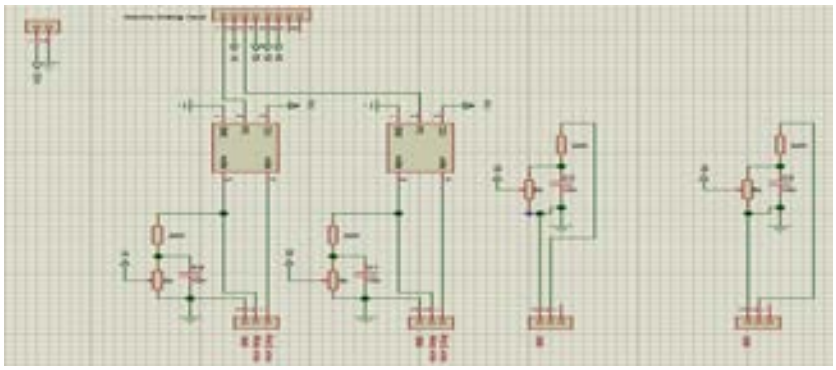

Figure 4. Sensor Card-1 Proteus ISIS Design

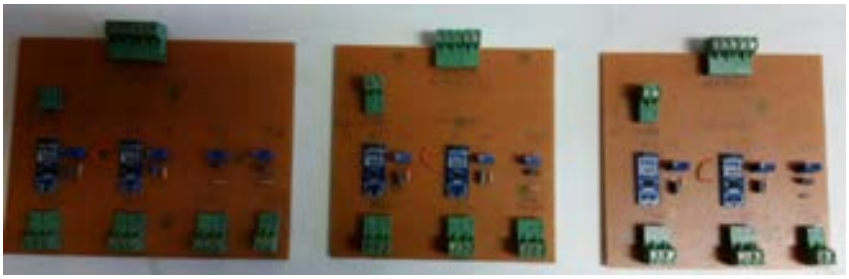

Figure 5. Designed Sensor Cards

Table 1. Output Kinds of Sensor Cards

Sensor Card-1 (Monocrystalline)	Sensor Card-2 (Polycrystalline)	Sensor Card-3 (Black thin film)
Solar Panel Current	Solar Panel Current	Solar Panel Current
Solar Panel Voltage	Solar Panel Voltage	Solar Panel Voltage
DC Load Current	DC Load Current	DC Load Current
DC Load Voltage	DC Load Voltage	DC Load Voltage
Fuel Cell Voltage	Battery Voltage	Battery Voltage
Battery Voltage		

3.2. Arduino Microcontroller and Software

Arduino Mega 2560 microcontroller card is used in measuring system. Resolution of the Arduino Mega is 10 bit. It serves to from 0 to 1024 ADC number. If 5 Volt is applied to analog inputs 1024 ADC number value is obtained. Arduino Mega has 16 analog inputs and 54 digital outputs. It can be supplied with USB connection cable or external power source. For the data communication USB connection is used. But Arduino Mega microcontroller card is based of RS-232 communication. RS-232 communication is converted to USB on the Arduino Mega card.

In Arduino software 16 analog inputs variables are defined and taken. ADC sensor values determined to taken average of fifty sensor input values. ADC sensor values converted real voltage or current value. All sensor card outputs calibrated particularly. Coefficient of analog ADC values determined separately for taking more accurate results. These data are sent as a string type from the Arduino card [13]. This process gets advantage to microcontroller for decreasing runtime and it can be affected Arduino speed. Arduino software logic steps can be seen at Figure 6..

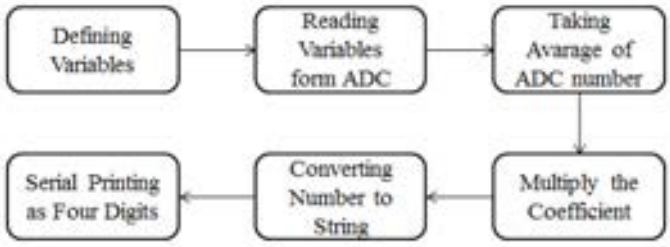

Figure 6. Arduino Software Programming Logic

3.3. Labview Software

The Labview software was composed of two main program block. The first block is related with taking serial data from the Arduino and second block includes the recording operation of the received data. Received data is taken string data type from the Arduino card and this string type data is converted as anumeric data type.These data are saved as a txt. file extension with data's date and clock. In Figure-7 data saving and string to numeric data converting process block schema can be seen. Figure-8 is shown that Labview software processing flow.

Figure 7. Labview Data Saving Block

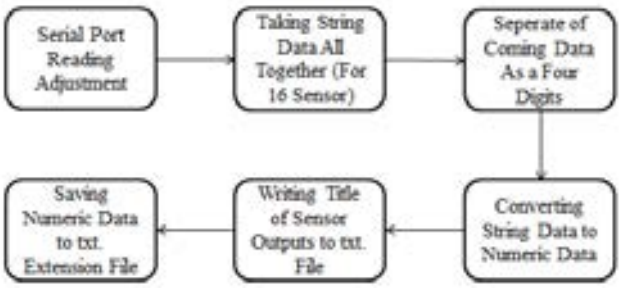

Figure 8. Labview Software Processing Flow

4. WORKING PRINCIPLE OF DATA ACQUISITION SYSTEM

Voltage and current sensors are used to sensing the real voltage and current values. Voltage sensor decreases the input voltage applicable level to Arduino analog inputs. The maximum voltage value of Arduino analog input has to be 5 V. If applied voltage is 5V then ADC section gives 1024 ADC number in theoretical. In practice this value can be different. So each sensor outputs have to be controlled in calibration stage. Taken 5 V from the voltage outputs sensor cards is mean 60 V. There is a coefficient number and it was chosen 12. Maximum voltage level is determined as 60 V according to black solar panel maximum output voltage value from the from the product catalog. The coming signal voltage is detected with this method.

Current sensor is ACS-712 can sense current from -30A to +30A.Sensor has to supply with 5 V. At 0 A sensor output gives 2.5 V. If current increases towards to positive direction, output voltage decreases from 2.5 V to 0.5 V or if this event occurs opposite then sensor's output voltage is decrease from 0 V to -2.5 V value. While 30 A current is passing through the current sensor, sensor output voltage decrease to 0.5 V. At -30 A this voltage value will be done 4.5 V. Change of maximum and minimum voltage value can stem from the inlet side of the load or solar panels cable. Also if the cable connection of current sensor inlet changes at the 30 A sensor output voltage can be measured 4.5 V.

The cables from the power sources are entered to the sensor cards.And voltage and current values senses by means of these cards. And sensor cards outputs are transferred to Arduino card analog inputs separately. These voltage values are interpreted with Arduino software and real measured values are sent to Labview with serial communication. Data are taken with USB cable. All sensors outputs values are sent only one byte size as a string data type. These taken data are converted to numerical data in Labview software. And each of data is saved to txt. extension file with their received time and date. Herewith data acquisition system can be created.

5. EXPERIMENTAL RESULTS AND DISCUSSION

There are three kinds of solar panels which are monocrystalline, polycrystalline and black thin used for hybrid energy generation system. Data was taken Afyonkarahisar city of Turkey between the 1 May 2014 and 30 April 2015. According to taken data from hybrid energy generation system total generated energy and the energy generated by each solar panel is calculated. Power value was changed according to months. The main reason of this changingsunshine duration and intensity of radiation varies throughout the year. Also power is changed right proportion with sunshine duration and intensity of radiation. These results are demonstrated as a graphical form.

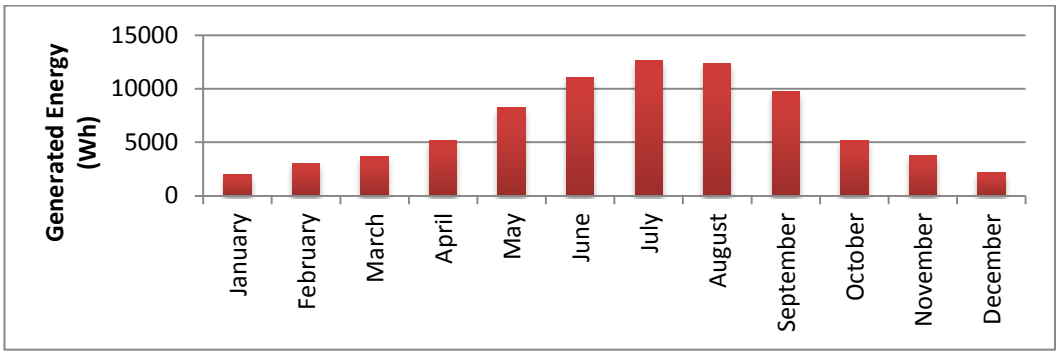

Figure 9. Black Thin Solar Panel Monthly Generated Energy

Generated energy is given monthly at Figure 9 by black thin solar panel. Maximum energy generation was obtained on July as nearly 12500 Watt-hour (Wh). Also minimum energy generation was achieved on January month as nearly 2000 Wh.

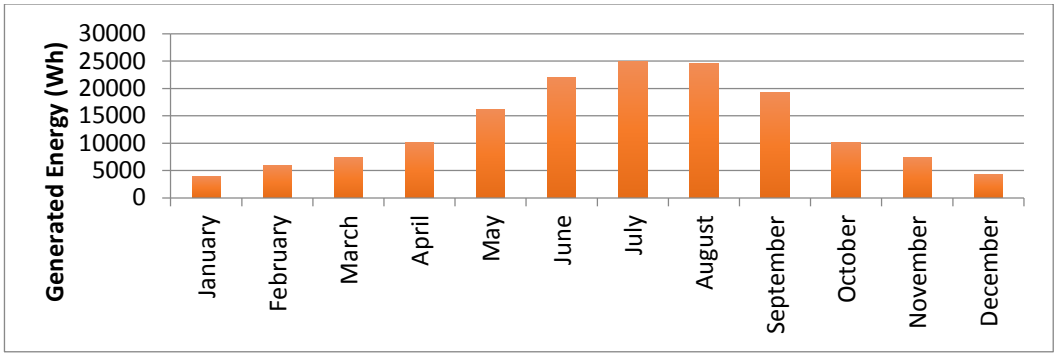

Figure 10. Monocrystalline Solar Panel Monthly Generated Energy

Generated energy is given monthly at Figure 10 by monocrystalline solar panel. Maximum energy generation was obtained on July as nearly 25000 Wh. Also minimum energy generation was achieved on January month as nearly 4000 Wh.

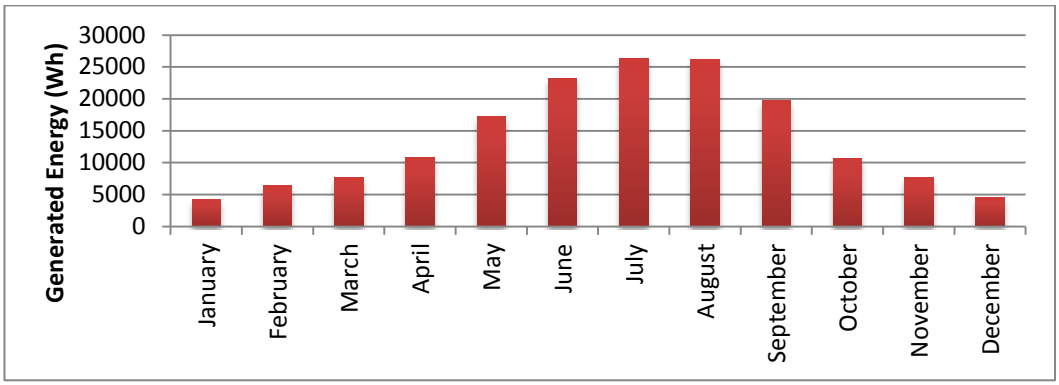

Figure 11. Polycrystalline Solar Panel Monthly Generated Energy

Generated energy is given monthly at Figure 11 by polycrystalline solar panel. Maximum energy generation was obtained on July as nearly 26000 Wh. Also minimum energy generation was achieved on January month as nearly 4200 Wh.

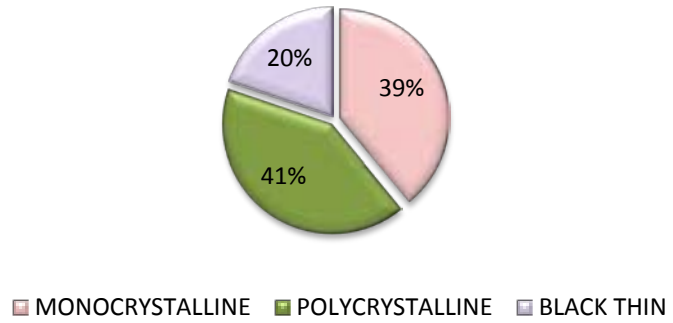

Figure 12. Share of Each Solar Panel on Total Generated Energy

Total energy generation was obtained nearly 396000 Wh. The share of the total energy produced each of solar panel is given at Figure 12. Monocrystalline solar panel was generated 39 percent of total energy, polycrystalline solar panel 41 percent of total energy and black thin solar panel was generated 20 percent of total energy generation.

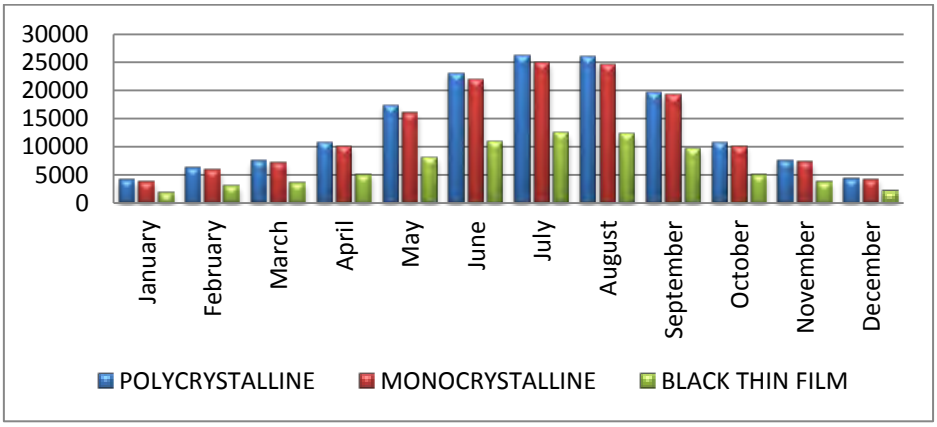

Figure 13. Solar Panels Comparison of Energy Production

Three kinds of solar panel monthly generated energy comparison is demonstrated at Figure 13. As seen the Figure 13 the most energy production is obtained by polycrystalline solar panel.

5. CONCLUSION

The energy produced from the solar panel is associated with mainly sunshine duration, intensity of radiation and efficiency of panels. According the results it has seen that generated energy varies month to month because of changing sunshine duration and intensity of radiation. In summer months for the three solar panels generated energy values reached maximum level. Normally when efficiency values are comparing between three solar panels monocrystalline solar panel has highest efficiency. So maximum energy generation is expected to be by monocrystalline solar panel. But according to data polycrystalline solar panel has maximum energy generation. At total generated energy polycrystalline panel have produced two percent more energy according to monocrystalline. Black thin solar panel which has lowest efficiency value was generated lowest energy.

ACKNOWLEDGMENT

This work is supported by Afyon Kocatepe University Scientific Research Project under 13.Teknoloji.02.

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Planners / Designers' Choice and Reflections on Project in Landscape Planning and Design

Ahmet Ergün[1], Nurhan Koçan[2]

Abstract

Recent years the relationship between the nature and human has become disappearing. Because people are forced to live in urban areas which are concrete and metal stack in todays. So city people have demanded to return the areas belonging to them from time to time where resembling the natural environment. In this regard urban parks are important for the city and the city people. This study focuses on the preferred qualities of area in terms of both environmental affordances and design characteristics. The study was conducted in the Bartın City. The study area planned and designed in different views of the planners/designers. After studies three projects prepared in different concepts were selected for example. The research instrument was a set of landscape plan and design projects including survey, spot, master, vegetable, construction, sketch and perspective elements. The study covers the importance of planners/designers' preference in landscape plan and design studios. The project phases involved setting thematic strategic objectives, conceptualizing spatial development scenario along with action plans and delivering model proposals. In compliance with protection and management of natural and cultural landscapes, the project introduces natural and cultural asset-based approach to form local sustainable development framework. Each development idea has been tested with others and the sustainability of natural-cultural landscapes, and subsequently spatial interaction analysis scrutinized. In conclusion, this paper outlined the area development strategy project alongside the author's point of view with a focus on concepts. Finally, the results were used to create a set of useful recommendations to help urban people and designers create more livable spaces in urban areas.

Key words: Urban open areas, urban parks, landscape planning, landscape design, recreation.

1. INTRODUCTION

Cities show continuous improvement in social and cultural facilities and services. However, the process of urbanization on the one hand provides better living conditions for people on the other hand breaks contact with nature [1]. While daily contact with nature is essential in large cities, such opportunities are often limited, thus reducing chances for psychological restoration. Such a space the provision of more livable urban environments depends on the presence of natural elements.

Planners and designers primary goal for human existence and society is to consider the most consistent and most productive forms of the natural environment. The protection of an optimal combination of ecological and aesthetic use of land, to provide ecological and landscape diversity optimal is for the structural and visual diversity and changes requirements in planning and design [9].

The subject and site selection, determining the choice, defining the concept, the interpretation of the project, to produce solutions for the problems, the establishment of cause-effect relationships, the evaluation of the project's past and future axes as a holistic, make up healthy insight and etc. (several stages forming the project process) is developed depending on the planners/ designers' critical and analytical thinking in landscaping projects.

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Planners and designers have a set of skills and attitude that required in the creation and application phases of the project. Thus; expectations of individuals who requesting the project and will experience the result of the project are defined correctly and alternative perspectives on the results of the project are developed. In addition, consistency of alternative about the area is evaluated healthy, is treated conscious and scientifically and healthy vision is made.

The works were done within the awareness for perception of the place and using this place with correct choice and every decision and the line has an answer corresponding to the planner's/designer's mind. This is may be called to ask right questions to think right and to find the right answers. Thus, by developing alternative assumptions and theories is reaching practical consequences in the landscape project. Effective and harmonious cooperation with experts and other people able to identified / established in the analysis of complex problems.

Furthermore, landscape architecture needs to move toward an evidence-based profession in terms of social and cultural components of design in making decisions about the use and shaping of the land. Drawing on previous experience, preference judgments are based on perceptions and are linked to basic concerns and needs. As a key element of preference, perception is defined as the process of achieving awareness and comprehending sensory information [2], in corporation both the content of a scene and a very quick unconscious assessment of what it is possible to do in the setting [6].

According to Gibson's affordance theory pleasure and beauty can be considered as environmental affordances [5] because they reflect an assessment of the environment in terms of its compatibility with human needs and purposes, which affects effective human functioning in the settings [6]. We can explore the environmental affordances and attributes through preference research to learn about those that are more important and meaningful to people.

The few preference studies have focused on environmental affordances of urban settings as the predictor of preference. It should be acknowledged that the role of concept as a critical aspect of landscape preferences emerged during the process of data analysis thus leading to organizing the presentation of the results in terms of both natural and cultural attributes [4];[7].

Although it is easy for planner and designer in preference studies on outdoor spaces to make judgments actually concept helps to explain their choices in terms of the reasons behind their judgments the nature and culture. The preference and categorization of the concept provides the basis for examining the interconnections between land and requirements.

2. MATERIAL AND METHOD

The study area is located in the city center of Bartın. Bartın Municipal 1/1000 zoning plan is used as the base of the plan. The present situation was analyzed with survey works. In this context, survey plan, stains plan, preliminary and final design works were carried out in the planning and design studios. Hand drawing techniques were applied in drawing the project. Projects have been developed considering the balance between protection and use of natural and cultural values. Produced project has been selected from three different project proposals for evaluation.

The project is basically divided into some phases as follows:

1. Identification of the project ıssue and study area;
2. Gaining knowledge about project area, survey works and ıssue;
3. Identification of project concept;
4. Decision of the goals;
5. Identification of the principles of the planning and design;
6. Decision of the solutions according to the developed potential and problems;
7. Conclusion of the project with the decision and lines in accordance with the concept;

3. CONCLUSION

3.1. Project 1. Star Hill

- This is a project created by subtracting the forefront of national feelings and national values.
- There are two entries in total which of them including the parking entrance.

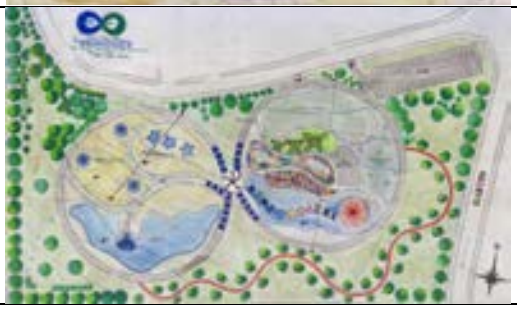
Figure 1. The process and details of the Project 1

- Parking includes 38 vehicles. The main circulation was designed with line moon and star icon used in the formation of the logo. It also has been noted to be accessible to all use.
- Culture road is located in the center of the main axis. Light of the garden, Ataturk corner, museums and Ottoman gardens, recreational areas and stretching systems located in culture path. The pond located in two corners of the star symbolizing the area, children's playground located in the other two corners, cafe-style

eating and drinking places located in the center. Amphitheatre, archery and horse riding areas are located in the north-east of the area. The most striking point symbolized the moon and the star where use of the various venue. At the same time, places in which serves local food and drink (disrupt, turnips, sorbet, such as compote) and revitalization of tradition make this project attractive.

3.2. Project 2. Blue-Green Infinity

- Blue and green colors main components of the project that symbolize the air, water, plant will continue forever in the nature.
- The logo represents the infinity symbolizes the continuation of the natural resources forever. There is only one entrance in the project area. The area is divided into two groups including the living area and breathing area. The pond representing blue, relaxation area, observation tower is situated in the living area. Green areas are forefront more in the breathing area. Among these kites slope, the colors garden and wonderland for children were designed.
- Circulating axle was created on the lake with suspended tensioning system and spring color garden. Glass terrace and observation terraces were formed around the pond where People can relax and watch the lake. Floral compositions were designed in the Colors garden which includes fragrance and nice view. Also butterfly garden area, colors garden and Zen garden is located in the area with different wealth. Walking path which was designed red axle was established in the area. Only one parking area for 40 cars was designed in the project.
- Floral arrangements and limited areas were created by making buffer zones in the sloped area. Floor coverings are predominant in the blue and green which are complementary of the concept.

SURVEY PLAN	
LAND USE PLAN	
MASTER PLAN	

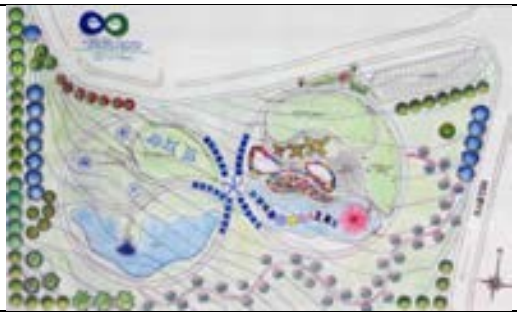
PLANT DESIGN	

Figure 2. The process and details of the Project 2

3.3. Project 3. Green Step

- The project's main target is to create a place where the people any age can find comfort and peace.
- Picnic areas with large grass area were formed where people can walk comfortably and rescue the stress of the day.
- Beautiful and fragrant floral arrangements were designed in terms of being the focal point along the main transport axis.
- Basic entry including two places is from the north and the east. Observation deck was formed in the North which is dominated a view from entry to environment. At the same time, cafés and restaurants can meet the needs of people eating and drinking in this region.

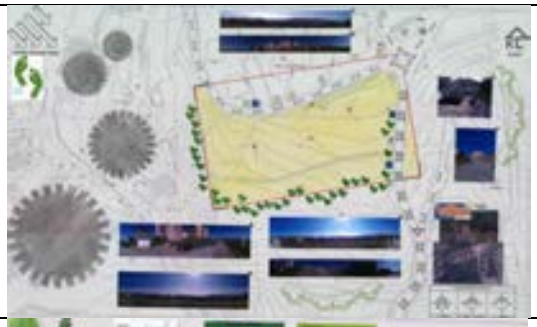
SURVEY PLAN	
LAND USE PLAN	

Figure 3. The process and details of the Project 3

- Children's play areas different age groups and disabilities playground were formed in the project. Grass dunes were designed to appeal the children's in the area.
- Ponds symbolizes the step are in the center of the area. Living units and extensive lawn area is located around the pond.
- There are 3parking area has a total of 16 cars.
- Sports areas were designed in the south-east of the area. Football, basketball, tennis courts and indoor fitness center are the in sports activities. Paintball fields were designed in the south west of the area for people who love more adrenaline and adventure.
- There are different kinds of colorful gardens from each other in the project area. These are: Bartın garden consisting of plants that grow in the area, botanical garden, herbal garden, the autumn and the winter gardens.

4. RESULTS AND DISCUSSION

Landscape project process that includes a comprehensive thought and procedures can take place only by the information system analysis, synthesis and evaluation. Therefore healthy and comprehensive thinking but without prejudice were preferred to achieving results in generating projects. For this, firstly data collection, data analysis, create a synthesis of the data, the question identification, considering possible responses that might be thinking of reasons to support each answer, the defense of justification of the right choice and to evaluate the results subtraction were applied. Example planning and design implications extracted from the concept can be considered as a step toward design approach, linking research findings with planning and design solutions.

Decisions of planners and designers in the creation of the project, determination of planning preferences, selection of herbal and structural elements have shown efficacy in several phases as design lines. Thus integrity has been provided from general to the special in the every detail. Project proposals were evaluated in terms of the abundance of space with ideas for the protection of natural and cultural values (diversity). Primarily expectations from the project were identified in the selected project examples. Understanding of the subject at all stages of the project accurately have been effective in completing the all stages.

Although working areas have identical geography, climate, history, values and culture in general firstly beginning the process with the understanding protection of natural and cultural values later have diversified from each other with the formation of the different project concepts. Thus, the solution of the problem of planners / designers not for one where will likely be many correct solution but defend the right reasons have been put forth.

We can conclude that selection and generalization mechanisms the spatial conception is a kind of mythical construction. It does not originate simply from the physical reality of the space but rather primarily from the meanings attached to this reality. The study useful for other preferred projects and areas in terms of the plan and design characteristics of such spaces in urban residential. Suggested projects in the study address the design attributes of the spaces and thus make the linkages between the findings and planning and design processes. Considering all the preferred landscape scenes under the concept affordance and attributes categories brings an interesting point into focus.

The project's main planning decisions:

- The preferred seating areas mainly include relatively small spaces with rounded arrangements of benches, picnic benches and gazebos surrounded by green that encourage small gatherings;

- The common characteristic of the scenes are the presence of well-defined edges separating different materials which create clear boundaries and make the scenes easier to read;

- Densely planted shrubs which can build visual barriers and shorten the view distance couldn't be preferred in the projects;

- Small green spaces were considered in the project that provides opportunities for socializing and for growing vegetables and ornamental plants;

- Projects considered to be aesthetically and ecologically well-designed by professionals, they are also meet users' needs and preferences and become part of their lives.

The expectation is that physical and cultural context will generate different place-specific design solutions. It should also be acknowledged that the design recommendations presented here are specific to place. The approach for making recommendations, however, can be applied in any context. The results of this study support the necessity of community design to improve social interaction and provide a variety of ways of meeting this need.

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How to be Mediatorship the Concept Creation of The Landscape Project?

Nurhan Koçan[1], Ahmet Ergun[2]

Abstract

When planning and designing, we always encounter the problem of defining the identity of the landscape. The perception of the project area is shaped by means of communication within the plan and design process. Therefore, the conception of the project tends inevitably towards uniformity, regardless of its actual geographical diversity. Specific landscapes emerge as representative of the whole, usually appearing as symbolic places that epitomize the project area. Such an image of space is realistic; it clears the vision and blinds us to quality life and environment. The choice of concepts for specific places as part of the general conception is based on the assignment of meaning. The choice of the project concept starts with personal opinions, but in the end it is rather the result of the application and budget. The key issue is the distinction between the objective, physical structures and the subjective image, that constitutes and sustains itself in the processes of social communication. The study was conducted in the Bartın City. The study area planned as a city park and recreation area and designs were made in different concepts. The research instrument was a set of landscape plan and design projects including survey, spot, master, vegetable, construction, sketch and perspective elements. After studies three concept prepared in different concepts are evaluated and explained. In conclusion, this paper outlined the area planned and designed different concept evaluated and seen different meaning reflects the project different fiction and line. So projects alongside the planners/designers' point of view develops with a focus on concepts. Finally, the results can be used to create another projects example and planners/designers can be advanced more in their profession.

Key words: Project process, concept, landscape planning, landscape design.

1. INTRODUCTION

The most distinctive feature man from other creatures is to have a mental world created using abstract symbols and signs. Culture could be created through this abstract world. There has been a continuing debate about the role of culture in the nature of landscape. There is general agreement, that, in spite of being made of predominantly natural material, landscapes are perceived (and therefore also constructed) within the cultural sphere of any social group. Landscapes are the work of the mind, built as much from strata of memory as from layers of rock. Landscapes are perceived by collective memory which is built on symbols, mythologies and social conventions [6].

Tangible, measurable, real landscapes which are the basis for any operation of spatial planning should thus be seen through the frame of multiple meanings. Therefore, it is legitimate to presume that differences can be found between physical descriptions of landscapes (such as typological classification, for example) and individual or social perception and evaluation of these very same landscapes [3]. This is important because the constructed conception of the landscapes that form our dwelling space (regardless of its dimensions), deeply and mostly

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insidiously influences the way we evaluate our environment and change it accordingly. The question of landscape identity, which inevitably arises in the planning process, is more or less related to the social and cultural identities of the population living and working in these precise landscapes. Therefore in spite of the fact that the geographical and climatic characteristics of a certain area condition the choice of specific land use and its structural articulation, and that the articulation of space is also due to the social system, the level of economic power and planners/designers' idea. This kind of knowledge is an important input in landscape planning and designing.

1.1. Changeability and Adaptability of the Conception in the Landscape Project

In landscape planning one constantly encounters the question of how to define the identity of the landscape. In this context what immediately arises is the problem of the erroneous perception of spatial identity as unchangeable; it is dealt with as a physical phenomenon, a given situation in space, while in reality it involves ever new relationships, since landscapes are created through the reciprocal interaction between the space and the individuals and society who change the space and inscribe their culture on it through their actions [1]. A place can be described according to its physical components, but in this case we grasp only its image at a particular moment in time.

Spatial inventory and an analysis of the data will objectively and accurately determine the spatial components of the area. When planning, we must also determine the prevailing social values that are expressed through the social identification with the space. Landscape features act as message carriers. A number of such conceptions influence our relationship with this environment, but they also influence their own construction. Landscapes are thus evaluated and transformed according to a certain generally accepted, idealized image, which may no longer correspond to ever-changing spatial reality [5]. If we assume that with measurable space and objectively given phenomena, which one could call landscape identity, the question is more about the relationship towards the landscape about the identification with the landscape. There is the question of how such a single image affects the relationship of project and individuals and thereby the diversity of the landscape reality.

Landscape identity is a social construct. It is formed on the basis of the geographical characteristics of the certain physics or for example, recognizable landscape patterns, but once they enter the processes of social communication. Since identification with space is, as much as any other identification, an ever evolving creation of concepts, the search for landscape identity should focus on the components that define particular landscapes as national, not in the physical reality, but where concepts evolve: in social communication [3]. A mere fact that a certain landscape element appears within the image is more important than anything else: its role or allocation within the formal composition, its number or the quantity of the area of the image taken by the element [2]. The elements within such an image act as signs acquire a value only in a combination with other signs. So in each specific combination they carry a special allusive message.

The concept is composed of a collage of selected places, landscape patterns, and individual features and on the period, that is, on the value system currently prevailing in the current society. The symbolic image of project area can best be assembled from landscape scenes, linked to the conception of identity that circulates in the systems of social communication [4]. The choice of visual material is supported by the fact that we primarily perceive landscapes visually and because the depictions of landscapes themselves infer a choice. The landscape components and patterns as carriers of spatial identity as well as proving that the evolution of a conception involves the permanent interweaving of the relationship between physical and symbolic factors.

The concept of project area is formed on various levels and it is composed of variously sized and variously constituted units. These can be locations of special importance such as the recreation and sport; they can also be areas that have acquired symbolic significance in the cultural memory [4]. These may also possibly apply to individual landscape features that were united into a type by categorization and only as such will become a conceptualization of the project. The intention of the conceptions establishes and maintains one's self-image in relation to other people and space. Through recognizing the characteristics and significance of the landscape units that build the conception of project in the perception and assessment are aimed at discovering more intimate levels of the place they live in. The answers confirmed the changeability of the conception proved that many conceptions can simultaneously coexist and that they employ different combinations of elements or places.

The study did not seek an absolute landscape identity describable through geographical data, but rather attempted to understand how the conception of project and recreation areas formed by concept. The final goal was to

emphasize the relationship between the physical and symbolic factors that determine the social conception. The study proved that in conceptualizing space a motif appears that is no longer dependent on one's standpoint. In the processes of perception and comprehension, it can very well appear as an individual landscape unit.

2. MATERIAL AND METHOD

The area selected as a study material located in Bartın Province. The area opens to the Black Sea in the north via of the Inkum. The Bartın River and industry in the west and Bartın urban settlements in the south is neighbor of the study area. The area is located on a high point dominated the landscape in terms of location in the city center. Ease of gaining access is a significant advantage. The Bartın City development plan (1/1000), survey layouts (1/200), stains plan layouts (1/100), preliminary layouts (1/100), final project layouts (1/100) were used in the planning and design work in the study. Project area survey work was done, project concept was determined, goals and objectives were clearly defined, planning decisions and design principles were decided, solutions were created based on improved prospects and problems in the planning process. Project has been finalized in accordance with the holistic concept and line decision in design stage. Concept has affected the identification of land use policy, the choice of program elements and the relationship between the elements. Alternative land use scenarios and design were produced considering the balance between protection and use of natural and cultural values for the study area. 3 projects with different concepts as an example have been discussed and evaluated in terms of landscape planning and design principles in the study. Project proposals have been selected in terms of the protection of natural and cultural values (diversity) and the abundance of ideas for area.

The main criteria taken into account in the evaluation are as follows:

- Concept;
- Project logo;
- General planning decisions;
- Structural and plant design;
- Place diversity;
- Integrity of the project.

3. CONCLUSION

3.1. Project-1 Dance with Life

- **Concept:** Dance with life. Project has been developed that brings out different aspects of life.
- **Purpose:** The purpose is to create a place where people can find art and culture. The project aims to create rich content to people with different artistic and cultural venues and a social environment.
- **Master Plan Decision:** The project to be appeared mainly an art project. Project was designed as an interesting and to be felt lack of places in the Bartın City. Culture, art, concerts, exhibitions, theater, in many amateur branches places and art events were formed will be together. It is a project that brought together sports and art at the same time.
- **Details:**
    - There are two inputs including both the north and east of the project area. The main transport ax was passed the music key which was inspired by the project concept and the logo symbol;
    - There are two parking including 16 and 6 cars;
    - There are welcome area including fragrant and colorful flowers and especially water fountain system in the input of the area;
    - The sports areas of the project are located north of project and there is indoor sports facility;
    - There is an area where can be done such activities as pictures, exhibition, sculptures, theater and other artistic activities in the west of the project. There is also private school designed for amateur music-making artists. The most interesting areas in the project are music school and amateur art areas;
    - Different cafes and restaurants on the pond are designed as places where people can relax after a variety of activities. Vegetation islands were formed in order to increase aesthetic even more in the center of the pond.
        - Observation deck is considered to be in the north for the view point of the area;

- Bicycle circulation was created especially for people who use the bike in the field with the main transport axis;
- Large grass areas around the project have created where people can relax and do various events (festivals, etc.);
- There are playgrounds located in the south of the area belonging to different age groups.

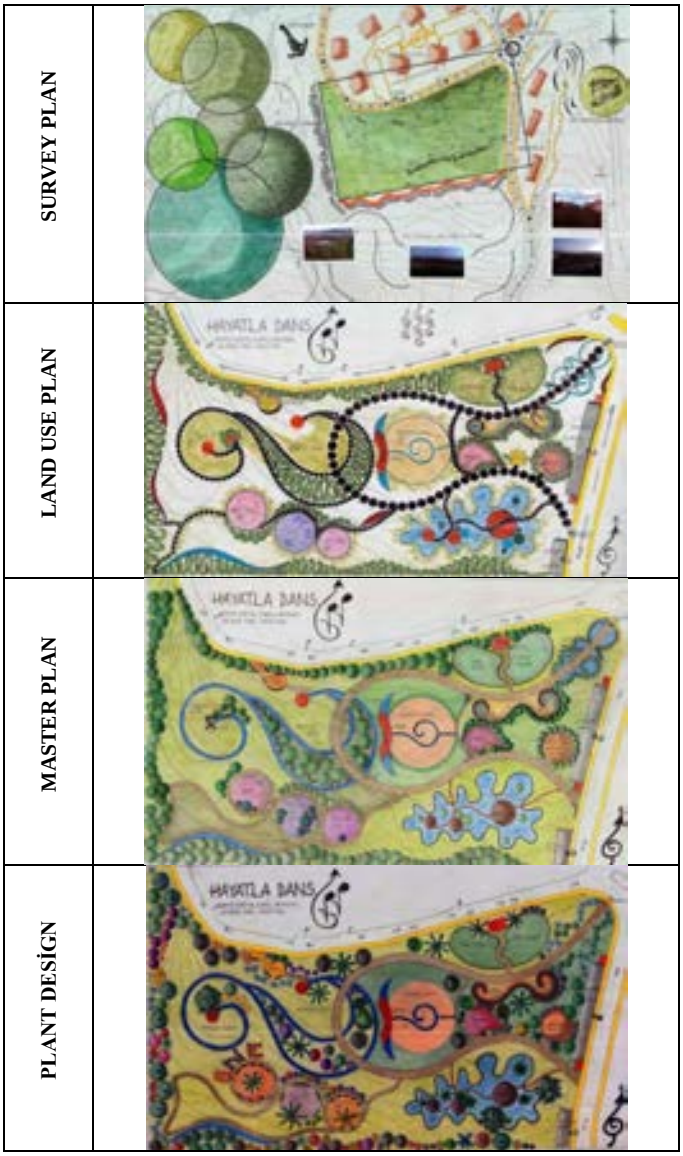


Figure 1. The process and details of the Project 1

3.2. Project-2 Eco Park

- **Concept:** Eco Park. It was developed as an environmentally friendly project.
- **Purpose:** The project has been created with the idea that we can protect the environment at every scale and there are other creatures in nature. For example, the most attractive and the most active areas in the project for users are biological pond and around it.

- **Master Plan Decision:** Close to natural spaces by creating diverse plant compositions designed in all areas have been established. The project will not harm nature but in harmony with nature. Lighting equipment materials providing energy from the solar and systems they collect rainwater were used in the project.

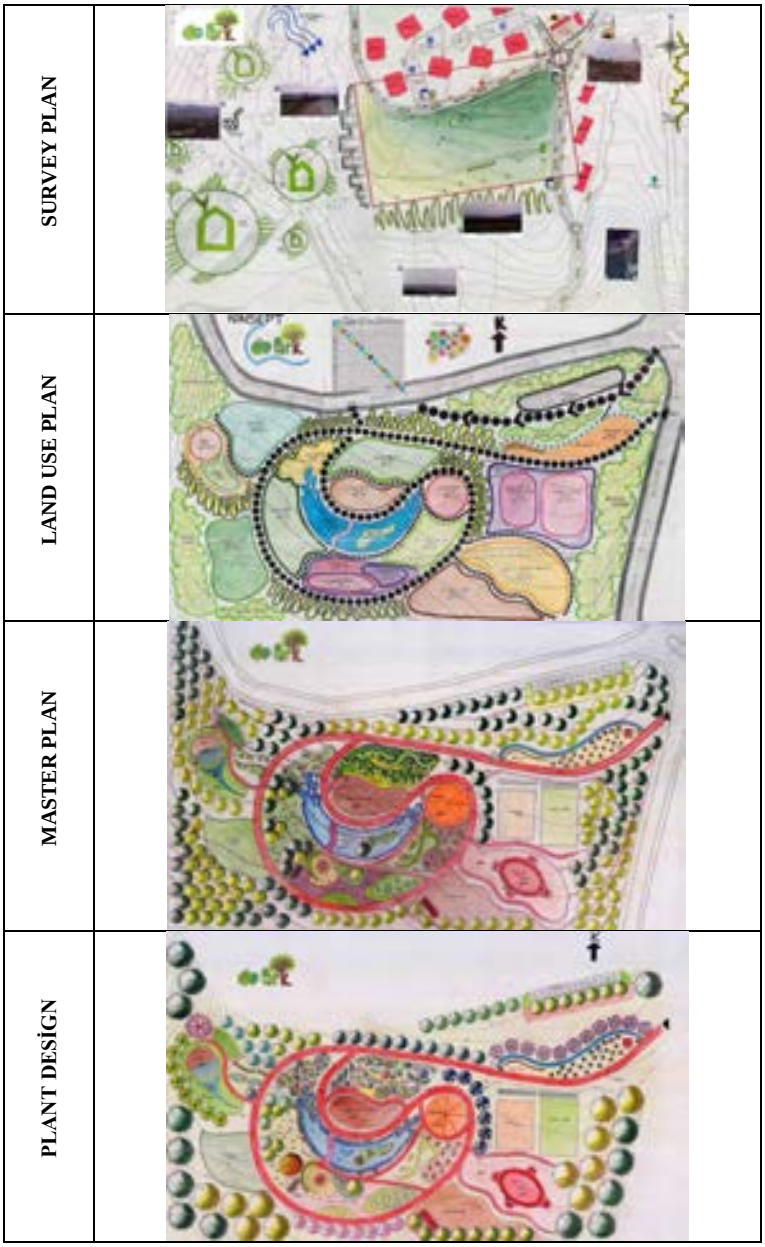


Figure 2. The process and details of the Project 2

- **Details:**
  - There is a single entrance to the project area. The reception area with entrance area invites people to the area. There are security units and areas where will be done a variety of cocktails and exhibitions;
  - Sports fields east of the site are designed. These include football and basketball courts, skating tracks and horse riding venues;

- There is observation deck dominant full view in the center of the field. Plant designs were performed biological pond area, the rock garden and English gardens which are under the observation terrace. Picnic areas have been established in terms of being close to the pond area. Step-shaped seating units where people can sit and can relax cafe and restaurants are around the biological pond. The duck house was created and designed an island in the pond;
- Playground for children including the grass hills and Fairytale Park is remarkable. Closed spaces where children can play in the winter were formed. Kite field and grass amphitheater have been created in the west of the area. This area has become richer in terms of visual elements with water and vegetable syllogism;
- There is only parking area including 14 vehicles.

3.3. Project-3 Every Shade of Green

The details of the project are below;

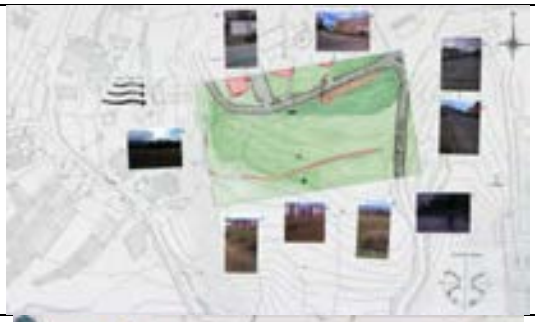
SURVEY PLAN	
LAND USE PLAN	
MASTER PLAN	

Figure 3. The process and details of the Project 3

- **Concept:** Every shade of green. Every shade of green areas has been identified as a concept used to keep green areas more foreground.
- **Purpose:** To keep the plant design in balance with structural design, to awaken the impression of a natural area with plants take place in every shade of green.
- **Master Plan Decision:** The lines of modern design were integrated with natural plants and structural elements in the project. It was used to highlight different materials axles and green areas.
- **Details:**

- There are 3 inputs including one parking entrance. One place is designed as parking area for 20 cars;
- The use of main transport ax has been noted to ensure accessibility migrating all the in the project area. Located in the center of the main axis areas is reminiscent of the iconic logo created for the project. It also stands out as the most striking points of this place;
- Three pieces of wood pergolas, pools, gardens situated with colors and adorned various seasonal flowers and ground cover plants in the main centers of the project. Tree-lined was created with the plant that symbolizes the balance logo. reception area has been set up where can be done ceremony or various events (concerts, exhibitions, festivals, such as the wedding) north of the area. This area is enriched with plant pots and seating;
- Open wooden deck was designed in the pond area as a port style and water pergolas were used to benefit from the imagery of the water and to create relaxing effect;
- There are cafes and bars where people can meet the need the eating and resting in the open field the dominant point of view;
- Adventure park was designed in the west of the area where will be able to appeal to different age groups' adventure capability and to discover. Also there can be made of football, basketball and volleyball sports and an indoor sport.

4. RESULTS AND DISCUSSION

Identification of project concepts, the creation of planning and design principles, the establishment of relationship between cause and effect on the basis of developed ideas, identification of alternative solutions is possible the evaluation of the project within the concept and holistic.

The study has been diversified moving the process from the beginning protecting of the natural and cultural values to creating of the projects which are composed of different concepts from each other. Concepts are defined in relation to both the attributes of the environment, the attributes of the individual such as needs and intentions, as well as the characteristics of the nature and culture. Since needs and intentions are not static, perceptions of environmental attributes are likely to vary as planner/designer opinion. It is revealed that, the solution of the problem for planners/designers is no single but there will be many options with possible reasons. The new planning scenario was realized with different concept which can gain new impetus to the city's culture and tourism axle and this area will be used for recreation in the results of the study.

General planning principles are complied with suggestions are follows:

- Small business units have been considered in the area and activity area is planned for the craft;
- It is aimed to increase the capacity of daily visitors with recreation areas;
- Firstly 1st and 2nd degrees pedestrian access and bike paths are considered in the area;

- The structures brought to the area have been preferred according to historical values and strengthens the natural perception;
- The wide green spaces have been left in the area, plant design has been proposed in areas where there are no archaeological remains and container plant application has been considered in some sections of the area;
- The reduction of the vehicle density and the use of vehicles in the area have been considered via of the parking area;
- The current situation in the area is in the opportunity to use non-criminal elements at night. The area constituting the city's entire history and the memory has been destroyed completely out of control with the use and so the life of the area has been shortened. The night lighting and use of place has been considered in the area and the security and viability of the area provided every hour of the day;
- It is aimed to obtain information of visitors with the exhibition grounds and museums in the area.

Upon execution of the proposal plan, the quality life of the visitors and the urban citizens living in the area will be developed and the new reference identity of the city will be formed.

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The Diversity of Using Glycerol as a By-Product of Biodiesel Production

Veli Gökhan Demir[1], Hayrettin Yüksel[2], Hakan Serhad Soyhan[3]

Abstract

Using biodiesel as an alternative fuel or additive for diesel engine fuel has become a necessity due to the toxic pollutants and green effects of petroleum based fuel (D2) emissions. The main obstacle in the commercialization of biodiesel is its high cost of producing. Utilization of by-products of biodiesel production processes plays a role of contributing to the sustainable consolidation of the biodiesel markets and decreasing biodiesel fuel prices. The predominant biodiesel production process involves a phase of transesterification that yields glycerol as a by-product. Using refined glycerol is limited because of its high cost refining costs. International crude glycerol market is still at an early stage, however, in literature, various researches have indicated the possible uses for using unrefined glycerol and they reported that using crude glycerol could lead to reducing in total production costs of biodiesel fuel perceptibly. In this work, the diversity of using unrefined glycerol is represented as an overview.

Keywords: Glycerol, Transesterification, Biodiesel.

1. INTRODUCTION

Using energy plays a major role in industrial development, transportation, agriculture sector and to meet many other basic human needs. Hence, the global energy demand is increasing rapidly. The depletion of world petroleum source, volatilities of crude oil prices, increased dependence on foreign energy resources and increased environmental pollution and greenhouse concerns has lead researching for alternative, nontoxic renewable and environmentally friendly fuels [1]. Renewable energy sources contain wind power, solar power, hydroelectric power, tidal power, geothermal energy, biomass and the renewable part of wastes. At present, biomass is the largest renewable energy source and provides 10% of world primary energy supply [2]. Biomass energy is the energy stored in biomass that is non-fossil organic materials such as wood, vegetable oils, animal fats and wastes from forestry, agriculture etc., as well as municipal solid waste. Like the energy in fossil fuels (e.g., coal), bioenergy is derived from solar energy stored in plants through the process of photosynthesis. The principal difference is that fossil fuels require thousands of years to be converted into usable forms, while properly managed biomass energy can be used in an ongoing, renewable fashion [3]. Vegetable oil is derived from various sources, and it is an alternative fuel source for diesel fuel. Vegetable oils have high heating power and in combustion, the exhaust gases have almost no sulfur and aromatic polycyclic compounds. Vegetable oils are produced from plants, therefore, their burning leads to a complete recyclable carbon dioxide CO_2. Despite the fact that vegetable oils can be used in diesel engines, however, their viscosity values are much higher than petroleum based diesel fuel and it needs modifications of the engines when using them [4]. For preventing these difficulties, various methods such as: direct use and blending of raw oils, micro-emulsions, thermal cracking, and transesterification have been used

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for using oils as a biofuel. The most commonly used method is transesterification. In that process, oils composed of triglycerides %98-99 are converted to biodiesel [5].

2. BIODIESEL PRODUCTION BY TRANSESTERIFICATION

Transesterification is the reaction of oil (vegetable oil, waste oil and animal fat) with an alcohol to form esters and glycerol. The reaction is shown in figure 1. In the reaction, catalyst is used to increasing the reaction rate and yield. Glycerol occurs as a by-product. In a stoichiometric transesterification, a 3:1 molar ratio of alcohol to triglycerides is needed to complete the reaction. However, in practice, a higher molar ratio needs to be to drive the equilibrium to a maximum ester yield [6]. Methanol is the most preferred used alcohol due to its low cost and it is polar and shortest chain alcohol high performance in reactions. Transesterification can be performed base catalyzed (alkali), acid catalyzed or enzyme-catalyzed. The enzyme catalyzed reactions requires much longer reaction time than acid catalyzed and alkali catalyzed reactions. Also, alkali catalyzed (commonly used KOH and NaOH) reaction is much faster than acid catalyzed transesterification, therefore, it is commonly used commercially [7].

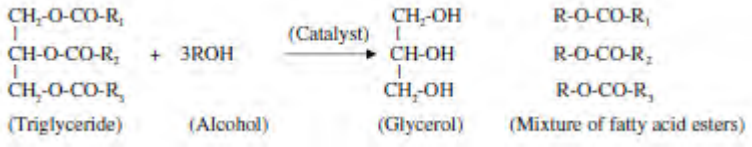

Figure 1. Transesterification reaction mechanism

Transesterification products are composed of methyl ester, glycerol, methanol, catalyst and tri-, di- and monoglycerides. The big difference in densities (biodiesel, glycerol=880, 1050 kg/m^3 respectively) is well enough for separation of biodiesel and glycerol phases by simple techniques such as gravitational settling and centrifugation. [8]. As it seen in figure 2, the two layers occurred after transesterification reaction and settling. The upper layer is crude methyl esters (crude biodiesel) also the bottom layer is crude glycerol.

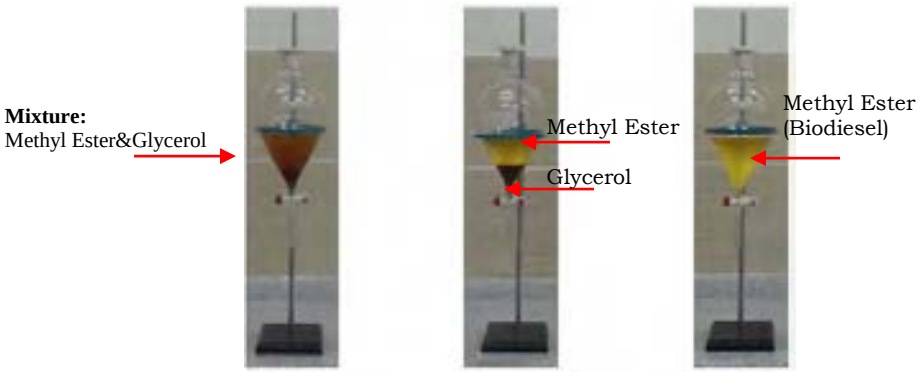

Figure 2. Biodiesel production processes

3. UTILIZATION OF GLYCEROL

3.1. Properties of Glycerol

Glycerol is the main by-product of biodiesel production process. In general, approximately 1:10 weight ratio of oil is converted to glycerol in biodiesel productions [9,10]. Glycerol is a water-soluble, nontoxic, colorless, odorless, viscous, hygroscopic liquid and it has a high boiling point. Beside those properties, glycerol is a trihydric alcohol and yet stable under various conditions. Crude glycerol is composed of C, H and O. The major component is C with a 52.8% percent, it makes glycerol a suitable material for renewable energy sources, also O is an another valuable compound that has a 36.1% content value. A list of physical and chemical properties which are important for glycerol applications is shown in Table 1 [11].

The term of ‘glycerin’ is usually used for purified/refined products including more than 95% purity while ‘glycerol’ term is generally is used for the chemical compound of 1,2.3-propanetriol and to the anhydrous content

in a glycerol product or in a formulation [12]. The crude glycerol derived from transesterification needs some purification processes such as neutralization (by acids) and separating water and methanol. After these operations crude glycerol has 80–88% purity and at becomes a product which can be sold easily in market. If it is desired to produce more purified product, expensive and more complex purified processes are needed. The final product called refined or purified glycerol (glycerin) has 99% or higher purities and it is consumed in food, cosmetic and pharmaceutical markets. The acidic value of purified glycerol is slightly less than crude glycerol and it has lighter color due to the existence of less impurities as moisture, ash and soap contents. Quality parameters of different types of glycerol (crude, refined, synthetic) are shown in table 2 [9].

Table 1. Some physical and chemical properties of glycerol [11]

Properties	Value
Molecular formula	$CH_2OH–CHOH–CH_2OH$
Molar mass	92.09 g/mol
Form and color	Colorless and liquid
Melting point	17.9 ºC
Boiling point (101.3 kPa)	290 ºC
Viscosity of glycerol At 100% purity	10 cP
At 50% purity	25 cP

On the other hand, purification process is uneconomic and the glycerol market is already saturated. Crude glycerol plays big role on biodiesel production cost but the mentioned drawbacks in purification process tends crude glycerol to declining. High costs of purifying processes cause consumers to use alternative substances like sorbitol and synthetic glycerol instead of purified glycerol. Glycerol generated from biodiesel production is divided in 3 main categories as: crude glycerol, purified glycerol, refined/commercial glycerol. All their major properties are shown in table 2 [9,10]. In general, the purified glycerol is prepared close to the quality of commercial glycerol (synthetic) due to its utilizing in sensitive materials such as medicine, food and cosmetic products. As regards table 2, the quality differences between crude, purified and synthesized glycerol can be seen clearly. The crude glycerol has 60–80% purity while the purified or commercial glycerol is close to 100%. According to other properties, the purified and synthesized glycerol is almost same while the crude glycerol has fairly low qualities. [10].

Table 2. Qualities of 3 different type of glycerol [10].

Properties	Crude Glycerol	Purified Glycerol	Refined/Commercially Synthesized Glycerol
Glycerol content (%)	60–80	99.1–99.8	99.2–99.98
Moisture contents (%)	1.5–6.5	0.11–0.8.	0.14–0.29
Ash (%)	1.5–2.5	0.054	<0.002
Soap (%)	3.0–5.0	0.56	N/A
Acidity (pH)	0.7–1.3	0.10–0.16	0.04–0.07
Chloride(ppm)	ND	1.0	0.6-9.5
Color (APHA)	Dark	34–45	1.8–10.3

The purified or refined glycerol which has 99.5–99.7% purity and is commonly produced from crude glycerol as a by-product in biodiesel industry. The common purified glycerol available in the market is produced to be appreciate to the United States Pharmacopeia (USP) and the Food Chemicals Codex (FCC) but technical grade and not certified glycerol products also exist in the market. Thus, the quality of purified glycerol can be identified by its grade. In practice, purified glycerol is categorized into three main types as: Grade I (Technical grade), Grade II (USP grade), Grade III (Kosher or USP/FCC grade) [9,13].

*Table 3. B*asic grades of purified glycerol [13].

Grade	Type	Preparation and usage
Grade-I	Technical grade ~99.7%	Derived by synthetic processes and used in many chemicals, however not suitable for using in foods or drugs
Grade-II	USP grade 96–99.5%	Derived from animal fat or plant oil, appreciate to be used in foods, pharmaceuticals and cosmetics
Grade-III	Kosher or USP/FCC grade 99.5–99.7%	Derived from plant oil sources, appreciate to use in kosher foods and drinks

Commonly used, glycerol based; technical, USP and Kosher grade products are illustrated in the figure 3.

Figure 3. Glycerol (Glycerin) products in Tecnical, USP and Kasher Grades.

a) Technical Grade Product - Technical grade glycerin is a clear, colorless, odorless, syrupy liquid. It is soluble in water and alcohol. Many uses include resins, gums, dynamite, perfumes, and softeners. This grade is not pure enough for food, pharmaceutical, or e-juice use [14].

b) USP Grade Product – This powerful skin protectant helps to cure and smooth cracked, chafed and chapped lips and skin. Simply apply the necessary amount needed over dry or chapped skin and deeply rub in for fast-acting results. Also helps prevents and protects against wind-burned skin and lips [15].

c) Kosher Grade Product - Distilled Glycerol Monostearate is milky white beads or powder. This product has a heavy metal percentage of greater than or equal to .0005%. It can be used to prevent dough from aging, increase stability, improve taste, and texture. It is used in cakes, breads, flour products, ice cream and with anti-foaming agents [16].

3.2. The Impurities in Crude Glycerol Obtained from Biodiesel Production

The impurities exist in crude glycerol cause decreasing glycerol's price. After biodiesel production, the separated glycerol has moisture, ash, soap, catalyst and chloride as major impurities. Ca, K, Mg, Na, P, and S are the minor materials that exist in 4–163 ppm in glycerol while Na is commonly presented about 1%. Beside the metals, glycerol is composed of at ranges of 0.06–0.44% proteins, 1–13% fats and 75–83% carbohydrates [17]. Before the purification processes crude glycerol has 65–80% purity. The impurities mainly occur from methanol and soap [18].

3.3. Glycerol Production

Glycerol is generated as a co-product from biodiesel, fatty acid and soap production. During last decades, biodiesel production has become the major process to obtain glycerol. Hence, it can be said that the price of glycerol is almost related with the demand and production of biodiesel.

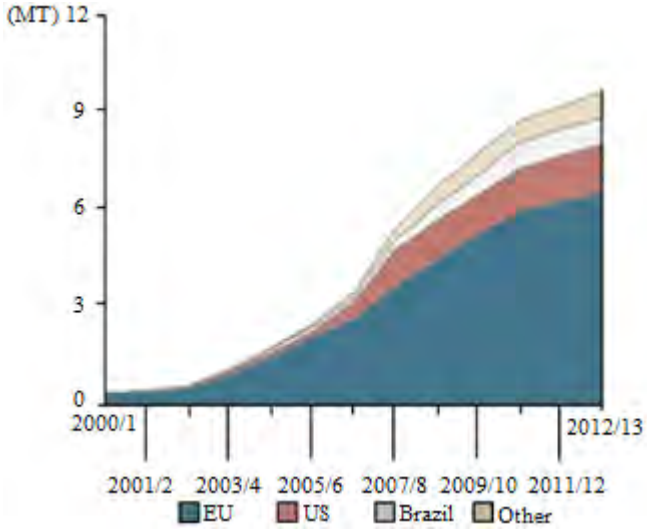

Figure 4. Using vegetable oil for biofuel production in the world [19]

In the year of 2003, the EU was the biggest biodiesel producer who supply 82% amount of biodiesel in the world. EU Council reported that, in 2006, EU produced 5 million metric tons (MMT) biodiesel. It meant that in 2006, a huge increment can be seen (about 28%) from 2000. Also, in global market, 10 million cubic meters biodiesel production was carried out in 2006. According to European Union Directive (2003/30/CE), by the year 2010, the countries who are the members of EU have been required to use 5.75% biofuel in their petroleum-based fuels used for transportation. It inferred that 10 MMT biofuel have been used per year by the year 2010, in consequence of that rule, roughly 1 MMT of glycerol has been produced per year [20].

Table 4. Sources of glycerol during 1992–2008 and in estimated year 2010 [21].

Glycerol Sources	World glycerol production ($\times 10^3$ metric tons/year)							
	1992	1995	1999	2003	2005	2006	2008	2010
Soaps	208	208	198	188	167	146	125	83
Fatty Acids	271	292	313	333	396	438	479	531
Biodiesel	0	42	42	167	375	521	1125	1583
Fatty Alcohol	83	104	125	104	125	167	250	250
Synthetic	83	83	63	63	21	0	0	0
Others	0	0	42	63	42	0	21	21
TOTAL PRODUCTION	646	729	781	917	1125	1271	2000	2458

In the world, most of the crude glycerol is produced by European Union, the United States and South East Asian countries. In figure 5, the estimated crude glycerol production capacity from 2000 to 2020 is shown [22]. As regards that figure, the crude glycerol production will be 5.8 billion pounds by 2020. The reason of this rapid increasing value of glycerol production is related to the biodiesel production. The estimated biodiesel production is 8 billion gallons in 2020. It is also seen that, after 2006, the glycerol production was rapidly increased; moreover, many countries have started to produce glycerol such as Indonesia, Malaysia, China and India as powerful opponents.

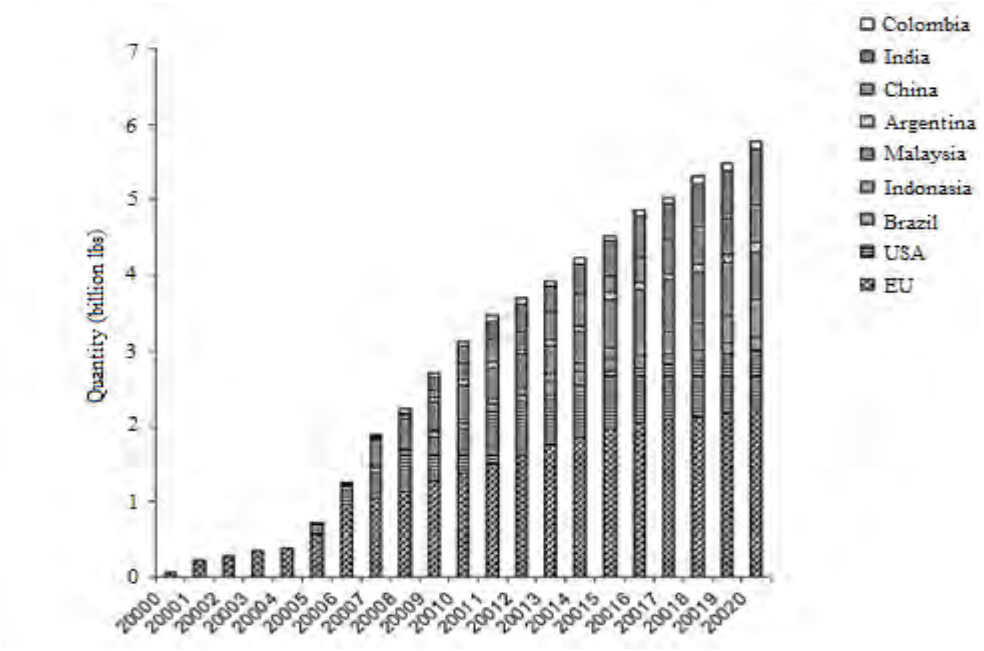

Figure 5.Crude glycerol production by different countries [22].

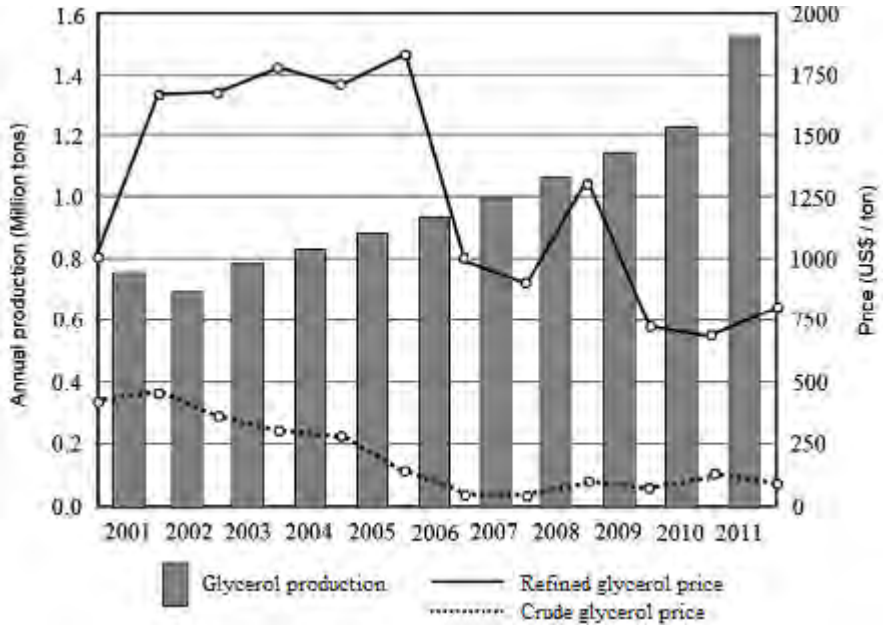

Figure 6. Glycerol production and prices in the world [20]

3.4. Impact of Glycerol Price on Biodiesel Cost

Despite of many advantages of biodiesel, the major reason of not being able to be widespread of biodiesel is its high production costs. In general, biodiesel costs US$ 0.5/L and equals to about 1.5 times of petroleum-based diesel [23,24]. Zhang et al. [25] reported that, the glycerol provides a reduction of cost of biodiesel about 13–14%. In another study, Woo C. [26] declared that the price of glycerol was decreasing related to rising of biodiesel production. Fan et al. [27] claimed that, biodiesel production costs can be decreased about 25% by using crude glycerol. According to the literature it can be understood that biodiesel production cost is directly related to the cost of raw materials and inversely proportional to glycerol credit.

3.5. Global Utilization of Glycerol

In biodiesel industry, industrialists evaluate crude glycerol in many areas such as: combustion, composting, animal feeding, and thermo-chemical or biological conversions to value-added products. Although a great deal of crude glycerol is sold to refineries for purification, especially lately, the market has exceeded related to the rapid improving biodiesel industry, [28]. Soap and Detergent Association reported that [12], there are 1500 uses of glycerol at least. There have been many investigations into alternative uses of crude glycerol. combustion, composting, animal-feeding, thermo-chemical conversions, and biological conversion methods for glycerol usage and disposal have all been proposed. Stelmachowski illustrated most of the using areas of glycerol as Cosmetics and Foods; it can be seen in figure 7 clearly [29].

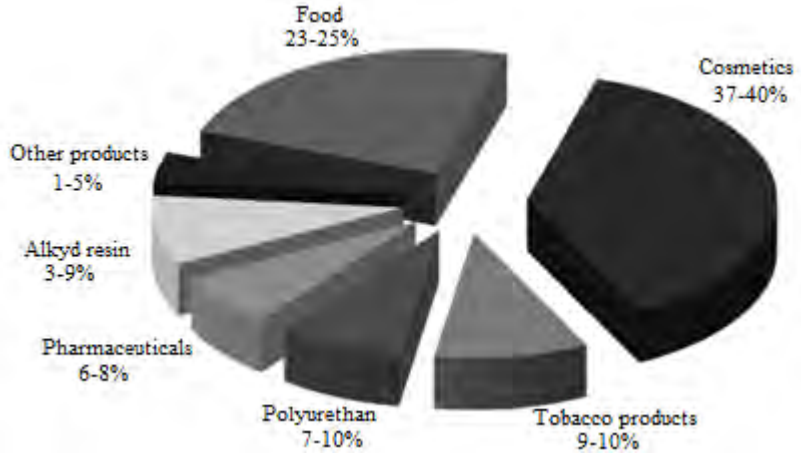

Figure 7. Glycerol uses with average worldwide values [29]

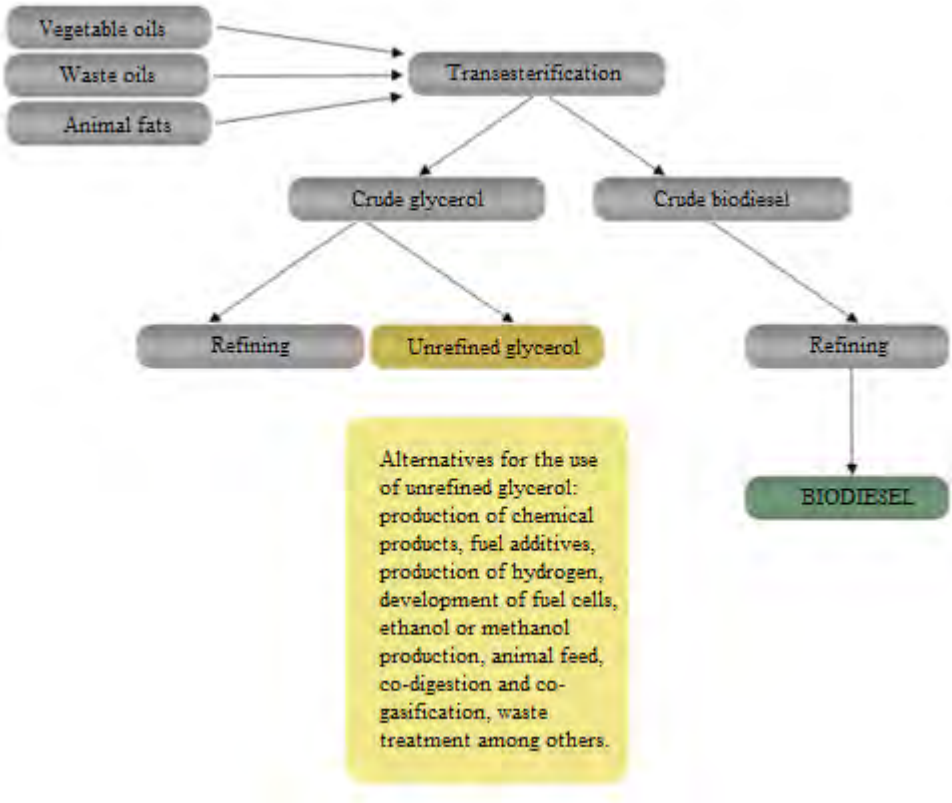

Figure 8. Schematic summary of forming glycerin and its alternative routes [30]

3.5.1. Using Crude Glycerol in Different Fields

Crude oil can be used almost directly in animal feeding or combustion. The caloric value of glycerol is related to its feedstock. Glycerol's calorific value is half of fossil fuels, however, it is comparable with many types of biomass energy sources: wood, straw, oilseed cake, bark, sawdust, etc. In addition, crude glycerol is converted to commodity chemicals and biofuels by various methods such as oxidation, hydrogenolysis, catalytic dehydration, pyrolysis, gasification, etherification, carboxylation etc. [20].

The simplest method of utilization of crude glycerol is using it for combustion. There is no need to purification or refining in this process. If it is considered with biodiesel production, that worthy by-product would have additional advantages in energy integration. Also, it can eliminate transporting cost and use of petroleum based fuels [31].

The stoichiometry for burning glycerol is [20]:

$C_3H_5(OH)_3 + 3.5O_2 \rightarrow 3CO_2 + 4H_2O - 1655$ kj/mol (1)

Even pure and refined glycerol is highly viscous. It causes obstructing atomization, especially at room temperature. Glycerol's viscosity could be drastically reduced by directly heating it or heating it with steam [20]. Hence, burning crude glycerol is the most common methods used in the combustion process.

Modern boilers have been designed to with stand high thermal loads in the furnaces, sousing glycerol directly in existing boilers is unacceptable because of the high ignition point (370^0C) and low adiabatic flame temperature [20]. Therefore, it requires some modifications for conventional furnaces or designing furnaces in accordance with glycerol burning conditions.

As it seen figure 9, an individual furnace was designed for burning glycerol. In this mechanism a starter fuel is used for preheating system approximately to 1000^0C. The starter fuel propane is injected horizontally through two ports. Prior to spraying glycerol, this initial combustion process is performed to facilitating atomization of glycerol by lowering its viscosity. The burner is run on propane until the metal of the flame enclosure heats to the point where it glows red. At this point, glycerol can be sprayed and efficiently burned inside the preheated enclosure. When the glycerol is sprayed and combustion becomes stabile, propane charging is cut off [31].

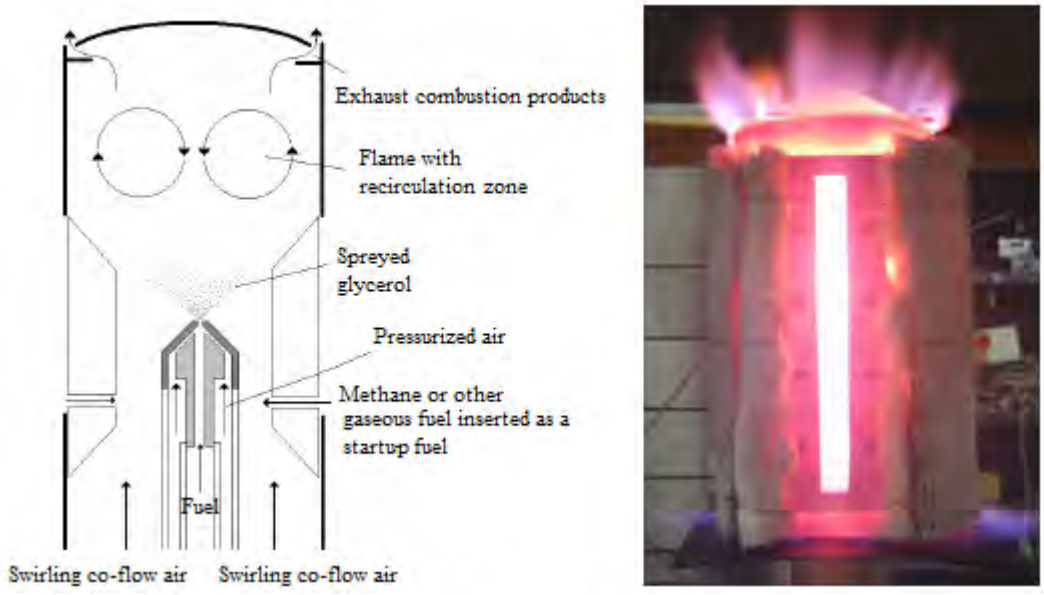

Figure 9. Mechanisms of crude glycerol furnaces [31]

Brady and Kawai Tam combined waste glycerol (by-product of biodiesel) with waste biomass to produce combustible pellets as an alternative to coal for energy production. The researchers found the optimum pellet producing parameters at 1:1.6 weight ratio of glycerol to sawdust. The product's energy value was 16.7 kJ/g. They reported that the pellets can be viably manufactured using simple manufacturing equipment, and can be combusted as fuel in existing fuel pellet and coal burning facilities [32].

Figure 10. Pellets produced from glycerol and saw dusts [32]

Crude glycerol is also used for producing H_2, however, there has not been a significant tendency to it. Currently, many researchers have investigated to produce H_2 from biodiesel by-product glycerol related to improvements in biodiesel industry. Adhikari et al. [33] reported that the major method for producing H_2 is steam reforming. They introduced this method as an endothermic reaction which forms H_2 from the reaction of glycerol and water in the presence of a catalyst. They also made a study about comparing catalysts (Ni/MgO, Ni/TiO_2, and Ni/CeO_2) for producing H_2 by steam reforming. They reached maximum H_2 (56.5%) at a temperature of 650℃ and in the presence of Ni/MgO catalyst and 4 mol H_2 was formed while stoichiometric value was 7. The referred reaction is shown as follows:

$$C_3H_8O_3 + 3H_2O \rightarrow 3CO_2 + 7H_2 \ (\Delta H^0_{298} = +123 \text{ kJ/mol}) \quad (2)$$

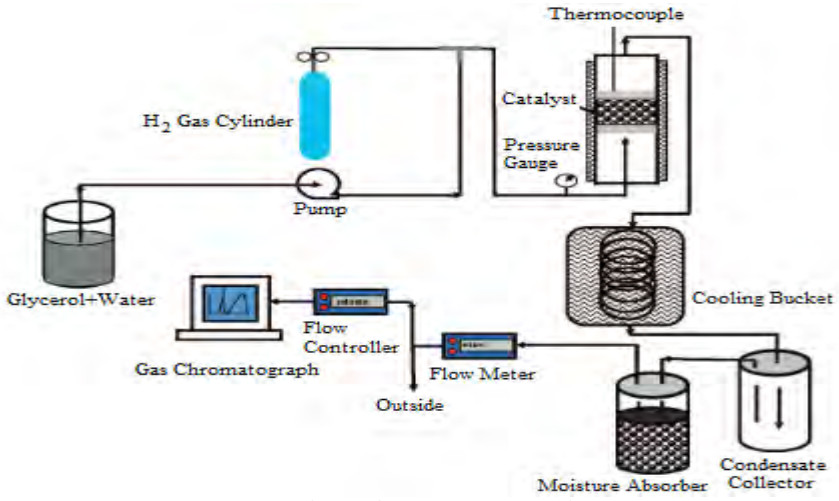

Figure 11. Schematic figure of the glycerol steam reforming system [33]

The thermoneutral zone is described as the region of temperatures in which cattle are comfortable and do not need to spend energy to either cool down or increase body temperatures. For beef cows in Florida, this region is generally (although variable with breed, acclimation and hair coat) between -4°C and 30° C, but young calves can experience cold stress in temperatures as high as 10° C. When extreme weather conditions push beef cattle out of their thermoneutral zone, they need to spend extra energy to maintain their body temperature, and that energy is driven away from productive processes, such as milk production and body reserves restoration. Usually, one of the underutilized feeding strategies during winter supplementation in Florida is using liquid feeds, such as: molasses or crude glycerol as a high-energy, winter supplement. The University of Florida's North Florida Research and Education Center has been conducting experiments to test the utilization of blends of glycerol and molasses as a supplement for beef cattle consuming hay. Preliminary experimental results specify that a blend of 50% molasses/ 50% crude glycerol fed at 3 to 5 pounds per head, per day, can increase productivity without any negative effects on fiber digestion [34].

Figure 12. Liquid feeds for winter cattle supplementation [34]

According to the animal feed standards for utilizing of glycerol obtained by biodiesel production as a by-product; the glycerol can be added at the proportion of 10% in the ratio and it must has at least 80% of glycerol and up to 150 parts per million (ppm) of methanol (in accordance with the Food and Drug Administration (FDA) of The United States) [30].

Ashby et al. [35] investigated about utilizing of biodiesel production process wastes such as glycerol, residual methyl esters etc. in production on polyesters. They claimed that glycerol can be synthesized biodiesel for the production of polymers (polyesters) by bacterial synthesis. The authors concluded that the by-products of biodiesel production can be used as a carbon source to produce PHB (poly(3-hydroxybutyrate)) and mcl-PHA (medium-chain-length poly (hydroxyalkanoate)), depending on the bacterial strain employed.

Hutňan et. al investigated about biogas production from crude glycerol (by-product of biodiesel production). The experiments were carried out in the UASB reactor that is seen in figure 13. Anaerobic treatment of crude glycerol with suspended sludge with effective volume of 4 liters which was operated under the temperature of 37 °C. Results from long-term co-digestion of maize silage and crude glycerol in full scale anaerobic reactor at biogas plant were observed. As a result, max organic loading rate achieved was 6,486 $kg/m^3.d$. Maximum specific production of biogas was achieved at glycerol dose of 15 ml/d and it reached 0,840 l per 1 ml of crude glycerol. Long term processing of crude glycerol in the full scale biogas plant for anaerobic treatment of maize silage showed that crude glycerol is suitable co-substrate. Evaluated specific production of biogas from crude glycerol was about 0,89 m^3 per 1 kg of crude glycerol added. Dose of crude glycerol which represents only 5.2 % of overall dose to biogas plant produces almost 15 % of overall biogas production. Use of this co-substrate has significant influence on positive economical balance of biogas plant [36].

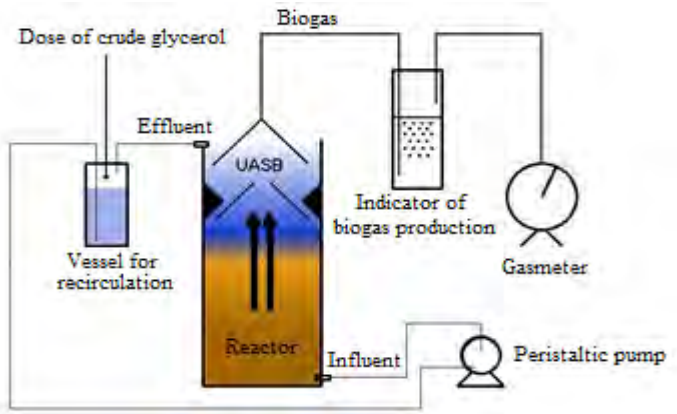

Figure 13. Scheme of the laboratory UASB reactor for anaerobic treatment of crude glycerol [36].

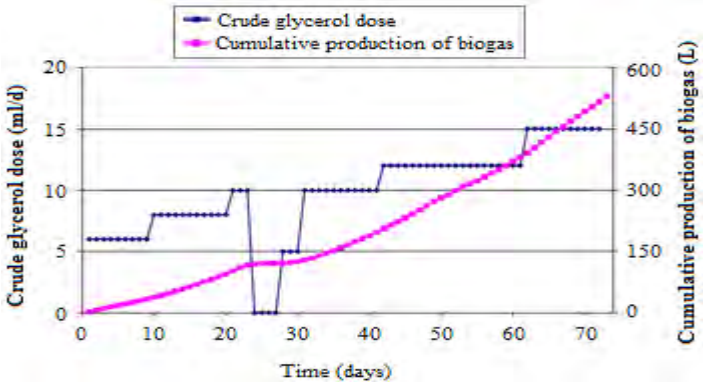

Figure 14. Crude glycerol dosing and cumulative production of biogas in UASB reactor with granulated biomass [36].

4. CONCLUCION

Biodiesel is generally derived from vegetable oils, waste oils and animal fats. That renewable fuel becomes more attractive day by day due to the fact that it is more environmentally friendly than petroleum based fuels. Glycerol is the major by-product of biodiesel production process; approximately 10% of the weight of biodiesel is formed. The most general applications of glycerol use the purified or distilled form of this product but it needs fairly complex and expensive processes. The crude/unrefined form of glycerol as a by-product of biodiesel production provides a reduction of biodiesel cost by utilization of it in various areas such as combustion, animal feed, co-gasification, etc. The news and mainly researches about the utilization of crude glycerol were addressed in this review study.

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BIOGRAPHY

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ICOEST 1st INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND TECHNOLOGY
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9 - 13th September 2015

Convenience of Using Microwave Irradiation in a Batch Biodiesel Reactor and Producing Methyl Esters from Waste Frying Sunflower Oil

Veli Gökhan Demir[1], Hakan Serhad Soyhan[2]

Abstract

Biodiesel is a nontoxic, biodegradable and environmentally friendly renewable fuel and commonly derived from vegetable oils and animal fats. The basic obstacle to biodiesel commercialization is its high production cost and raw material supply problem. In spite of these difficulties, using waste cooking oils as a raw material and microwave irradiation for heating can reduce biodiesel production cost, since, with respect to literature, using microwave irradiation provides increasing ester yields and lessens both reaction time and energy consumption. In this study, methyl esters were produced by transesterification of waste frying sunflower oil in a 60 L capacity microwave assisted batch biodiesel reactor. For a quite short 5 minutes transesterification reaction and purification process, it was observed that the methyl ester had excellent fuel qualities such as 0.885 g/cm^3 (at 15°C) for density, 4.64 mm^2/s (at 40°C) for viscosity and 178°C for flash point which met EN14214, also Fourier Transform Infrared Spectroscopy (FTIR) analysis outputs were similar to literature data which belongs to methyl esters appropriated to EN14214 standards. As a result, it is seen that compared to using vegetable oils and conventional heating systems, providing feedstock from waste oil and accomplishing biodiesel production by microwave assisted reactor can be possible to get high quality biodiesel with a fairly decreased fuel cost.

Keywords: Renewable Energy, Transesterification, Methyl Esters, Microwave Irradiation.

1. INTRODUCTION

Biodiesel is an alternative to petroleum based fuels derived from vegetable oils, animal fats, and used waste cooking oils. Due to the petroleum crises, the rapidly rising petroleum prices and obscures of petroleum availability, and also increasing worries about the environment and greenhouse gases effects have lead increasing attention to vegetable oils as a substitute of fossil fuels [1]. Vegetable oils can be used as fuels for diesel engines, however their viscosities are much higher (about 10 to 20 times) than petroleum based diesel fuel and require modifications of the engines [2]. Other constraints of using vegetable oil directly are its low volatility and polyunsaturated character. To overcome these restrictions, the processes such as dilution, pyrolysis, micro-emulsification, transesterification, etc. were developed [3]. By transesterification method, a new form of oil without glycerin called biodiesel can be formed.

Compared to petroleum diesel, biodiesel has a more favorable combustion emission characteristic such as low emissions of CO, PM and HC. CO_2 produced by combustion of biodiesel can be recycled by photosynthesis, thereby minimizing the impact of biodiesel combustion on the greenhouse effect [4]. Moreover, biodiesel is a safer fuel than petroleum diesel with its high level flash point value and it has a lubricator feature. Biodiesel is

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commonly blended with petroleum based diesel to make biodiesel blends. These are denoted as B#, in which the number refers to the percent biodiesel. B100 is also called pure Biodiesel and, B20 and B2 are fairly common blend levels [5]. Transesterification of the vegetable oils in batch processes is the most commonly used method for biodiesel production. In the reaction, a short chain alcohol (generally methanol) reacts with the oil by the aid of a catalyst to accelerate the reaction in a stirred tank to produce the alkyl esters of fatty acids (biodiesel) [6].

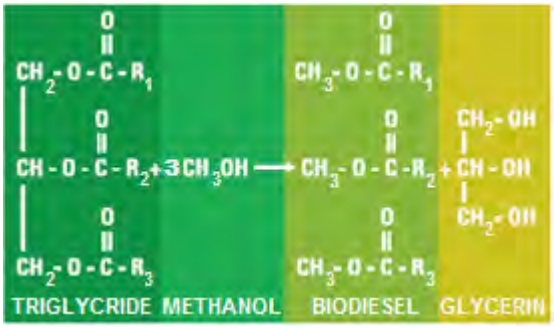

Figure 1. Transesterification reaction chemistry

Triglycerides, the main components of oils and fats, compose about 90–98% of total mass. Transesterification reaction is a chemical process of reacting triglycerides with alcohol in the presence of a catalyst (Fig. 1) [7]. In transesterification, methanol is the commonly preferred alcohol due to its low price, physical and chemical advantages (polar and the shortest chain alcohol). It can be easily reacted with triglycerides and catalysts. Generally the most preferred catalysts are also sulfuric, sulfonic, and hydrochloric acids as acid catalysts, and sodium hydroxide (NaOH), sodium methoxide (NaOMe), potassium hydroxide (KOH) and potassium methoxide (KOMe) as alkaline catalyst. However, the researchers have suggested that the free fatty (acid) FFA level of the feedstock should be reduced to less than 1% before using an alkaline catalyst [8,9,10]. Also the presence of water may cause ester saponification under alkaline conditions; dehydrated oil must have water content less than 0.5 wt.%. According to various studies of alkali-catalyzed transesterification, the reaction temperature near the boiling point of the alcohol (e.g., 60℃ for methanol) and a 6:1 molar ratio of alcohol to oil were recommended [4,9]. Biodiesel is generally produced from high quality food-grade vegetable oils. Therefore, using high-quality virgin oils makes biodiesel more expensive than petroleum based diesel fuel. Hence, low cost feedstocks such as waste cooking and frying oils, rendered animal fats, leather industry wastes etc. should be used to produce low cost biodiesel [11]. Moreover in Turkey, using B2 is excise tax free for biodiesel produced from waste cooking vegetable oils.

Microwave irradiations are electromagnetic irradiations that have wavelengths in the range of from 0.01 to 1 m and corresponding frequency range of 0.3 to 300.10^3 MHz. Microwave reactors used for chemical synthesis and all domestic microwave ovens operate at 2450 MHz frequency, which corresponds to a wavelength of 12.25 cm [12]. The electromagnetic spectrum is shown in Fig. 7, microwave are in the region between the infrared and radio frequencies.

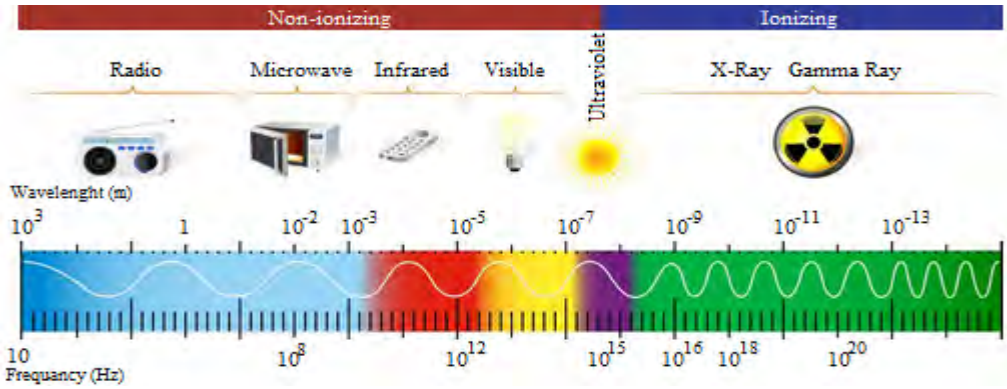

Figure 2. The electromagnetic spectrum

Microwave irradiations activate the smallest degree of variance of ions and polar molecules such as methanol by changing magnetic fields progressively. Also changing of electrical fields interacts with the molecular dipoles and charged ion, causes these molecules or ions to have a rapid rotation and heat is generated because of the molecular frictions. Therefore, microwaves make the chemical reactions faster and high product yields can be achieved in a much shorter time. Also in some studies it is claimed that microwave irradiations makes the separation process easier compared to conventional heating [13,14,15].

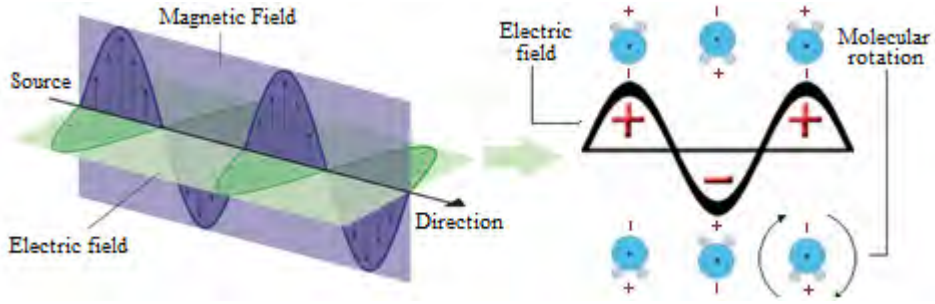

Figure 3. Electric-magnetic fields and interactions between the molecules and microwave.

Numerous research groups have recently focused on the microwave irradiation method for producing methyl ester by transesterification method. Azcan and Danışman [16] investigated about comparison of microwave and conventional heating systems on transesterification of cottonseed oil, and determining optimum reaction parameters in the presence of methanol and potassium hydroxide (KOH). As a result of this study, 7 min reaction time, 60°C temperature and 1.5% catalyst–oil ratio were obtained as optimum reaction parameters (99.8% ester content) for microwave irradiation heating. Similar results were observed for conventional heating in a 30 min reaction time. Yaakob et al. investigated the effect of parameters such as quantity of catalyst, reaction temperature and reaction time. They specified that the best yields conversion for Jatropha (89.7%) and waste frying palm oil (88.63%) were obtained by using 1% NaOH and a 12:1 molar ratio of methanol to oil in a 7 min reaction time at 65°C [17]. Duz et al. transesterified safflower oil with NOH (1 wt% of oil) and methanol (10:1 molar ratio of oil) in a 500 mL reactor. They defined optimum conditions for achieving 98.4% conversion with a 6 min reaction time at 60°C by using a maximal power of 300W [18]. Kanitkar et al. produced biodiesel from rice oil. 97.2% conversion yield was obtained by applying 0.15-0.18% NaOH as a catalyst with a methanol to oil molar ratio of 5:1 for 5 min at 60°C [19]. Lin at al. compared using microwave irradiation in transesterification of Jatropha oil to conventional heating systems. They reported that the optimal yield (96.2%) was achieved with using $NaNH_2$ (1.0 wt.%) and methanol (molar ratio of 9:1) by microwave irradiation. Same results were obtained by conventional heating system in 90 min. As a result, microwave reduced the reaction time from 90 to 7 min, also microwave consumed energy 10 times less than conventional heating system [20].

As it seen, all these studies have specified that using microwave for chemical reactions is more efficient than using conventional techniques, and that microwave can increase the reaction rate, product yields, and purity of methyl ester. In this study, our own design 60 L capacity microwave assisted biodiesel reactor was used for producing methyl esters from waste frying sunflower oil.

2. MATERIALS AND METHODS

2.1. Material Used

In this study, waste frying sunflower oil (WFSO) was obtained from several food companies in Balıkesir, TURKEY. Firstly, the WFSO was filtered to remove the insoluble materials (such as meat and bone particles). Then, moisture content and FFA level of the oil were determined to define the biodiesel production process. According to titration (EN 14104), the acid value of the WFSO was found under 2 mg KOH g^{-1} and moisture content measured 356.40 ppm by Karl Fischer method (EN ISO 12937), so it did not require any pretreatment processes to the feedstock. Some properties of the WFSO are shown in Table 1. In this study molar ratio between oil and methanol was used for determining quantity of methanol, hence molecular weight of WFSO was calculated according to equation (1) [21]. Fatty acid composition of WFSO analyzed by Gas Chromatography (GC). Table 2 shows the fatty acid composition of the WFSO. By equation (1) and fatty acid composition of

WFSO, the molecular weight of oil was calculated as 879.14 $g.mol^{-1}$. The chemicals (alcohol=methanol and catalyst=potassium hydroxide, KOH) used for experiments were analytical reagent grade and were used without further purification, both of them were purchased from Sigma–Aldrich. 55 ºC preheated warm distilled water was used for washing solvent.

Table 1. Some properties of WFSO

Properties	Unit	Value
Density (at 15°C)	$g\ cm^{-3}$	0.925
Viscosity (at 40°C)	$mm^2\ s^{-1}$	36.47
Acid value	mg KOH g^{-1}	0.41
Water content	% mass	0.346

Table 2. Fatty acid composition of the WFSO

Fatty Acid	Lipid Number	Chemical Formula	Molecular Weight	Mass (%)
Linoleic	C18:2	$C_{18}H_{32}O_2$	280.45	57.04
Oleic	C18:1	$C_{18}H_{34}O_2$	282.46	28.58
Palmitic	C16:0	$C_{16}H_{32}O_2$	256.42	6.29
Stearic	C18:0	$C_{18}H_{36}O_2$	284.48	3.91
Behenic	C22:0	$C_{22}H_{44}O_2$	340.58	0.71
Arachidic	C20:0	$C_{20}H_{40}O_2$	312.53	0.27
Lignoseric	C24:0	$C_{24}H_{48}O_2$	368.64	0.24
Gadoleic	C20:1	$C_{20}H_{38}O_2$	310.51	0.13
Palmitoleic	C16:1	$C_{16}H_{30}O_2$	254.41	0.10
Mistiric	C14:0	$C_{14}H_{28}O_2$	228.37	0.07
Linolenic	C18:3	$C_{18}H_{30}O_2$	278.43	0.05
Margaric	C17:0	$C_{17}H_{34}O_2$	270.45	0.03

$$M_{W_{tri}} = 3M_{W_{FFA}} + M_{W_{gly}} - 3M_{W_{water}} \quad (1)$$

Where $M_{W_{tri}}$ is the WFSO molecular weight, $M_{W_{FFA}}$ is the average of the free fatty acid molecular weight, $M_{W_{gly}}$ is the glycerin moleculer weight and also $M_{W_{water}}$ is the water molecular weight.

2.2. Biodiesel Reactor

The reactor and whole biodiesel processor system are shown in figure 4 and 5. The reactor has 60 L capacity and is composed of 3.6 kW microwave heating system, 2.7 kW conventional heating system (electric resistance), mechanic stirrer (56 rpm), circulation pump (60 L/m), intake fan, manometer and relief valve. It has a PLC circuit and software to control reaction parameters sensitive.

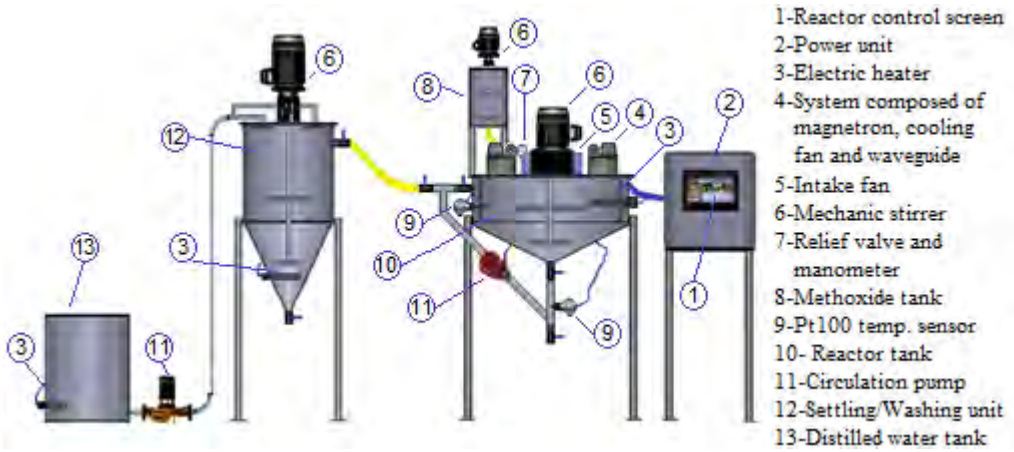

Figure 4. The whole biodiesel processor system.

Microwave heating system is composed of four magnetrons and a magnetron has 0.9 kW. Two pt100 sensors were used to measure temperatures and the system uses the average of them. For heating, microwave effective power can be adjusted and conventional heating system can be selected from the control monitor, it is designed to allow to compare conventional and microwave heating systems. Also, reaction temperature setting; circulation pump, mechanic stirrer and intake fan are operated from the control screen. In the full capacity biodiesel producing process, firstly methoxide is prepared in methoxide tank and transferred to reactor inside preheated oil to perform transesterification. At the end of the reaction, the mixture is pumped to separating and washing tank, after sedimentation the methyl ester is washed with 55℃ distilled water by mixing gently (13 rpm). At the end of the process methyl ester is dried at 110℃.

Figure 5. Top view of the biodiesel reactor

2.3. Transesterification Process

For the first trial of microwave assisted reactor, the transesterification reaction was carried out from WFSO. The reactor was filled with 35-kg WFSO. Amounts of methanol and catalyst were defined as 6:1 molar ratio to oil and 1 wt.% of oil respectively. The catalyst, potassium hydroxide was dissolved in methanol and then added to the reactor into the preheated oil. The reaction temperature was set to 60℃ and mechanic stirrer (56 rpm) and circulation pump (60 L/m) were run together. The whole reaction retained 40 min and 8 samples were taken per 5 min. At the end of the reaction, the mixture was cooled to room temperature and transferred to separatory funnels. Two layers occurred by sedimentation (figure 6), the up layer is crude methyl ester while the down layer is glycerin. After removing glycerin (figure 7), the methyl ester phases were washed with 55℃ distilled water (figure 8), then dirty water separated from the methyl esters, the washing process was applied four times. Excess methanol and water residuals were removed by drying at a higher temperature of water boiling point in atmospheric pressure. Finally, purified methyl esters were filtered to be ready for analyzing.

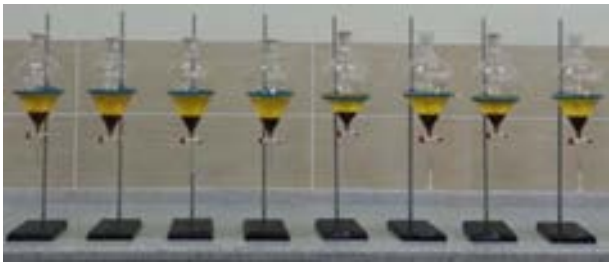

Figure 6. Methyl esters with glycerin

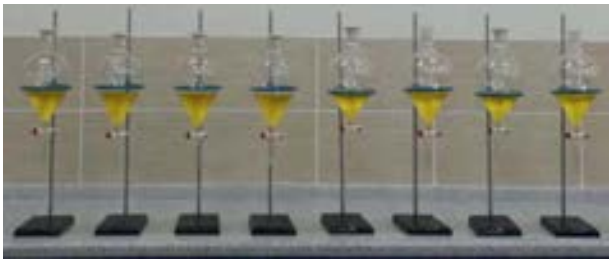

Figure 7. Crude methyl esters

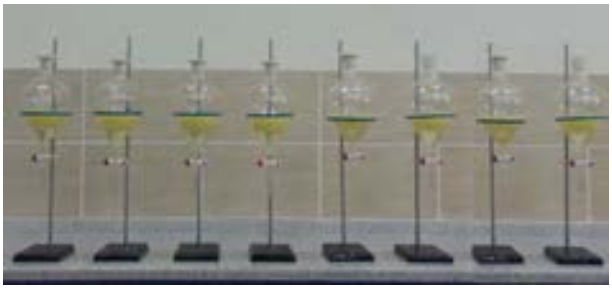

Figure 8. Wet washing process, methyl esters with distilled water

3. RESULTS AND DISCUSSION

3.1. Measurements of Density, Viscosity and Flash Point Temperature

Kinematic viscosity and density are the key fuel properties for efficient combustion in diesel engines. They influence on the atomization quality, the size of fuel drop and engine output power. Also, flash point temperature is a safety characteristic of fuels and it is used in shipping and safety regulations to define flammable and combustible materials. The flash point temperature is the minimum temperature at which the biodiesel will flash upon application of an ignition source [22]. Therefore, quality evaluations of the methyl esters of waste frying sunflower oil (MEWFSO) were determined by measuring physical parameters such as density, viscosity and flash point according to the European Union Draft Standards, EN 14214. It is observed that all properties of No 1 to N0 8's are in the range of specified EN 14214 standards, as shown in table 3.

Table 3. Some properties of MEWFSO

	Density (at 15°C) (g cm^{-3})	Viscosity (at 40°C) (mm^2 s^{-1})	Flash Point (°C)
EN 14214	0.86-0.90	3.5-5.0	min. 101
No 1 (5 min)	0.885	4.64	178
No 2 (10 min)	0.885	4.59	174
No 3 (15 min)	0.883	4.63	173
No 4 (20 min)	0.884	4.61	175
No 5 (25 min)	0.884	4.60	176
No 6 (30 min)	0.883	4.58	171
No 7 (35 min)	0.884	4.60	172
No 8 (40 min)	0.884	4.61	174

3.2. FTIR Analyses

Infrared spectroscopy is a mostly used method for quantitative and qualitative analyses. Within the biodiesel measurements, the fatty acid methyl esters have characteristic absorptions at around 1745 cm^{-1} due to the carbonyl groups. In literature there are various studies using FTIR analyses for defining biodiesel quality related to its ester content. According to their studies, Rabelo et al., Ivanoiu et al. and Soares et al. noticed that the FAME contents which were almost appropriate to EN14214 standards gave the peak value of the methyl ester wavenumber at around 1745 cm^{-1} [23-25]. In this study, FTIR analyses of 8 samples were performed by PerkinElmer Frontier Spectrum 65 analyzer spectrometer equipped with a 9-reflection diamond UATR sampling accessory. The methyl esters (5 min to 40 min) have infrared absorptions at almost same wavenumbers. Moreover, as it seen in figures 9, 10, and 11; at the range of 1700-1800 cm^{-1}, the peak values of sample no 1 and 8 are same: 1741.77 cm^{-1} while sample 4 is 1741.76 cm^{-1}. All these results mean that performing transesterification for 5 min by the microwave assisted reactor is enough to produce excellent quality biodiesel.

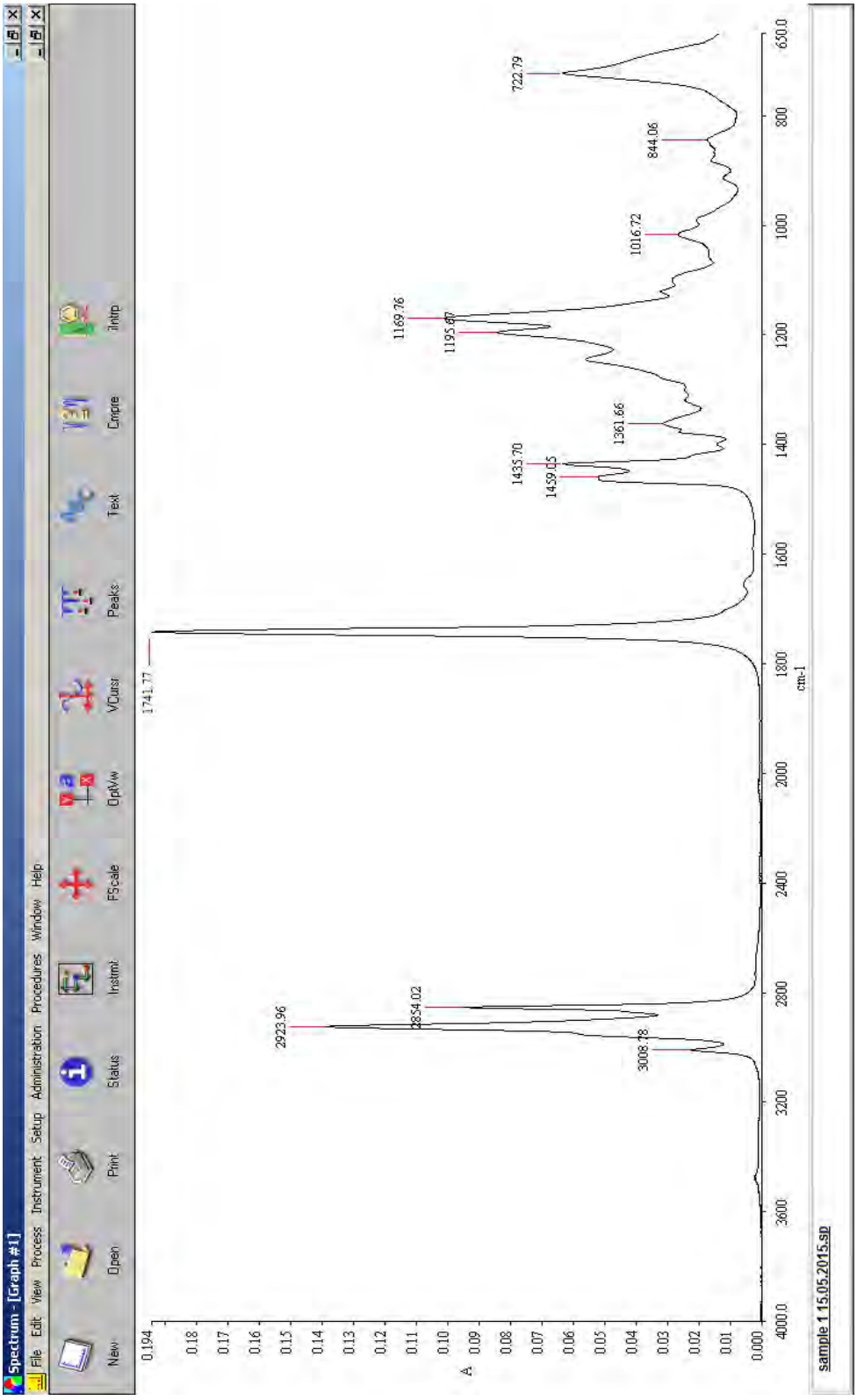

Figure 9. FTIR analysis of sample 1

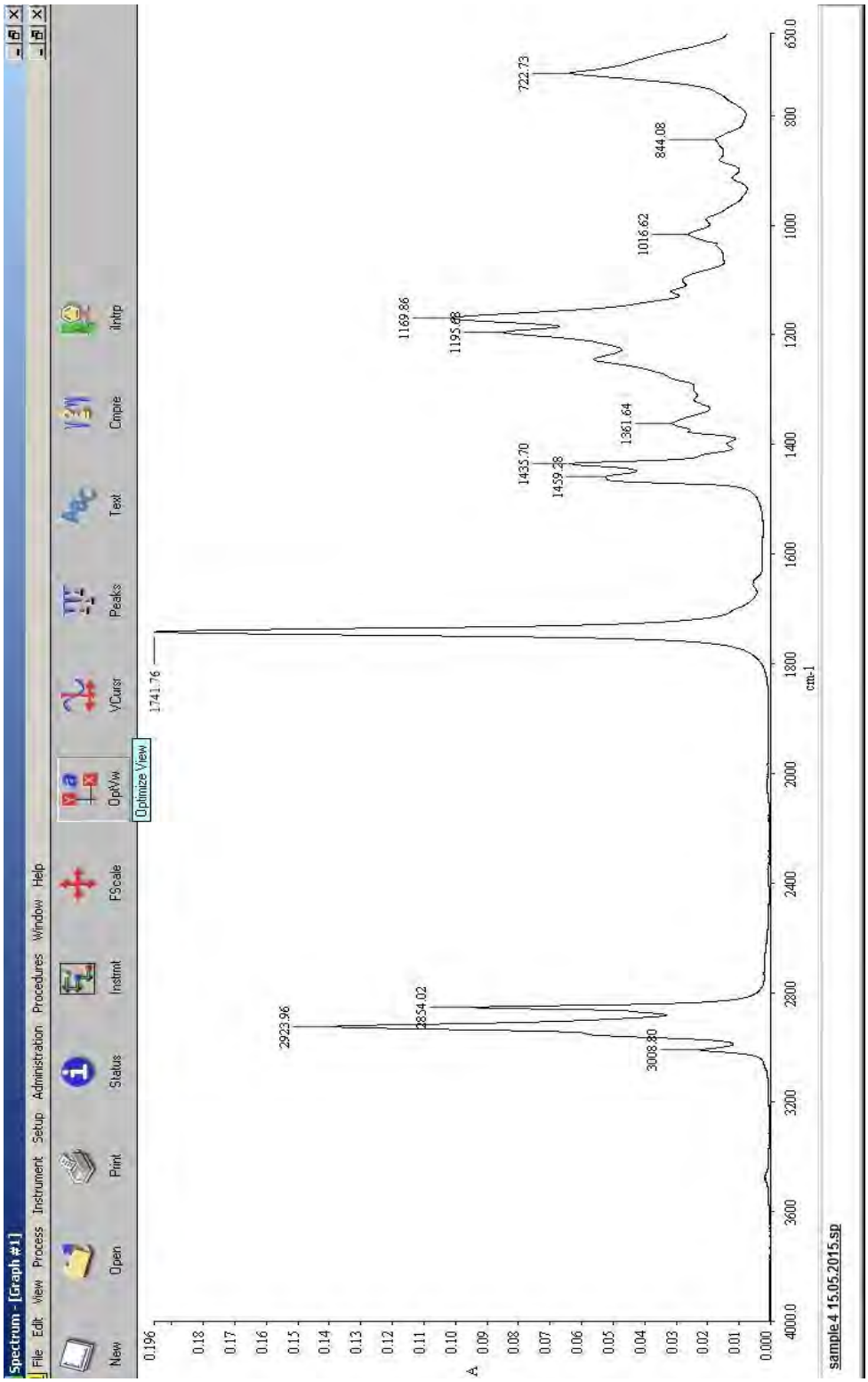

Figure 10. FTIR analysis of sample 4

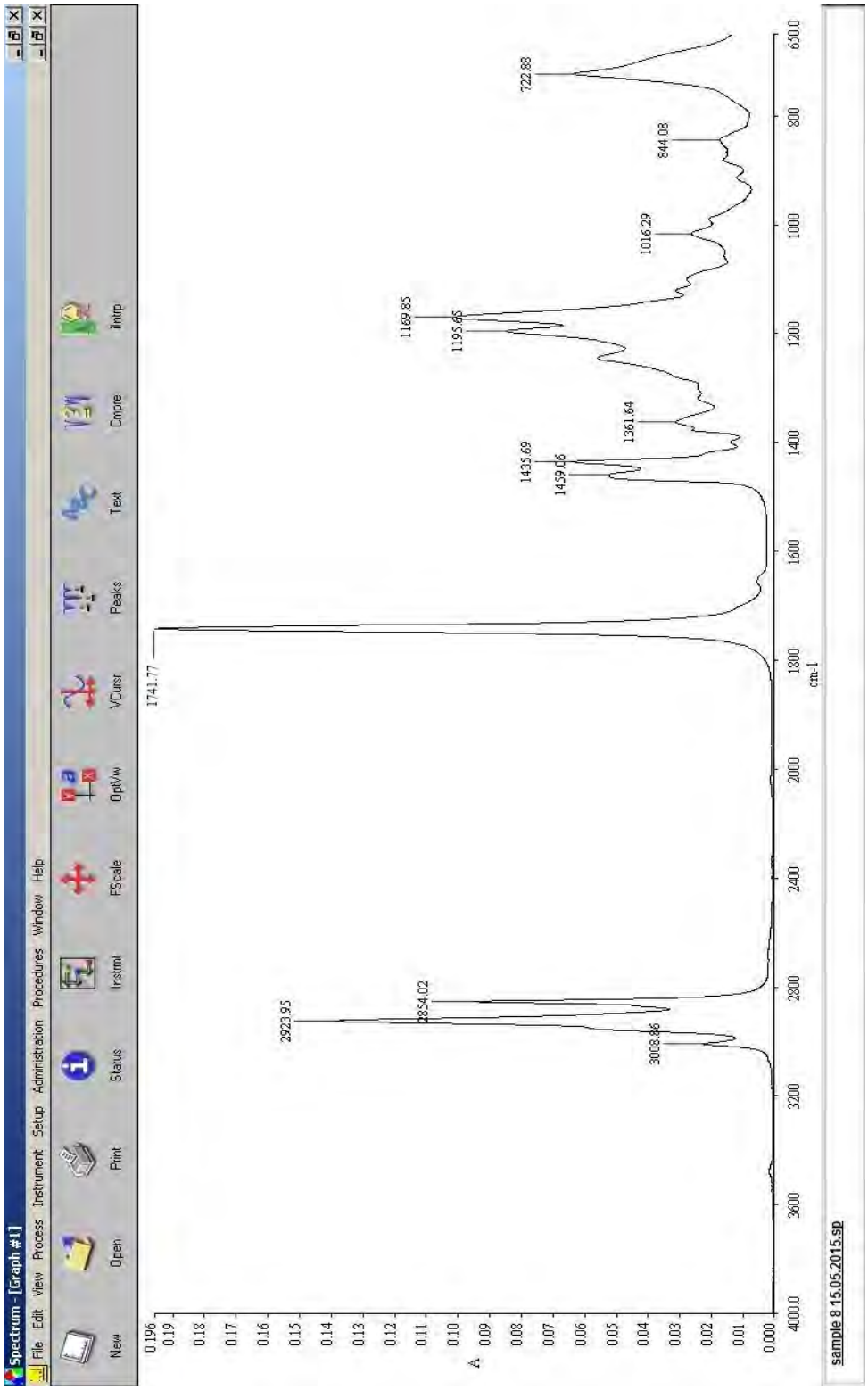

Figure 11. FTIR analysis of sample 8

4. CONCLUSION

In this study, the production of fuel quality methyl esters from waste frying sunflower oil was investigated. Transesterification process without any pretreatment was used to convert oil to its ester due to its low %FFA and moisture content values. Transesterification reaction was performed in the presence of 6:1 molar ratio methanol to oil and KOH 1wt% of oil in our own design 60 L capacity microwave assisted batch biodiesel reactor. To define fuel properties such as density, viscosity, flash point temperature and estimated ester content, physical measurements and FTIR analyses were carried out. The preliminary experimental study about using an industrial scale microwave assisted biodiesel reactor has almost demonstrated that even 5 min transesterification can be adequate to obtain methyl ester that is suitable for EN 14214 standards with much less fuel production cost comparing to conventional systems.

ACKNOWLEDGMENT

Major support from Balıkesir University is appreciated. Also, we express our sincere thanks to "Mikromak-Industrial Microwave Drying Systems co." and "Baliteknik-PTFE coatings co." for technique supports, and "Lokmacı Ali Usta - food co." for feedstock supplying support during the course of this work.

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BIOGRAPHY

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ICOEST 1st INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND TECHNOLOGY
SARAJEVO
9 - 13th September 2015

Research on the Utilization Potentials of Wind and Solar Energies in Eastern Anatolia Region Of Turkey

Rasim Behçet[1], Cumali İlkiliç[2], Faruk Oral[3]

Abstract

When the conventional energy resources and the potential of the renewable energy resources of Turkey are compared, solar and wind energies especially gain great importance. Considering the utilization of these energies in the regions of Turkey, Eastern Anatolia Region ranks one of the last places. In this research, having important places among the renewable energy resources in Eastern Anatolia Region, the potential and utilization of solar and wind energies are examined. In this context, after carrying out a research on the sources of wind and solar energies in Eastern Anatolia Region, the places where these energies can be utilized most efficiently are determined. Besides, the potential of wind and solar energies in Eastern Anatolia Region in terms of production technologies, the utilization level and method of these potentials both sole and together are discussed. Moreover, some suggestions to utilize the wind and solar energies efficiently and prevalently in Eastern Anatolia Region are put forward.

Key Words: Wind energy, Solar energy, potential of energy, Eastern Anatolia Region.

1. INTRODUCTION

Energy is one of the fundamental needs to develop in the industrializing countries. Industrialized countries obtain %65 of the energies they use from the fossil fuels. If these countries continue to use fossil fuels at this percentage for their energy consumption, the increase of air pollution, the rise of the greenhouse effect around the world, the decrease in oil reserves and the increase in prices will be inevitable[1]. When the energy resources and potentials existing in the world are examined, one can state that the renewable energy resources, especially solar and wind energies have a quite high potential when compared to conventional energy resources. Wind and solar energies can be renewed for free, and they are environment friendly. They are also energy resources which are redundant in atmosphere and easy to obtain. Today, one of the practices that first come to mind in terms of renewable and clean energy sources is wind energy. Wind energy is utilized by several countries in the world, and has recently started to gain importance in Turkey. [2,3]. This type of energy has been utilized for purposes such as water pumping, grain milling and mechanical power for thousands of years. Today, there are hundred thousands of windmills around the world. Many of these are systems used for water pumping. The modern equivalents of windmills are wind turbines which produce electricity from wind energy. Wind energy is also used for moving ships. A wind power generator was produced in United States and Australia between 1920 and 1930. Later, electricity generation was started in various places in the world by developing wind energy systems. [4]. Another renewable, clean and free energy resource is solar energy. Solar energy is redundant, stable, renewable and free, and as it prevents the environmental problems resulted from the consumption of conventional fuels, it is

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clean and environment friendly. Today, solar energy is used for air-conditioning (heating and cooling) of houses and offices, cooking, providing hot water and heating swimming pools. The utilization areas of solar energy are heating of greenhouses and desiccating of agricultural products in agricultural technology; solar cookers, solar ovens, obtaining salt and fresh water from sea water, solar pumps, solar cells, solar pools, application of heat pipes in industry; signalization and automation in means of transport and communication; and electricity production. As renewable energy resources, wind and solar energies are variable both during a day and a year, because they are unstable. Hence, the sole usage of these energy resources decreases the credibility of the system. The credibility of the system can be increased by using two or more complementary renewable energy resources together, which is called hybrid energy systems. [5-10].

Like the rest of the world, several works have been carried out in Turkey for utilizing from solar and wind powers. Some of these are about the utilization from only wind energy, some other are about the utilization from only solar energy, and some are about the utilization of wind and solar energies together. Gençoğlu et al. [11]. carried out a research about the utilization potentials of water pumping systems which are supported by a photovoltaic resource to evaluate the potential of solar energy in Eastern Anatolia Region. To utilize from solar energy, Yeşilata and Aktacir [12]. examined the designs of water pumps with photovoltaic (PV) power systems, drew graphics with the assistance of a technique helping them to easily choose the system components, and searched the effects of graphics required for the selection of photovoltaic solar panel. Yanıktepe et al. [13], were able to lighten up some classes in Osmaniye Korkut Ata University Faculty of Engineering by designing a hybrid system having an installed capacity of 600W, including a (300W) wind turbine and 3 solar panels (100W each). Aktacir et al. [14], established a prototype wind-solar hybrid system for field lighting in Osmanbey Campus of Harran University. Hybrid system is observed to provide continuously and safely the necessary electric energy for constant power consuming applications like especially lighting. Brian and Byron [15], used the electric energy, generated from wind and solar energies, in water pumping system and worked on the analysis of the performance of the system. Getachew and Palm [16] worked on the feasibility of solar-wind energy system applications in Ethiopia. The research of Reichling and Kulacki [17] is about electric generation from wind and solar energies in a beneficial scale in Minnesota.

In this research, as wind and solar energies have great importance in terms of renewable energy sources in Eastern Anatolia Region, the present potential of these energies, the level and method of utilization from them are analyzed. Besides, some suggestions are put forward about the ways to efficiently utilize from wind and solar energies.

2. THE HISTORICAL DEVELOPMENT OF WIND AND SOLAR ENERGIES AND THEIR POTENTIAL OF USAGE

2.1. Wind Energy

The usage of wind energy is not a new technology, and has played an important role in the history of humankind. Human's discovery of wind power and taking advantage of it dates back to old times in history. Wind is a movement of the air resulted from the heating of the earth by the sun. Wind energy, on the other hand, is the movement energy that the air movement, forming the wind, has. The kinetic energy in the wind first transforms into mechanical energy, and then via wind turbine into electric energy. It is known that Egyptians used wind energy in addition to the power of galley slaves in B.C. 2800. Egyptians utilized from wind power to float quite heavy ships by blowing up meters long sails. From Holland to America in many countries, wind energy is being generated via wind mills, and used for obtaining water from wells. People in Iran and Afghanistan used wind power for grain milling. Today, wind energy is mostly used for generating electricity. The first wind turbine used for generating electricity was produced in Denmark in 1890. In this period, %25 of the electricity used in industry was obtained from wind turbines[18]. High utilization of wind power in the world started in United States in 1947, and wind turbines (up to 100 kW) became commonly-used in USA and Europe. In the following years, big powerful systems called Wind Electric Power Plant (RES) became more and more commonly-used. Considering recent developments in wind energy, the wind energy in the world as of 2013, the total installed capacity of 300 GW of power plants are past cases. 73% of this installed capacity is located within the boundaries of the five countries. Wind power installed capacity will be ranked countries in the matter; China, 91 GW, reaching the installed wind power with this ranking in the first row, while U.S. 61 GW and the second, Germany 34.25 GW third, Spain 23 GW fourth, while in India 20 GW, and the fifth is in order. The first electric generation from wind energy toward general utilization in Turkey is obtained in Çeşme with a wind turbine of 55 kW nominal powers in 1986, and later on this power increased to 8.7 MW [4]. As a result of the researches about wind energy, the area around Çanakkale Bosporus, Bozcaada, Gökçeada, Sinop, İnebolu, Bozkurt, Samsun, Bandırma, Balıkesir, Çorlu,

Edremit, Ayvalık, Dikili, Çeşme, Bodrum, Bergama, Antakya, Anamur, Silifke, Mardin, Malatya, Erzurum, Seydişehir, Karaman and Afyon were determined to be utilizable areas for wind energy. Considering the average annual rate, the best wind resources of Turkey exist nearby coastlines, high hills, tops of mountains and open areas. Turkey is a rich country in terms of wind, and is stipulated to meet the %25 of its energy deficit. The regional distribution of wind energy potential of Turkey is given at the table 1 [19]

Table 1. Turkey's wind energy potential distribution by geographic region.

Regions	**Annual average wind speed (m/s)**	**Annual average wind density (W/m^2)**
Marmara Region	3.29	51.91
Aegean Coast	2.65	23.47
Mediterranean Coast	2.45	21.36
Central Anatolia Region	2.46	20.14
Black Sea Region	2.38	21.31
South Eastern Anatolia Region	2.69	29.33
Eastern Anatolia Region	2.12	13.19
Average	**2.58**	**25.52**

Turkey is a rich country in terms of wind, and if she turns it into utilizable energy, she will gain benefits by all means. Even though the wind energy potential of Turkey is 7 times higher than Germany, 5 times higher than Denmark and twice as much as Spain, she ranks after all these countries in terms of utilizing this energy. [20-23]
Another way to generate utilizable energy from wind energy is to transform wind energy into electric energy via wind turbines. The power provided by the wind is in direct proportion with the cube of the speed of the wind and the rotor swept area of the wind turbine that will be used. The speed of the wind, an important factor to obtain power, increases logarithmically as it arches from the ground. The power, which can be obtained from wind power plant, is limited to the number and size of the turbines used. According to the data of 2014, the development of the installed wind power throughout the years in Turkey is given at Fig. 1. [20].

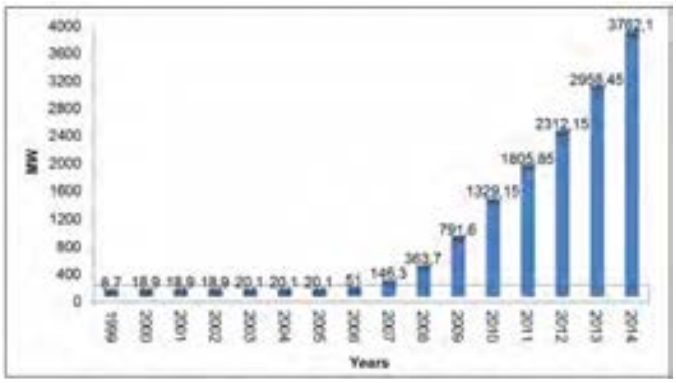

Figure 1. The development of the installed wind power in Turkey according to years

The power of the installed wind energy according to regions in Turkey is given at Fig. 2. Considering the wind power between 1999 and 2014, the power of installed wind energy in Turkey in 1999 was 8.7 MW, and it increased to 3762.1 MW in 2014. In other words, the power of installed wind energy in Turkey increased 432 times as much. Especially in the last six years, there has been a dramatic increase.

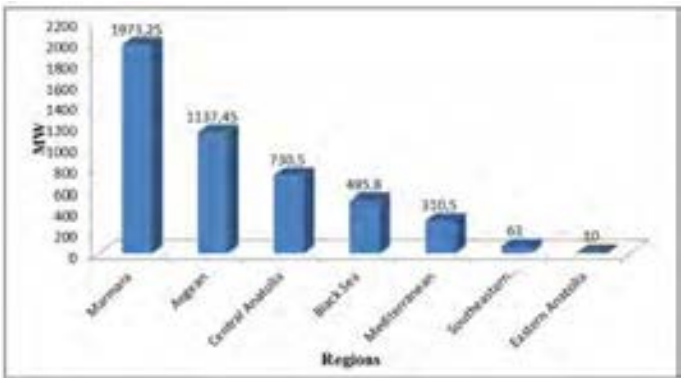

Figure 2. The distribution of the installed wind energy in Turkey according to geographic regions

2.2. Solar Energy

The most important energy resource of the world is sun. Solar energy is the main energy resource affecting the physical formations in the earth and atmosphere. In order to have the most efficient benefits from solar energy, it is required to be located in the area between 45° north-south latitudes, called "Sunbelt" [5]. Solar energy enables the flow of matter and energy in the world [9]. Even though solar energy was used by people since ancient ages, the first developments in this field were carried out during 18^{th} and 19^{th} century. The works about utilizing from solar energy gained momentum especially after 1970s, and the solar energy systems technologically developed and their cost decreased. It adopted itself to the society as an environment friendly energy resource. Coming to the fore by decreasing the global warming and carbon dioxide emissions, clean and renewable energy gained more importance day by day. As a result of these developments, the first industrial type of energy generation was carried out in Los Angeles in 1984 with parabolic reflector system, producing 354 MW power generations. In 1990s, as one in California (10 MW) and one in Jordan (30MW), two solar tower systems were built. Later on, the works and investments in solar energy increasingly continued in the very beginning of 2000s. Especially production of photovoltaic industry developed, and in 2006, world photovoltaic production reached to the capacity of 2.520 MWp modules [24, 25]. The electricity generation from solar energy is being ignored in Turkey for a long time, but recently the Ministry of Energy and Natural Resources has stated that they started to work for building an electricity generation system with a capacity of 600 MW till the end of 2013 [26]. Compared to the other energies, solar energy is easy to obtain and clean, but expensive to transform into other energy types. The applications of high heat, on the other hand, are thermal systems making intensifications. The most prevalent intensifier thermal systems are the parabolic gutter collectors. Applications of low heat have been used since old times, but applications of high heat rapidly increased after the oil crises in 1973, and many projects on solar energy power plants were carried out in 1980s. Another field, in which solar energy is utilized, is the photovoltaic (FV) power systems used as generators of electric energy. These systems are used for independent applications far from networks such as meeting the demand of a small settlement (village etc.) or a house that does not have network connection, water pumping, street lighting, base stations, and signalization systems. They are also used for network dependent applications of private (home, building etc.), state (universities etc.) and business firms (supermarkets etc.), and for network connected electricity generation in areas built as centrals called "sun field [4-8].

2.3. The Usage of Wind-Solar Energies Together and the Hybrid Systems

The systems in which two energies at least are used together are called hybrid systems. Hybrid systems are important for the areas where wind and solar energies and complementary. These systems are especially suitable for continuous applications in summer and winter seasons when the need for energy is high. In hybrid applications, the dual and triple usage of solar, wind and diesel generator energy resources are possible. The energy resources that will be used are determined according to the meteorological conditions of the region [1, 4]. The solar power is low in winter when the speed of the wind is high, and it is strong and bright in summer when the speed of the wind is low. Thus, the efficient energy generation in wind and solar energies differ according to the time of the day and the year. As a result, solar energy can be utilized when the speed of the wind isn't efficient, and wind energy can be utilized when the solar energy is inefficient. Therefore the sustainability of energy generation in systems can be accomplished. In case solar and wind energies is inefficient on their own, battery operated hybrid systems are very useful energy resources for areas where there is no network energy. These negative issues, resulted from the unstable characteristics of the wind and solar resources, can be overcome by designing suitable combinations of these two resources in which the powerful one will step in when the other resource is weak [4]. Solar and wind energies are crucial resources to take into consideration for especially small rural settlements and agricultural generation systems where there is no network connection.

3. THE POTENTIAL AND USAGE OF WIND-SOLAR ENERGIES IN EASTERN ANATOLIA REGION

The Eastern Anatolia Region is located in the easternmost part of Turkey. This region of Turkey is one of the seven geographical regions cover about 21% of Turkey's land in terms of surface area. Van largest province in terms of population, is the largest province of Erzurum terms of surface. Map of Turkey's regions and location of cities at the east Anatolia region of Turkey can be shown from Figure 3.

Figure 3. Map of Turkey's regions and location of cities at East Anatolia region of Turkey

3.1. The potential and usage of wind energy

Wind energy is an energy resource causing no pollution and very little harm to the environment. Wind energy can be obtained in % 95 of the world, and agriculture and silviculture can be carried out in those areas. It is also an alternative energy resource for domestic utilization. In the past, it is used for geographical discoveries by blowing up the sails of the ships, graining mills and water pumping. Today, it is used for electric generation via wind plants. The kinetic energy in the wind first transforms into mechanical energy, and then via wind turbine into electric energy. Wind turbines can be designed in two ways: vertical and horizontal axis. Horizontal axis turbines provide electric generation more efficiently than the vertical axis turbines. Thus, horizontal axis turbines are commonly used for electric generation. [3,4]. Eastern Anatolia Region and Southeastern Anatolia Region have several great rural areas, and their potential of wind energy are suitable for electric generation. The average density of wind power in Eastern Anatolia Region is 13.19 W/m^2 and its average wind speed is 2.12 m/s. The average density of wind power in Southeastern Anatolia Region is 29.39 W/m^2 and its average wind speed is 2.69 m/s [3]. Considering the wind potentials of these regions, the wind energy systems that will be built there will have important economic benefits as there are many rural areas. Making different kinds of renewable energy resources utilizable in addition to present energy resources will help both the region and the country to develop.

This will enable our country to utilize from the potential of the wind and, pave the way for more studies in the field. Wind energy can be utilized by developing the technologies to use the wind power in many cities of Turkey such as Çanakkale, Sinop, Samsun, Balıkesir, Afyon, Antakya, Mersin, Karaman, Şanlıurfa, Mardin, Erzurum, and Malatya. The places where wind energy can be utilized in Eastern Anatolia Region are respectively Malatya, Elazığ, Erzincan and Erzurum. In terms of wind potential, Malatya ranks the first place among the cities in Eastern Anatolia Region. 7 m/s wind speed and a capacity of more than %35 are required for the investment in economical wind power plant (RES). As it can be observed in Figure 4, Arapkir district of Malatya is the most suitable place to build a wind energy plant, and meets the conditions. Arapkir has the best wind energy potential in the region. It is planned to generate 27.000.000 kWh electricity annually from the wind power plants consisting of 5 units which will be built within the scope of wind power-based RES project in Onar and Aktaş villages of Arapkir. Works in order to start generation in 2014 in the 5 units, built in an area publicized for 49 years, are still ongoing. Another city, where works are being carried out to build RES facilities in order to utilize from wind energy in Eastern Anatolia Region, is Erzurum. The RES facility, which is still being built in Yakutiye village of Erzurum, is expected to start working in autumn of 2015, and to generate 55.188.000 kWh electricity annually. As it can be observed in the wind atlas of Turkey given in Figure 4, the regions with the highest wind rates are Marmara, Southeastern and Aegean Regions. Even though Eastern Anatolia Region ranks the last place in terms of utilizing from the wind power, the RES facilities in Malatya and Erzurum, building processes of which are ongoing, will have crucial benefits to the region in terms of energy generation. Wind electricity plants are causing less harm to the environment when compared to other energy generation systems. Besides, they generate cleaner and cheaper energy.

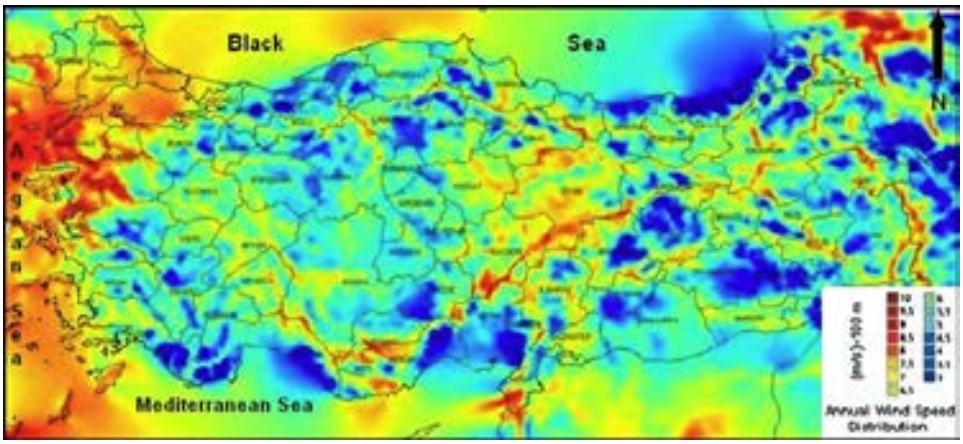

Figure 4. The wind energy potential atlas of Turkey [6]

3.2. The Potential and Usage of Solar Energy

As solar energy is a free, continuous, renewable, clean and environment friendly energy resource, it is used for air conditioning of houses and offices, providing hot water, heating of swimming pools and greenhouses, desiccating of agricultural products, electricity generation, and many other areas in industry. The most prevalent usage of solar energy in Turkey is for the systems of hot water and greenhouse heating. Southeastern Anatolia Region receives the solar power the most, when Black Sea Region receives it the least. When the regions are compared in terms of the annual amount of insolation periods, Southeastern Anatolia Region ranks the first place with 2993 hours, Mediterranean Region ranks the second with 2956 hours, and Eastern Anatolia Region ranks the third place. As it is stated in the Table 4, when the insolation periods of the cities in Eastern Anatolia Region compared, Van ranks the first, Hakkari the second, and Malatya the third. Ardahan ranks the last place in terms of insolation periods. All regions, but Black Sea Region, are suitable for photovoltaic generation systems with thermal and mechanical transformations. The distribution rates of the potential and the insolation periods of solar energy in Turkey are given at Table 2.

Table 2: Turkey's radiation and insolation rates distribution by geographic region.

Regions	Total Solar Energy (KWh/m -yıl)	Sunbathing Time (hours / year)
Southeastern Anatolia	1460	2993
Mediterranean	1390	2956
Eastern Anatolia	1365	2664
Central Anatolia	1314	2628
Aegean	1304	2738
Marmara	1168	2409
Black Sea	1120	1971

According to the results obtained from the General Directorate of State Meteorology by resorting to the data about the insolation periods and radiation intensity between 1954-2013, the average annual total of insolation period in Turkey is 2640 hours (7,2 hours in total per day) when it is 2664 hours (7,3 hours in total per day) in Eastern Anatolia Region. Besides, the rates of total radiation intensity are respectively 1311 kWh/m -year (3,2 kWh/m in total per day), and 1365 kWh/m2-year (3,74 kWh/m in total per day). The average radiation intensity in total is 3,6 kWh/m in total per day. The potentials of solar energy and the insolation periods according to the months in Eastern Anatolia Region are given at Table 4. Just like in the rest of Turkey, solar energy is used for heating buildings and greenhouses, and providing hot water in Eastern Anatolia Region. Solar energy is most prevalently used for providing hot water.

As chicken breeding for meat is one the most important fields in food sector, the usage of solar energy in chicken breeding farms, the air conditioning in summer, and heating in winter will have important contributions. Moreover, the number of works to benefit from the solar energy in public organizations of the region is increasing day by day. Many works were carried out towards investigation in the universities of the region to benefit from solar energy, and some works are still ongoing. In Fırat University, works on water pumping in the wells by using solar energy were carried out. İnönü University started to build a solar power plant generating 5 MW energy in an area of 100,000 m . After this facility starts working, it will constitute the %60 of the installed solar energy power in Turkey. Being the biggest solar power plant in Turkey, it is aimed at meeting %32 of the total energy demand of Turgut Özal Medical Center by generating 8,5 million kWh annually. The second area to utilize from solar energy in universities was joining to the competition, organized by TÜBİTAK, about cars working by using solar energy. Another way to benefit from solar energy was building tent cities for seasonal workers to make their social and working life better, and meeting the electricity demand of tents by solar energy in Malatya. The monthly average distribution of the solar energy potentials and insolation periods in Eastern Anatolia Region of Turkey is given at Table 3.

Table 3: The monthly average total of solar energy potentials in Eastern Anatolia Region of Turkey [6]

Months	Monthly total sun energy (kWh/m^2-month)	Sunbathing time (H / month)
January	51,75	103,0
February	63,27	115,0
March	96,65	165,0
April	122,23	197,0
May	153,86	273,0
June	168,75	325,0
July	175,38	365,0

August	158,40	343,0
September	123,28	280,0
October	89,90	214,0
November	60,82	157,0
December	46,87	103,0
Total	1311	2640
Average	3,6 kWh/m^2-day	7,2 hours / day

When looking into the solar energy rates according to the months given at Table 4 for the cities of Eastern Anatolia Region, it can be observed that there is a high radiation in June, July and August. Radiation is in its lowest level in January and December. Considering the annual insolation periods in Eastern Anatolia Region, Van ranks the first place with 7,79 hours on average per day, when Ardahan ranks the last place with 5,64 hours. When the insolation periods according to the months in Eastern Anatolia Region are examined, it is concluded that Ağrı and Bitlis has the lowest radiation in December with 2 hours when Malatya has the highest radiation in July with 12,4 hours. As it can be observed in Fig. 6, in terms of having the most solar energy annually in Eastern Anatolia Region, Van ranks the first place with 93,5 hours, Hakkari the second with 90,3 hours, Malatya the third, and Ardahan the last with 67,7 hours. Turkey and Eastern Anatolia Region are very suitable areas for utilizing from solar energy, because Turkey is located between 36-42° north latitudes, and even the Black Sea Region, located in the most inconvenient place as it is stated in Table 2, has 1971 hours of insolation when Eastern Anatolia Region has approximately 2700 hours of insolation.

Table 4. The distribution of average insolation periods of cities in Eastern Anatolia Region according to months [6]

	Sunbathing Times (hours)													
Cities	January	February	March	April	May	June	July	August	September	October	November	December	Annual average	Annual total
Van	4,4	5,2	6,6	7,1	9,2	11,5	12,1	11,3	9,5	7,1	5,3	4,2	7,79	93,5
Hakkari	4,1	5,1	5,5	6,4	9	11,5	12,2	11,3	10,1	7,2	5,2	4,6	7,68	92,2
Malatya	3,3	4,2	5,4	7,2	9,3	11,4	12,4	11,6	10	7,3	5,1	3,1	7,53	90,3
Tunceli	3,2	4,1	5,3	6,3	8,5	11,2	11,6	11,1	9,4	6,5	5	3	7,10	85,2
Muş	2,1	3,1	4,5	6,4	9,1	11,5	12,3	12,6	10,3	7,1	4,1	2,1	7,10	85,2
Elazığ	2,4	3,5	5,2	6,4	9,1	11,3	12,1	11,3	9,5	7,1	4,4	2,3	7,05	84,6
Erzurum	3,1	4,2	5	6,3	8	10,3	11,2	10,7	9	6,7	4,7	2,9	6,84	82,1
Erzincan	3,6	3,6	5,1	5,5	7,4	9,6	11	10,2	8,6	6,3	4,3	2,4	6,47	77,6
Kars	3,1	4,1	5,1	5,6	7,2	9,2	10,6	10,2	8,3	6,3	4,3	3,1	6,43	77,1
Iğdır	2,3	4,6	5,2	6,6	7,3	9,4	10,1	9,5	8,4	6,2	4,2	2,3	6,34	76,1
Bingöl	3,2	4,2	5	5,3	7,3	9,4	9,6	9,2	8,3	6,2	4,3	3,1	6,26	75,1
Ağrı	2,1	2,5	4,2	5,4	7,5	10	10,2	10,1	9,1	6,3	4	2	6,12	73,4
Bitlis	2,2	3,2	5	5,5	7,2	9,2	9,5	9,4	9,1	5,2	2,6	2	5,84	70,1
Ardahan	2,5	3,3	4,6	5,1	7	8,4	8,6	8,3	7,3	5,6	4,6	2,4	5,64	67,7

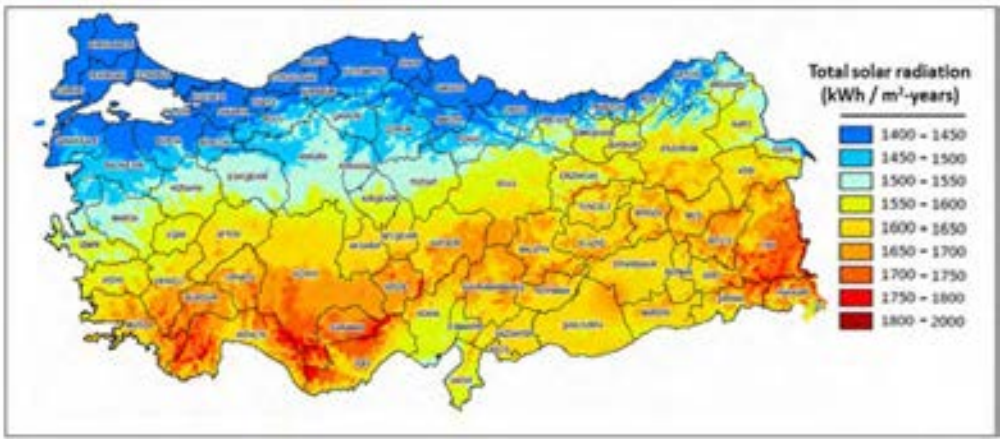

Figure 6. The Solar Energy Potential Atlas of Turkey

According to the Figure 6, the cities where the number of the areas, stated with light and dark red, where solar energy can be best utilized, is more are respectively Van, Hakkari and Malatya. In the red colored areas, the rates of solar energy global radiation are high. The average radiation in these cities is between 1600 and 1800. As the dark red areas show the places where solar energy can be better utilized, and the distribution of global radiation is between 1400 and 2000, it can be referred that Van, Hakkari and Malatya are above the average of the distribution of global radiation. The global radiation rate of annual average total solar energy of Van is 1.635 kWh/m year. When this rate is compared to the other cities where the global radiation of solar energy is highest, it ranks the third place after Karaman (1660 kWh/ m) and Antalya (1646 kWh/ m). Van is dramatically above the average of Turkey in terms of both the global radiation rate of solar energy and the insolation periods. Considering the various parameters affecting the efficiency of the solar panels which are used for utilizing solar energy and especially electricity generation, Van is one of the cities with the highest potential of solar energy. Even though Van has a great potential as a source of solar energy, the solar energy applications in Van are limited to Akdamar Island in Gevaş district. The electricity demand of the island is provided by solar energy via building solar panels in Akdamar Island. In many cities, it is possible to come across applications such as lighting of parks and gardens with the electricity generated in solar panels, agricultural irrigation, and solar houses [21,26]. It can be said that Van is the most advantageous city and has the highest potential in terms of the investments for electricity power plants of solar energy.

4. CONCLUSION

Eastern Anatolia Region is geographically more suitable for wind energy plants to be built, and it is also more convenient for solar power plants. As it can be understood from the results of this research, Arapkir district of Malatya has a rich wind potential among the cities of Eastern Anatolia Region. In order wind power plants to be built and to work efficiently, Onar and Aktaş villages of Arapkir are the most suitable places. Even though Eastern Anatolia Region ranks the last place in terms of utilizing from wind energy, the RES facilities, which are still being built in Malatya and Erzurum, will have important contributions to the region for energy generation. Electricity power plants, giving less harm to the environment than the other energy generation systems, will enable to generate cleaner and cheaper energy when protecting the environment at the same time. Moreover, all cities of Eastern Anatolia Region are suitable for utilizing from solar energy. The cities where the potential of solar energy is the highest are respectively Van, Hakkari and Malatya, and they are the most convenient places to build solar power plants. The energy generation power plants that are prevalent in other regions of Turkey will be more common in our region too through the wind and solar power plants that will be built in those areas, and will contribute to the region's economy. Thus the diversity of resources for the energy generation in the region will be provided, and the loss, occurring when the electricity generated in other regions of Turkey is transformed to Eastern Anatolia Region, will be eliminated. Due to the unstable characteristics of wind and solar energies, they should be used together, and in case of a problem, when one of them is weak, the strong one should step in. Nonetheless, new employment areas will be provided with the wind and solar power plants which will be built in Eastern Anatolia Region. In this context, as the region is suitable for agriculture and livestock, the energy need of

related facilities will be provided by environment friendly energy resources and the nature of the region will remain unharmed. In conclusion, Eastern Anatolia Region should minimize its dependence to other regions in terms of economy and energy, and should focus on renewable energy resources, especially on wind and solar energies.

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Foam Concrete Production with a Fly Ash Addition

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Abstract

Foamed concrete is a versatile material which has become widely used in the construction industry. It is a lightweight concrete which most of the volume is composed of air voids. It has high fluidity, low unit weight, the minimum or no aggregate usage, controlled low strength and good insulation properties make it as a preferred material. Foam concrete shows a high resistance against water and freeze-thaw effect. It has excellent sound and heat insulation properties as compared to normal concrete. Due to the advances in the production equipment and foaming technology, foam concrete has found a wide range of production and use in recent years.

In this study, fly ash was used as the main raw materials in the production of foam concrete blocks. Fly ash were used in this study is a mineral waste which was obtained from Seyitomer Power Plant (Turkey). Average size of the fly ash was 27 microns, which is similar to cement average particle size. The fly ash has low in lime, fewer than 3 percent, and contains a greater combination of silica, alumina and iron than Class C ash. It was concluded that, Seyitomer Fly Ash (Turkey) can be utilized in foam concrete production without harmful effect on the engineering properties of the product and this way can be a solution to the mass consumption of the mineral waste.

Keywords: Foam concrete blocks, recycle, fly ash, sustainable production

1. INTRODUCTION

Foam concretes become preferential materials in construction industry because of their physical, mechanical and thermal properties. Foam concrete belongs to light weight concrete which is self flow, self compacted and no need for vibration material. It contains homogenously distributed very small air voids. Foaming agents are used for the pore generation in the concrete. Foam concrete has many application fields like heat and sound insulation, fill concrete, preventing waving in bridges, soft basement in road construction, radial base, precast or in site applications, blocks [1]. They don't contain any hazardous material during production or life cycle. They have reasonable cost with high productivity. They have enough strength for many construction applications [2-4].
Foam concrete properties can be classified in four groups [5];
1. Physical properties: drying shrinkage, density, pore ratio and structure, water absorption.

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2. Mechanical properties: Compressive and bending strength, modulus of elasticity.
3. Durability: freeze–thaw cycle
4. Functional properties: Heat and sound insulation, fire resistance etc.

The main objective of this study was to use the fly ash, which was generated by product of power plant, in the production of foam concrete. Optimum foam concrete production parameters were determined, physical and mechanical properties of the foam concrete samples were examined.
The worldwide production of coal combustion products was approximately 780 Million metric tonnes. The largest coal combustion product producing countries were China, North America, India, Europe Africa and Middle East as a minor contributor [6]. Using pozzolanic materials (i.e. fly ash, ground blast furnace slag) from industrial-production waste to make concrete is one possible approach to resolving this problem. One pozzolanic material, fly ash (FA), is a waste product of powdered coal that has been burned as fuel in power plants [7].

2. MATERIALS AND METHODS

Fly ash was supplied from a thermal power plant in Turkey. Fly ash sample was characteristic particle diameter d_{50}:28, d_{75}:56 and d_{90}:94 µm respectively (Table 1). Fly ash have mean particle size range of 30-150 µm, Blain finesse 4565 cm^2/g and specific gravity 2,1. XRD analysis of the fly ash is presented in Figure 1. Accordingly, mainly composed from fly ash and silica fume quartz phase has an almost non-crystalline phase structure. . CEM I 42.5R type Portland cement was used. Cement and fly ash properties are given in Table 1.

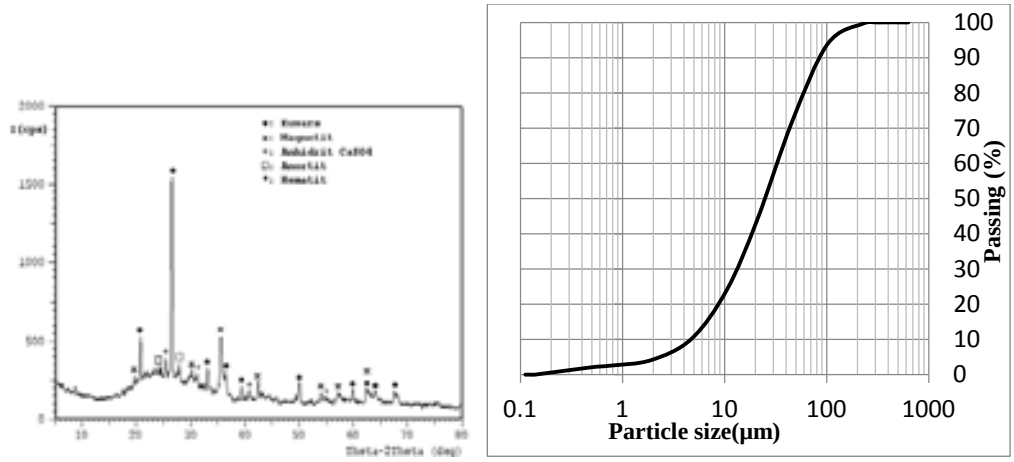

Figure 1. (a) XRD pattern of the *fly ash, (b) and p*article size distribution.

Table 1. The chemical properties of the cement and fly ash.

% Oxides	CEM I 42,5 R	Fly ash
SiO_2	16.80	56,01
Al_2O_3	4.81	22,36
Fe_2O_3	3.55	9,85
CaO	63.90	2,12
MgO	1.94	3,76
Na_2O	0.74	0,19
K_2O	1.24	2,07
SO_3	3.02	0,59
MnO	0.12	0,16
Cl^-	0.01	-
L.O.I	1.24	1,02
Free lime	1.90	-

Specific gravity gr/cm^3	3.12	2.1
Surface area, cm^2/gr	3315	-
Standard water dem., %	32	-
Setting time, start, (min)	177	-
Setting time, finish (min)	244	-

Organic origin foaming agent was used in this study. Foaming agent was diluted with water at a ratio of 1/30. Laboratory type foam generator was used. 70 gr/L foam density was produced (Figure 1). Synthetic fibres (polypropylene) were added of the 0.2% of the cement in order to prevent shrinkage cracks. Specimen series were produced with 6 different fresh mortar densities. For foam concrete the base mix is typically 1:1 fly ash to Portland cement. As the density was reduced the amount of foam was increased and at fresh mortar density varied between 650 -900 kg/m^3 (Table 2). Firstly; water, fibre, cement and fly ash was taken on the weight percentage. Total amount of plasticizer and accelerator agents used was 0.1-0.5% of the cement respectively. W/C ratio was selected 1.5 as a constant in all mixtures. Foam concrete was produced in two steps; (i) production of mortar which is self flow (ii) addition of previously produced foam to the mortar in mixer and allows homogenous mixture of foam concrete. Addition of foam continued until required mortar density reached. Foam density was selected as 70gr/L for all series. Fresh mortar was weighed after mixing process (Figure 2). Foam was added and mixing was continued until it reaches required mortar density. Fresh mortar was than cast into the mould without any waiting period. Curing must start as soon as without losing its stability or without any collapsing. Accelerator agent addition, curing temperature and time are important parameters. Foam concrete moulds were held up at 40 ^{0}C until completion of curing period (6 hour) in the oven. After curing in the moulds, samples were taken out from the moulds and atmospheric steam curing was applied to the samples (Figure 3). Samples were cured at steam for 6 hour at 50 ^{0}C. Physical and mechanical test were conducted after steam curing.

Table 2. Mix design of the specimens.

Seri	*Cement*	*Fly ash*	*Foam (g/L)*	*Fresh mortar dens. (g/L)*	*W/C*
1	*1*	*1*	*70*	*650*	*1.5*
2	*1*	*1*	*70*	*700*	*1.5*
3	*1*	*1*	*70*	*750*	*1.5*
4	*1*	*1*	*70*	*800*	*1.6*
5	*1*	*1*	*70*	*850*	*1.5*
6	*1*	*1*	*70*	*900*	*1.5*

Figure 2. (a) Checking density of the foam, (b) and mortar.

Figure 3. (a) Heating in the oven and (b) steam curing cabinet.

3. RESULTS AND DISCUSSION

Average values of the 6 sample result were presented. Unit weight of the samples determined. Raw materials, W/C, fresh mortar density, applied curing type and time, age of the concrete have strong influence on the strength development of the foam concrete. Unit weight of the samples is change between 460- 625 kg/m^3. Compressive strength of the samples is between 1.55 and 2.30 MPa. Compressive strength of the samples decreased with decrease in the unit weight exponentially. Fly ash has pozzolanic activity in cementitous systems. Inclusion of fly ash as a filler in foam concrete helps in achieving more uniform distribution of air voids than fine sand. Fly ash being finer, helps in uniform distribution of air voids by providing a well and uniform coating on each bubbles and preventing it from merging and overlapping [8]. Even though addition of FA causes a small increase in shrinkage, it has a major contribution toward increasing the strength of foam concrete of comparable density [9].

Amount of foam added to the mixture is an important factor of the production of foam concrete, which not only affects the density of products but also the mechanical property. This study has shown that the use of Seyitomer Power plant Fly Ash in foamed concrete can greatly improve its properties.

Table 3. Unit weight and compressive strength of the specimens.

Seri	1	2	3	4	5	6
Fresh mortar dens. (g/L)	650	700	750	800	850	900
Dry unite weight (Kg/m^3)	460	540	560	570	610	625
Comp. strh. (MPa)	1,55	1,70	1,75	1,90	2,10	2,30

ACKNOWLEDGEMENT

The authors are grateful to TUBİTAK for supporting this research financially (Project no: 5120029).

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Theoretical Investigation of a Swimming Pool Heating System by Using Waste Energy Rejected from an Ice Rink to Underground Energy Storage Tank

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Abstract

In this study, swimming pool heating system by using waste heat energy rejected from chiller unit of an ice rink to underground thermal energy storage (TES) tank has been theoretically investigated. Swimming pool and ice rink are assumed to be closed type, and they are considered to have been constructed in the city of Gaziantep. The system consists of a swimming pool, an ice rink, a spherical underground TES tank, a chiller and a heat pump. Total energy absorbed by refrigerant with the compressor of the chiller unit from the ice sheet is transferred to the underground TES tank and stored. Then, stored thermal energy is withdrawn by evaporator of the heating unit and transferred to the swimming pool. The analytical model which is developed to obtain thermal performance of the system is based on solution of transient heat transfer problem for the underground TES tank, and energy requirements of swimming pool and ice rink. The transient heat transfer problem is solved using a similarity transformation and Duhamel's superposition principle. A computer code is used to obtain the annual variation of swimming pool and ice rink energy requirements, water temperature in the TES tank, and system performance parameters depending on different swimming pool, ice rink, soil and TES tank parameters by using Matrix Laboratory (MATLAB) program. Results showed that operational time span of 5-7 years are necessary for obtain annually periodic operation condition. This means that after 5-7 years TES tank water temperature is not changed.

Keywords: Chiller, Heat pump, Ice rink, Swimming pool, Waste energy.

6. INTRODUCTION

Today, sport complexes are encountered in many places such as university campuses. The complexes contain several sections such as swimming pool, ice rink, basketball and volleyball courts, etc. Widely, swimming pool and ice rink are using for swimming race, water game, hockey, curling, and figure skating. The swimming pool is generally heated by conventional gas fired boiler, and recently solar energy is using instead of boiler [1-4]. The swimming pool water temperature should be between 22 ^{o}C and 28 ^{o}C for comfortable condition [5]. In the ice rink, to provide necessary hardness of the ice surface related to the different types of ice sports, the ice temperature should be kept between -6 ^{o}C to -1 ^{o}C by circulation of brine solution in the pipes or tubes under the ice layer. In addition, higher energy than the energy need of the ice rink is rejected from condenser of chiller unit to the environment by using

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conventional air source chillers [6-8]. Air source chillers can cause irregularity of COP because of the weather temperature and waste energy expenditure due to the disposal of energy into the environment. It is therefore, underground thermal energy storage (TES) tank is important for saving to the waste rejected energy. Analytical and experimental studies concentrating on the design, analysis and optimization of TES tank for heating and cooling application have been studied in the literature [9-12].

In this study, computational and analytical models for swimming pool heating and ice rink cooling systems with underground TES tank is developed. Analytical model is performed to find the performance parameters for the swimming pool heating system, the ice rink cooling system and periodic solution of transient heat transfer problem outside of TES tank. A program in Matlab is prepared to investigate effects of some system parameters such as earth type, Carnot efficiency and tank size on the performance parameters. Results obtained from the calculations are given as figures and discussed in the study.

7. DESCRIPTION OF SYSTEM

In this study, system is assumed to be settled in the city of Gaziantep in Turkey, which lies between 37º 4´ latitude N and 37º 29´ longitude E and has a Mediterranean climate. Figure 1 shows the simplified system scheme. The system consist of a swimming pool, an ice rink, a spherical underground TES tank, a cooling unit (Chiller) and a heating unit (Heat pump). Swimming pool and ice rink are considered to be constructed with following dimensions: 25m wide x 50m long with 2m depth for pool and 18m wide x 36m long for ice rink, and with 10m high indoor arena ceiling.

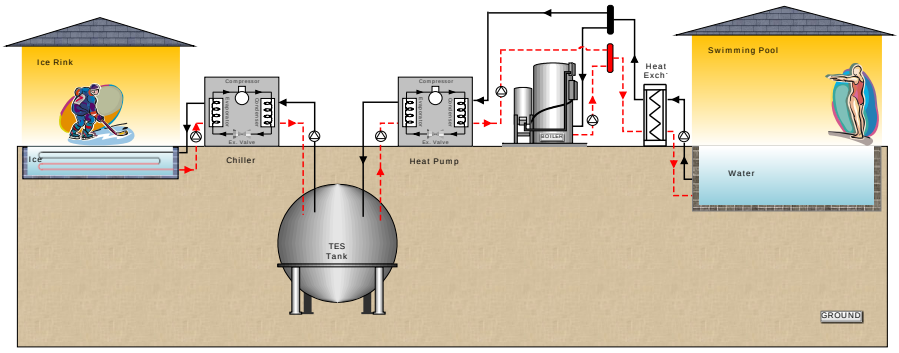

Figure 19. Swimming pool heating system by using waste heat energy rejected from chiller unit of an ice rink and stored in underground thermal energy storage (TES) tank.

The ice rink refrigeration system consist of cooling unit (Chiller) and brine system. In the brine system, the brine solution circulates as a secondary refrigerant through the pipes within the concrete slab and absorbs the heat from the ice sheet. Total energy absorbed by means of the compressor of the Chiller from brine system is transferred to the underground TES tank and stored. The TES tank is considered to be spherical and buried underground. The underground provides large energy storage medium and temperature is stable. This case improves performance of the system [11]. Stored thermal energy in the TES tank is extracted by evaporator of the heat pump and transferred to the swimming pool.

In the system, pool water is pre-heated to 26 ºC and ice is pre-cooled to -4 ºC. A standard gas-fired boiler is integrated to the system for pre-heat to the pool water and for balance to the energy demand of the pool in every season and weather conditions.

8. MODELING OF SYSTEM

In this section, a mathematical model for the thermal analysis of each component of the system is presented. This model developed for the determination of the transient temperature field problem around the TES tank, the swimming pool total heat loss, the ice rink total heat gain and coefficient of performance of the system.

8.1. Transient Temperature Field Problem around the TES Tank

The TES tank is considered to be spherical, filled with water and located in deep ground. Water temperature in the TES tank is initially at the deep ground temperature T_∞ and fully mixed at a spatially lumped time varying temperature, $T_w(t)$. Ground is assumed to have constant thermal properties and homogeneous structure.

In spherical coordinate system, transient temperature field problem around the TES tank and its initial and boundary conditions can be expressed as follows:

$$\frac{\partial^2 T}{\partial r^2}+\frac{2}{r}\frac{\partial T}{\partial r}=\frac{1}{\alpha}\frac{\partial T}{\partial t} \tag{1}$$

$$T(R,t)=T_w(t) \tag{2}$$

$$T(\infty,t)=T_\infty \tag{3}$$

$$T(r,0)=T_\infty \tag{4}$$

The energy transferred to the TES tank is equal to the difference between energy increase of the TES tank and the conduction heat loss from the TES tank to the surrounding ground. This can be expressed by:

$$Q=\rho_w c_w V_w \frac{dT_w}{dt}-kA\frac{\partial T}{\partial r}(R,t) \tag{5}$$

where ρ_w, c_w, and V_w are density, specific heat, and volume of the water in the TES tank. k, R, and A are tank radius, heat conduction coefficient of the surrounding earth, and tank surface area, respectively. Equations (1-5) can be transferred into dimensionless form by using following dimensionless variables:

$$x=\frac{r}{R},\quad \tau=\frac{\alpha t}{R^2},\quad q=\frac{Q}{4\pi R k T_\infty},\quad p=\frac{\rho_w c_w}{3\rho c},\quad \phi=\frac{T-T_\infty}{T_\infty},$$

$$\phi_w=\frac{T_w-T_\infty}{T_\infty},\quad \phi_a=\frac{T_a-T_\infty}{T_\infty},\quad \psi(x,\tau)=x\phi(x,\tau) \tag{6}$$

where x, τ, ϕ (or ψ), and q are dimensionless parameters of radial distance, time, temperature, and net energy to the tank, respectively. ρ and c are the density and the specific heat of the ground, respectively. Subscripts 'w' and 'a' stand for water and ambient air, respectively. The resulting dimensionless formulation of the problem is:

$$\frac{\partial^2 \psi}{\partial x^2}=\frac{\partial \psi}{\partial \tau} \tag{7}$$

$$\psi(1,\tau)=\phi w(\tau) \tag{8}$$

$$\psi(\infty,\tau)=0 \tag{9}$$

$$\psi(x,0)=0 \tag{10}$$

$$q=p\frac{d\phi_w}{d\tau}-\frac{\partial \phi}{\partial x}(1,\tau) \tag{11}$$

When the following similarity transformation variable η:

$$\eta = \frac{x-1}{2\sqrt{\tau}} \tag{12}$$

is applied to the transient heat transfer problem given in Eqs. (7-11), a solution of the resulting problem can be determined for constant ϕ_0 as:

$$\psi(x,\tau) = \phi_0 \left\{ 1 - erf\left(\frac{x-1}{2\sqrt{\tau}} \right) \right\} \tag{13}$$

The dimensionless transient temperature distribution in the earth surrounding the TES tank is obtained using Duhamel's superposition technique, which is given by the following expression:

$$\psi(x,\tau) = \phi_w(0) \left\{ 1 - erf\left(\frac{x-1}{2\sqrt{\tau}} \right) \right\} + \int_0^{\tau} \frac{d\phi_w(\xi)}{d\xi} \left\{ 1 - erf\left(\frac{x-1}{2\sqrt{\tau-\xi}} \right) \right\} d\xi \tag{14}$$

If the solution for ϕ is now differentiated with respect to the dimensionless variable x, the result evaluated at $x = 1$ and substituted into Eq. (11), the following integro-differential equation is obtained:

$$q = p\frac{d\phi_w}{d\tau} + \phi_w(\tau) + \int_0^{\tau} \frac{d\phi_w(\xi)}{d\xi} \frac{d\xi}{\sqrt{\pi(\tau-\xi)}} \tag{15}$$

Eq. (15) can be discretized and solved for the dimensionless temperature of the water in the TES tank at the nth time increment to yield:

$$\phi_w(\tau_n) = \frac{q(\tau_n) + \left(\frac{p}{\Delta\tau} + \frac{1}{\sqrt{\pi\Delta\tau}} \right) \phi_w(\tau_{n-1}) - \sum_{i=1}^{n-2} \frac{\phi_w(\tau_{i+1}) - \phi_w(\tau_i)}{\sqrt{\pi\Delta\tau(n-i)}}}{1 + \frac{p}{\Delta\tau} + \frac{1}{\sqrt{\pi\Delta\tau}}} \tag{16}$$

Eq. (16) will be used to calculate the water temperature of the spherical TES tank. The term $q(\tau)$ in Eq. (16) represents the dimensionless net heat input rate to the TES tank. The heat input rate to the TES tank is given by:

$$q(\tau) = q_{IR}(\tau) - q_{SP}(\tau) + \frac{w(\tau)}{\gamma} \tag{17}$$

where γ is dimensionless parameter, $\left[4\pi Rk/(UA)_h\right]$, and $q_{IR}(\tau)$ the dimensionless rejected energy rate by the chiller unit of ice rink. $q_{SP}(\tau)$ and $w(\tau)$ are the dimensionless heat requirement of the swimming pool and the heat pump work, respectively.

8.2. Thermal Analysis of Swimming Pool

Swimming pool heat loss takes place in five different ways: convection heat loss, latent heat loss due to evaporation from the surface of the water, conduction heat losses from bottom surface and side wall to the ground, the net radiation heat loss occurring between surface of the pool and around, and energy requirement for daily renovated feed water heating [13]:

$$Q_{SP} = Q_{SPconv} + Q_{SPcond} + Q_{SPeva} + Q_{SPrad} + Q_{SPren} \tag{18}$$

Swimming pool convection heat loss can be calculated on the basis of Newton's formula given below [14]:

$$Q_{SPconv} = h \cdot A_{ps} \cdot \left(T_w - T_{SPia}\right) \tag{19}$$

Swimming pool heat loss by conduction through the pool side and bottom surfaces is usually small. Heat loss by conduction is given by [14]:

$$Q_{SPcond} = U_{pw} A_{pw} \left(T_w - T_{SPg}\right) \tag{20}$$

The evaporation amount of water from water surface change depends on the difference between the saturated vapor pressure on the surface of the water with the indoor air saturation pressure Equation below can be used to find the amount of evaporation [15]:

$$M_{eva} = \frac{A_{ps}}{LH_{eva}} \cdot \left(p_w - p_a\right) \cdot \left(0.089 + 0.0782 \times u\right)(AF) \tag{21}$$

The heat exchange by radiation with the ceiling of the swimming pool can be calculated on the basis of the Stefan-Boltzmann law. The pool area can be taken as completely enclosed for indoor swimming pool. Radiation equation is given below [14]:

$$Q_{SPrad} = A_{ps} f_{pc} \sigma \left(\left(T_w + 273\right)^4 - \left(T_{SPc} + 273\right)^4 \right) \tag{22}$$

The rate of energy for renovated feed water heating depends on the amount of evaporation, feed water temperature and the designed pool water temperature. Renovated feed water heating can be calculated as [15]:

$$Q_{SPren} = M_{eva} C_w \left(T_w - T_{fw}\right) \tag{23}$$

8.3. Thermal Analysis of Ice Rink

Required energy of the ice rink can be calculated by summing the heat gain components at design operating conditions. Heat gains for ice rink are convective, condensation, radiation, conductive, ice resurfacing and lighting heat load [16].

$$Q_{IR} = Q_{IRconv} + Q_{IRcond} + Q_{IRrad} + Q_{IRrsurf} + Q_{IRlight} \tag{24}$$

The temperature of the air at near the ice surface is higher than the ice temperature. This temperature difference induce the convection. The convection heat gain can be calculated by equation [16]:

$$Q_{IRconv} = \left[h_{conv} A_{is} \left(T_{IRia} - T_{ice}\right) + K\left(X_a - X_i\right)\left(2852 kj/kg\right)\left(18 kg/mol\right)\right]/1000 \tag{25}$$

A wide variety of floor can be constructed depending on the sport to be performed on the ice rink. Heat gains from the ground can be calculated by Eq.20. The radiant heat gain from the ceiling which is generally warmer than ice surface, can be calculated by Stefan–Boltzmann equation as mentioned before in Eq. 22.

To maintain an ice surface, the ice resurfacing machine shaves the ice surface and then sprays a thin layer of warm water which is approximately 60-65 °C on the ice. Ice resurfacing heat load can be estimated by [16]:

$$Q_{IRrsurf} = \frac{1000 V_{flw} \left(LH_{frzw} + 4.2 T_{flw} - 2 T_{ice}\right) N_{rsurf}}{24\ t_{flw}} \tag{26}$$

Lighting is a major source of radiant heat to the ice sheet. The actual quantity depends on the type of lighting and its applied style. The direct radiant heat component of the lighting can be 60% of the luminaries [16]. Radiant heat component of the lighting can be expressed by:

$$Q_{IRlight} = 0.60\ Q_{lum} \tag{27}$$

8.4. Coefficient of Performance (COP) for the chiller and heat pump

In the ice rink cooling system, chiller absorbs heat and transfers to the underground TES tank. On the other hand, in the swimming pool heating system, heat pump extracts heat from the underground TES tank. Performance of chiller COP_C and heat pump COP_H may be represented as:

$$COP_C = \frac{Q_C}{W_{comp}} = \frac{Q_C}{(Q_H - Q_C)} \tag{28}$$

$$COP_H = \frac{Q_H}{W_{comp}} = \frac{Q_H}{(Q_H - Q_C)} \tag{29}$$

Tarnawski [17] expresses the actual COP of the chiller and heat pump by multiplying the Carnot Efficiency (CE) factor β :

$$COP_C = \beta \frac{T_C}{(T_H - T_C)} \tag{30}$$

$$COP_H = \beta \frac{T_H}{(T_H - T_C)} \tag{31}$$

Total cooling load of the ice rink and total heating load of the swimming pool may be expressed as a function of outdoor and indoor air temperature. Energy requirements of the ice rink and swimming pool in the whole year may be expressed as:

$$Q_{IR} = (UA)_{IR}(T_{oa} - T_{IRia}) \tag{32}$$

$$Q_{SP} = (UA)_{SP}(T_{SPia} - T_{oa}) \tag{33}$$

Energy requirements of the ice rink and swimming pool may also be expressed by:

$$Q_{IR} = (UA)_C(T_{ice} - T_C) \tag{34}$$

$$Q_{SP} = (UA)_H(T_H - T_w) \tag{35}$$

Eqs. (32) and (34) are combined and solved for T_C ; and Eqs. (33) and (35) are combined and solved for T_H . When T_C and T_H are substituted into Eq. (30) and (31), and the dimensionless parameters given in Eq. (6) are used; we obtain:

$$COP_C = \beta\left(\frac{u_C[\phi_i - \phi_a(\tau)] + \phi_i + 1}{u_C[\phi_a(\tau) - \phi_i] - \phi_i + \phi_w(\tau)}\right) \tag{36}$$

$$COP_H = \beta\left(\frac{u_H[\phi_i - \phi_a(\tau)] + \phi_i - \phi_w(\tau)}{u_H[\phi_i - \phi_a(\tau)] + \phi_i + 1}\right) \tag{37}$$

The parameters u_C and u_H in Eqs. (36) and (37) are defined as:

$$u_C = \frac{(UA)_{IR}}{(UA)_C} = \frac{T_{ice} - T_C}{T_{oa} - T_{IRia}} \tag{38}$$

$$u_H = \frac{(UA)_{SP}}{(UA)_H} = \frac{T_H - T_w}{T_{SPia} - T_{oa}} \tag{39}$$

9. RESULTS AND DISCUSSION

Effects of the system parameters such as earth type, the Carnot Efficiency (CE) factor and storage volume on the system performance were estimated. Results obtained from the numerical computatıons are shown in the figures and discussed in this section.

Figure 2 shows the annual variation of water temperature in the TES tank for coarse gravel type earth during the first, second, sixth, and seventh years of operation. It is clearly seen that annually periodic operating conditions are reached after the sixth year of operation.

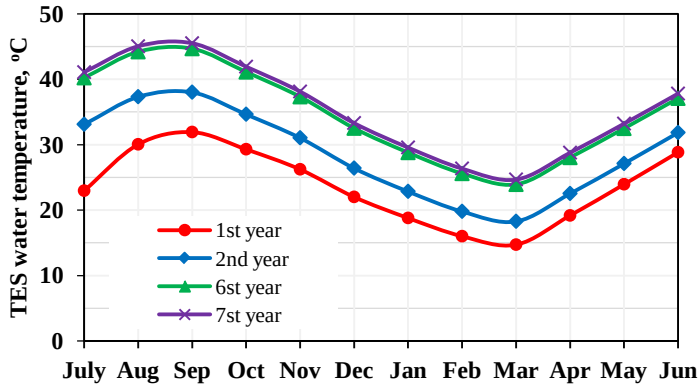

Figure 20. Annual temperature variation of water in the TES tank with number of operation years. (Coarse gravel, CE = 40% V = 100m^3)

Figure 3 annual variation of water temperature in the TES tank during the sixth year of operation for three different earth types; coarse gravel, limestone and granite. It is seen from Figure 3 that the highest and lowest temperatures are obtained at the August and March, respectively. Another observation that the highest water temperatures are obtained when the TES tank is surrounded with coarse gravel and the lowest one is obtained with the granite.

Figure 4 were prepared to emphasize effects of the TES tank size on water temperature. Figure 4 shows variation of water temperature in the TES tank for four different tank volumes during the fifth year operation. It can be seen that amplitude of the water temperature increases when the tank size is decreased.

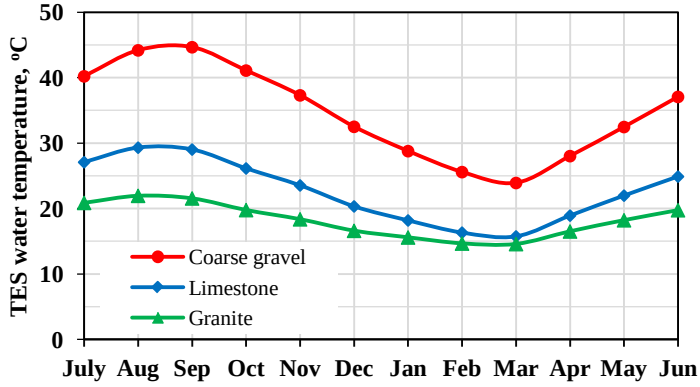

Figure 21. Effect of earth type on annual temperature variation of water in the TES tank during sixth year of operation. (CE = 40%, V = 100m^3)

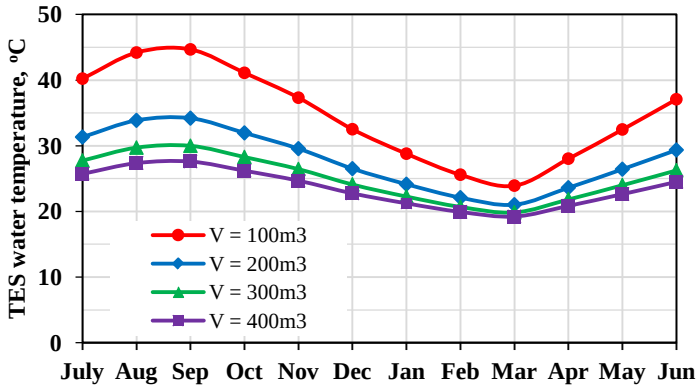

Figure 22. Effect of storage volume on annual temperature variation of water temperature in the TES tank during sixth year of operation. (Coarse gravel, CE = 40%)

The actual COP depends on the types and size of chiller and heat pump. Reference [18] shows CE values in the 0.30 to 0.50 range for small electric chiller and heat pumps. Three CE values (0.30, 0.40 and 0.50) were considered in the present study. Figure 5 and 6 are showed that COP_C decreases and COP_H increases with years up until annually periodic operational conditions are achieved. Annual COP value does not change once annually periodic operational conditions are achieved. CE has a stronger effect on the COP of the chiller and heat pump.

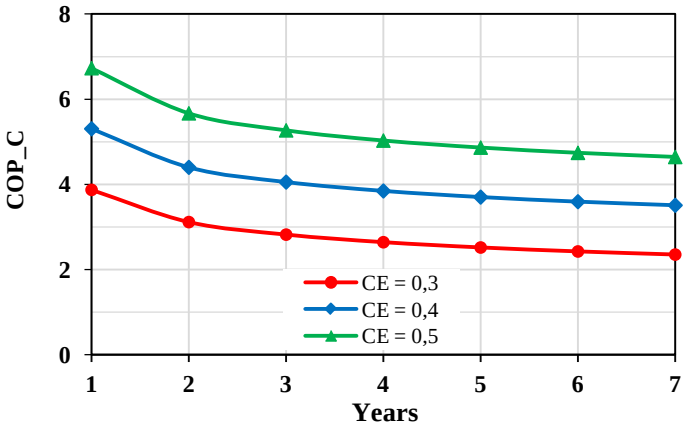

Figure 23. Effect of CE on COP_C of the chiller (Coarse gravel, V = 100m^3)

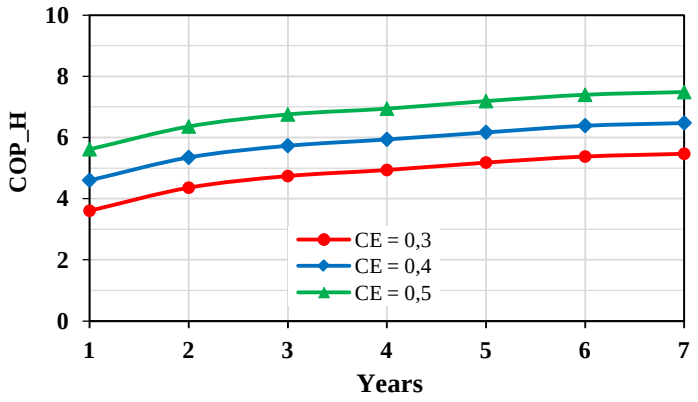

Figure 24. Effect of CE on COP_H of the heat pump (Coarse gravel, V = 100m^3)

10. CONCLUSIONS

The computational model for finding long term performance of the swimming pool heating system by using waste heat energy rejected from chiller unit of an ice rink to underground thermal energy storage (TES) tank is presented in this study. Results indicate that 5-7 years will be sufficient to achieve the annually periodic operating conditions for the system. Thermophysical properties of ground around the TES tank effects the performance of the system and coarse gravel yields the best thermal performance. CE has a stronger effect on the COP of the chiller and heat pump.

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Energy-efficient envelope design for high-rise apartmants in Erbil city

***Rosa Saber Maaroof*[1]**

Abstract

Since the building envelope is the barrier that separates the indoor space from the outdoors. [1] The architectural envelope has long been a compelling focus of interest for building physicists and designers, combining attributes of both appearance and performance in a holistic manner. Building envelopes form the outer skins of buildings, portraying the project image and creative intent. [2] It is important to collaborate with the architects to help guide decisions that will improve the thermal envelope's performance. Determine the greatest sources of heat gains and losses through the building's skin, and look for opportunities to minimize the effect. [3,p.161] however Thousands of buildings have been designed and built with a goal of energy performance. Some are formally recognized as sustainable structures using a variety of criteria including energy performance, e.g., those with USGBC LEED certification. However, many of these buildings offer less than desirable operating efficiencies, often a short time after construction. [4] This paper presents a simulation case study of envelope preliminary design options for the new construction building of PARK VIEW residential building in Erbil city. In this paper, the importance of envelope design has been covered under two segments.

***In the first section:** a building located in its climate (Erbil) has been optimized following a step-by-step approach to treat every element of the envelope, In order to create a high quality building envelope, thereby optimally control solar gains or reducing energy demand at the source itself.*

***The second section:** quantifies the energy-efficient of building envelope, employing innovative technologies and integrating concepts achieved by installing new technologies available in the market**.** It depends on the energy simulation and performance calculation, through the implication of Building Information Modelling (BIM) can lead to more detailed analysis. [5] Which apply software Ecotect & Revit program for sustaining, are figured out for achieving potential LEED credited points, which can demonstrate the sustainable level of the building with a single number from certain aspect. Table 1. show the parameters of the selected building:*

[1] ZAGROS İNŞAAT VE DIŞ TİC. SAN. LTD. ŞTİ KORE ŞEHİTLERİ C. DENİZ İŞ HANI NO: 50 KAT: 4 ZİNCİRLİKUYU ŞİŞLİ / İSTANBUL / TÜRKİYE TLF: +90 212 274 68 57 TLF: +90 212 274 68 58 FX: +90 212 274 68 59 asmarazez@yahoo.com

Table 1. Parameters of selected building

S. **No.**	**Parameter**	**Description**
1.	Usage	High rise residential building
2.	Location	PARK VIEW in Erbil city
3.	N. of floor	19
4.	Wall	Compact Laminate Cladding
5.	Roof	150 mm concrete
6.	Glazing	Double glazed with aluminium frame
7.	Built-up area	3538.363 m2

Simulation results showed that, selecting an optimum building orientation, using an optimum combination of glazing, window wall ratio, shading devices, glazing type and insulation in wall/roof resulted in 53.6% saving in annual energy demand. This is one of several papers to discuss the details of how the results of simulation contribute to improved on-going energy efficiency and sustainable buildings. Furthermore, it should be noted that greater savings and a more favourable payback period could be obtained if this highly energy efficient envelope is applied to other typical buildings, especially high-rise. [6]

1. INTRODUCTION

Country's progress is achieved through economic, urban and planning progress; they are the most important reasons that encourage technological progress by seeking the use of the latest materials& systems. [7] Densities of many Southeast Asian countries although Erbil city have created a little number of projects dominated by high-rise apartment buildings. PARK VIEW is one of the most well-known examples of this type of projects. About 90% of its total population live in high-rise buildings and half of these are in densely built-up public housing estates. [8] The increase in electricity consumption by the residential sector, particularly in the summer months, has been caused by the growing demand for air-conditioning systems to provide thermal comfort for the Occupants. [9] This phenomenon suggests that there is a potential to reduce the energy consumption and resultant greenhouse gas emissions by reducing the need for air-conditioning in high rise buildings. Local builder in Erbil city have largely ignored passive design strategies, which can moderate internal temperatures and hence reduce building energy consumption by m the building environment friendly. For high-rise office buildings the façade is the largest surface area of the building perimeter where direct heat exchange between the outside and inside environment takes place and therefore can contribute significantly to achieve more sustainable buildings. [10]

The building envelope is made up of below-grade foundation walls and basement slab on grade, exterior walls, fenestration (glass and windows), roofs, and skylights. Design of the building envelope is a complex balance of several variables with different expertise such as architectural aesthetics, structural forces resisting wind and building dead and live loads, heat and light transfer for indoor occupant comfort, safety and security, acoustics and sound attenuation, fire resistance, and constructability costs. [1] The building envelope must control solar heat gain, conduction or direct heat transmission, and infiltration or leakage heat transmission. [11] By decreasing the area of energy dissipated envelope surfaces relatively and increasing their solar control and heat rejection ability, an energy efficient skin is created for the building. [12] New generation of high-performance façade will not only play the key role in energy efficiency, also will help to solve other built environmental issues. [10]

Thus Understanding the science of building envelopes, the code compliance paths, and climates is the best tool that can be provided to the designers to arrive at an envelope that performs better than mandates of construction codes and is measurable. [1] In a nutshell, improving overall energy efficiency of the building is one of main purpose in this tall building design and research project. [12] (See Figure 1. & 2.).

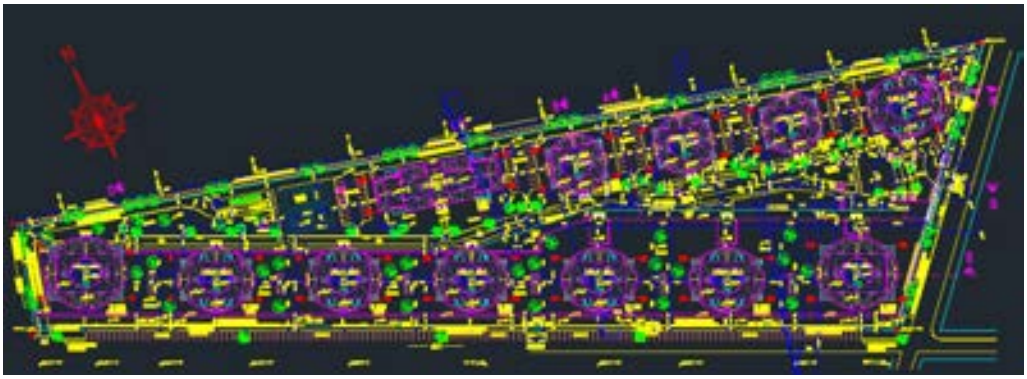

Figure 1. The site of PARK VIEW

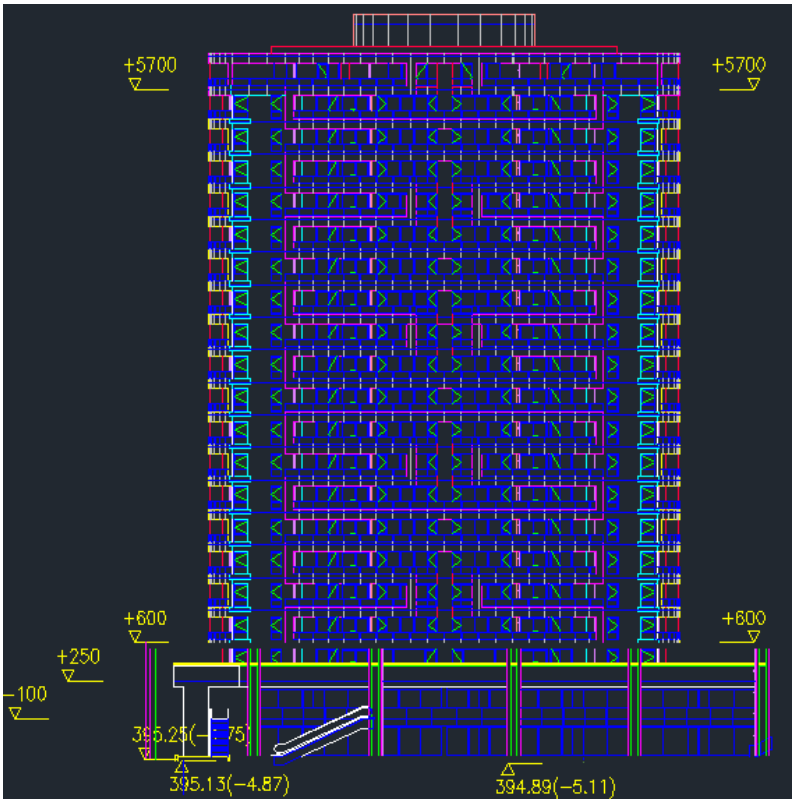

Figure 2. Section views of the building

2. PURPOSE OF THE SUTDY AND METHODOLOGY

The Purpose of this paper are:

- To demonstrate the energy efficiency of the building envelope &
- Employing innovative technologies.

Methodology steps are adopted for this paper as follows:
1-This paper was developed via review of existing literature;
2-The simulation through the implication of Building Information Modelling (BIM)

Kriegel and Nies [13] indicated that BIM can aid in the following aspects of sustainable design:

- Building orientation (selecting a good orientation can reduce energy costs);
- Building massing (to analyse building form and optimize the building envelope);
- Daylighting analysis;
- Energy modelling (reducing energy needs and analysing renewable energy options can contribute to low energy costs);
- Sustainable materials (reducing material needs and using recycled materials);
- Site and logistics management (to reduce waste and carbon footprints).

3-Achieving potential LEED credited points.

Now There are many building energy simulation software. Some are simplified energy analysis tools while other use more detailed models and run on hourly basis. The simulation in this paper have been done through the implication of Building Information Modelling (BIM) can lead to more detailed analysis which apply software Ecotect program. LEEDTM Credit EA1 Optimize Energy Performance. [14] Specified three compliance path options to evaluate the achievement of increasing levels of energy performance above the baseline in the prerequisite standard.

3. PREVIOUS RESEARCH

There is only a limited amount of research literature on energy efficient apartment building design in hot and dry climates. Most of the literature in the Middle East Asian region has focused on comfort conditions for building occupants. The envelope was more distant in degree categorized in facade elements and the roof element. The facade elements contributed almost as high as 90% gains in the building, of which, nearly one fourth was contributed by poorly-selected wall material and three fourth was from ill-treated windows. [2]

The study on Built Environment Research Group described an integrated passive design approach to reduce the cooling requirement for high-rise apartments through an improved building envelope design. The results show that a saving of 31.4% in annual required cooling energy and 36.8% in the peak cooling load for the BASECASE apartment can be achieved with this approach.

However, all the passive strategies have marginal effect on latent cooling load, often less than 1%. [15] Frank Lloyd Wright's holistic approach to design was based on the integration of architectural form and details with building technology (e.g., materials, systems, construction methods) as a response to local environment. [16]

However the article from Centre for Energy Research strived to make an exhaustive technical review of the building envelope components and respective improvements from an energy efficiency perspective. Different types of energy efficient walls such as Trombe walls, ventilated walls, and glazed walls are discussed. Performance of different fenestration technologies including aerogel, vacuum glazing and frames are presented. Advances in energy efficient roofs including the contemporary green roofs, photovoltaic roofs, radiant transitive barrier and evaporative roof cooling systems are discussed. Various types of thermal insulation materials are enumerated along with selection criteria of these materials. It concluded that Energy efficiency approaches sometimes might not require additional capital investment. For example, a holistic energy efficient building design approach can reduce the size of mechanical systems compensating the additional cost of energy efficiency features. [17] An energy effective building envelope design saved as much as 35% and 47% of total and peak cooling demands respectively. [18] Yet tall buildings are often believed to be non-sustainable, mainly due to the large amount of materials required for the structure. On one hand, construction of tall buildings is often considered to be energy-intensive; on the other hand, however, few analyses have been carried out to check if this statement is true and to support it numerically. [19] In Greece, thermal insulation (in walls, roof and floor) and low infiltration strategies reduced energy consumption by 20–40% and 20% respectively. According to the same study, external shadings (e.g. awnings) and light- coloured roof and external walls reduced the space cooling load by 30% and 2–4%, respectively. [20] The passive building technology is an element that is planned by an architect and is the first step for building energy reduction with focus on a design. [21] On the other hand Bojic et al. [22] investigated the influence of wall insulation thickness and its position in the building envelope on peak cooling load and energy consumption. The study showed that cooling energy consumption could be reduced by approximately7% by placing thermal insulation on the outside of the envelope walls. Chan et al. [23] review, on one hand, technologies for passive solar heating via buoyancy effect (Trombe wall, solar chimney, unglazed

perforated-absorber collector and roof-based systems) and on the other hand, technologies for passive solar cooling via evaporative effect and their building integration. In sum, previous studies have focused only on a particular envelope component in the buildings. There is a lack of comprehensive analysis on maxim energy efficiency of high rise building in hot & dry climate areas in a region like Erbil. However, the above and the Summarise researches in (Table 1.) are provided resources for this research. Yet by focusing on evaluating PARK VIEW energy performance, this study will provide a better understanding of energy and resource efficiency design for high rise buildings in hot and dry areas like Erbil city.

It can provide an increased understanding of annual energy consumption analysis in Rivet an architectural programme and design analysis in Ecotect. Meanwhile, the search depends on LEED rating systems point's calculation according to LEED 2009 focuses on site selection, Reduce heat islands to minimize impact on performance, Support the regional economy by increasing demand for building materials and products that are manufactured within the region, Introduce daylight and views into occupied areas of the building. Designing of an efficient building envelope for any new project based on many factors, yet LEED is the most important approach that must be studied to ensure that the project uses technologies &strategies to improve performance in the high rise building concerning reduction of energy using, increasing the environmental quality of the internal spaces and to reduce or eliminate the environmental impact of building. The buildings we find today are expected to achieve both energy efficient and environmental-friendly design. [24] There are two main goals to achieve for a sustainability in the buildings: green buildings and improvement of energy efficiency. This study will demonstrate a comprehensive analysis on maximizing the energy efficiency of high rise building in hot & dry climate areas; the research results will provide some innovative ideas about the design of high rise building. Table 2. show some of the previous research about the building envelopes and the energy saving consumption.

Table 2. The Summary of Previous research source [25]

Objective function	Design variables	Optimization method	Simulation method	Case study location	Major findings/limitations	Ref.
Solar irradiation of the equatorial-facing facade	Seven building shapes, shape aspect ratio	Parametric study	Energy Plus	Canada	Solar potential is maximized by reducing the ratio of shading to shaded facade lengths and increasing the angle enclosed between shading and shaded facades	[26]
Energy demand, lifecycle cost	Building shape, orientation and aspect ratio, wall, roof and floor insulation levels, windows area, glazing type, infiltration rate, thermal mass	Genetic alg.	DOE-2	USA	USA The building shape design variables have less impact on building energy use than the other design variables	[27]
Lifecycle cost, lifecycle environmental impact	Polygonal shape of building footprint, structural system, insulation levels, glazing type, windows- to-wall ratio, overhangs presence, depth and height	Genetic alg.	Unknown	Canada	Solutions with lower lifecycle cost have shapes close to the regular polygon, while solutions with lower lifecycle environmental impact have larger edge length on the south facade	[28]
Net present value, payback rate	Roof, wall and floor insulation levels	Parametric study	EC501	Italy	The optimal insulation configuration at the building level does not necessarily correspond to the optimal thermal transmittances calculated for the individual building components	[29]
Heating load, cooling load	Leaf area index of the green roof, roof insulation	Parametric study	TRNSYS	Greece, France, Sweden	The green roofs are more suitable for retrofitting non-or poorly insulated existing buildings than for use in well-insulated new buildings	[30]
Heating load, cooling load	Building aspect ratio, south windows size	Parametric study	SUNCODE - PC	Five cities in Turkey	The building aspect ratio has minor influence on energy performance compared to the south windows size in both cool and warm climates	[31]

Cooling load	Façade orientation ,louvers' slat tilt angle ,glass shading coefficient, height of light dimming sensor	Parametric study	IES-VE	Abu Dhabi	The use of dynamic louvers gives a very small margin over the optimal static louvers, not worth their extra cost and effort	[32]
Thermal comfort	Wall U-value, wall orientation, windows-to-wall ratio, shading device length	Parametric study	TAS, ESP-r, FLUENT	Singapore	Facade design guidelines are developed for Singapore	[33]

4. WEATHER AND CLIMATE ANALYSIS

Iraq is almost a landlocked country. It lays between Turkey to the north, Iran to the east, Saudi Arabia to the south, the Gulf and Kuwait on the southeast, and Jordan and Syria on the west. Erbil city (Figure 1). It has an altitude of 470 m a. s. l with longitude (44^0 04) and latitude (36^0 12). [34] Iraq experiences the highest temperatures in the world. Erbil city In March, April and mid-May. During these months, the rolling hills and green plains are alive and still blossoming. Temperatures are pleasant, warm during days, and cool during the nights. The months of October, November and mid-December, are great to visit Erbil. Cloudless skies and lovely temperatures are amazingly pleasant for tourism or visiting historical sites. May through September are summer months and are extremely dry and probably the hottest. Often, the temperatures reach 50 degrees during those months (Celsius). Winter months are quite cool and often with rain. Sometimes snow falls heavily over mountains resulting in ice. [35] The hot and dry long summer season of Erbil city creates a huge demand for air-conditioning for comfort cooling The (Table 3.) below are based on long-term weather and climate records. They are an average for Erbil weather in various months.

Table 3. The average for Erbil weather in various months

MONTH	AVG MAX TEMP	AVG MIN TEMP	AVG HRS OF SUNSHINE PER DAY	AVG DAYS W/ RAIN PER MO.	AVG MM OF RAIN PER MONTH
January	12	2	5	14	61-100 mm
February	15	3	6	11	61-100 mm
March	19	7	7	10	61-100 mm
April	25	11	8	10	61-100 mm
May	32	16	10	5	31-60 mm
June	39	21	14	1	0-5 mm
July	43	25	14	1	0-5 mm
August	42	24	13	1	0-5 mm
September	38	19	11	1	0-5 mm
October	29	14	8	5	6-30 mm
November	21	8	6	7	31-60 mm
December	14	4	5	10	61-100 mm

5. CLIMATE DATA FOR ERBIL

Erbil's climate is hot-summer Mediterranean climate, according to Koppen climate classification, with extremely hot summers and mild wet winters. January is the wettest month. [36] see (Table 4.).

Table 4. The climate data for Erbil city

Table 4: the climate data for Erbil city

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	20.1 (68.2)	27.9 (82.2)	31.3 (88.3)	34.5 (94.1)	41.9 (107.4)	43.3 (109.9)	48 (118)	49.3 (120.7)	44.8 (112.6)	38.2 (100.8)	30.6 (87.1)	24.2 (75.6)	49.3 (120.7)
Average high °C (°F)	12.4 (54.3)	14.2 (57.6)	18.1 (64.6)	24 (75)	31.5 (88.7)	38.1 (100.6)	42 (108)	41.9 (107.4)	37.9 (100.2)	30.7 (87.3)	21.2 (70.2)	14.4 (57.9)	27.2 (80.98)
Daily mean °C (°F)	7.4 (45.3)	8.9 (48)	12.4 (54.3)	17.5 (63.5)	24.1 (75.4)	29.7 (85.5)	33.4 (92.1)	33.1 (91.6)	29 (84)	22.6 (72.7)	15 (59)	9.1 (48.4)	20.18 (68.32)
Average low °C (°F)	2.4 (36.3)	3.6 (38.5)	6.7 (44.1)	11.1 (52)	16.7 (62.1)	21.4 (70.5)	24.9 (76.8)	24.4 (75.9)	20.1 (68.2)	14.5 (58.1)	8.9 (48)	3.9 (39)	13.22 (55.79)
Record low °C (°F)	−16.2 (2.8)	−14 (7)	−9.3 (15.3)	−2.1 (28.2)	2.6 (36.7)	9.1 (48.4)	11.7 (53.1)	10.3 (50.5)	9.5 (49.1)	1.6 (34.9)	−5.6 (21.9)	−12.3 (9.9)	−16.2 (2.8)
Average precipitation mm (inches)	111 (4.37)	97 (3.82)	89 (3.5)	69 (2.72)	26 (1.02)	0 (0)	0 (0)	0 (0)	0 (0)	12 (0.47)	56 (2.2)	80 (3.15)	540 (21.25)
Avg. precipitation days	9	9	10	9	4	1	—	—	1	3	6	10	—
Avg. snowy days	1	0	—	0	0	0	0	0	0	0	0	—	—
Average relative humidity (%)	74.5	70	65	58.5	41.5	28.5	25	27.5	30.5	43.5	60.5	75.5	50.04

Source: Climate-Data.org,[36] My Forecast for records, humidity, snow and precipitation days[37]

Source [40]: What's the Weather Like.org,[38] Erbilia [39]

6. ENVELOPE OPTIMIZATION THROUGH PASSIVE STRATEGIES

A simulation model was created using Ecotect software to compute the annual energy consumption and to study the effect of various improvements planned in the design. In climates where heating and cooling are both significant concerns, use a building simulation software program to understand the trade-offs associated with various solar heat gain coefficient values. [3,p.162] Five floor are extracted as a data from the floor schedule in the BIM model of the building because of the similarities of the result of the floor 2,3,4… or in another term the middle floors have been the same result, the differences demonstrated only on the first floor and the last floor. The annual energy consumption of the building, as well as all the alternatives, is calculated compared with the original models in order to evaluate optimal Envelope design. In passive solar building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. The key to design a passive solar building is to best take advantage of the local climate performing an accurate site analysis. Elements to be considered include window placement and size, and glazing type, thermal insulation, thermal mass, and shading. [40] As a first step, the following fundamentals of green design were adopted in terms of optimizing envelope performance:

6.1. Building Orientation Optimization

External surfaces of the building especially the large facades receive high amounts of solar radiation and daylight during the year there for tighten envelope is necessary in order to store solar energy in the winter and prevent solar heat in the summer. Solar heat gain such as direct radiation is greatly dependent on azimuth, for example the roof of the building is more heat gain through solar radiation than other elements of building continuously from sunrise to sunset; on the other hands shading provision is necessary for external walls in order to prevent from radiation depending on sun orientation and angle. Charron found that in cost-effective net-zero energy buildings ,the climate mostly influences the southern windows area and the exterior wall type ,while the building orientation mostly influences the overall windows area and the parameters of the active solar systems. [41] Therefore The simulations were performed for each of the different orientations separately, The solar azimuth different with the change of seasons. It moves from the south in the winter to the east and west in the summer, which receive the strongest solar radiation on the external walls of the envelope being on the south wall in winter and on the east and the west walls in summer. The energy performance for the baseline model averages the results of four simulations during one year of operation. One simulation is based on the actual orientation of the building on the site; the others rotate the entire building by 90°, 180°, and 270°, which enables the proposed design to receive credit for a well-sited building. This is easily accomplished when using BIM. [3,p.74]

The calculated overall energy consumption rates are almost near from each other for all four major orientations: north, east, south and west there are only little differences between the base case and the proposed model, yet south east has the deference. Thus, south is the optimum orientation of building both for winter - for solar heat gain - and summer. Hence, the larger surfaces of wall should face south with the least exposure on East. Thus, in the selected building, south east orientation contributed up to 1.6% saving on the annual energy consumption, 1.6, reducing it from 229684m^2Wh to 225969m^2Wh per year see (See Figure 3.).

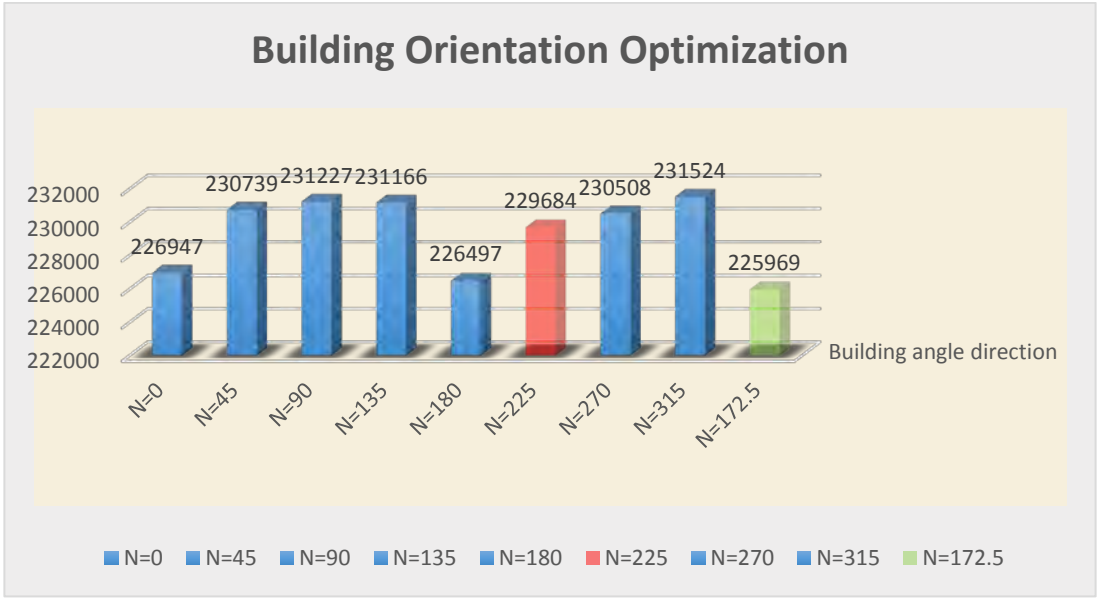

Figure 3. Graph highlighting impact of building orientation on energy consumption

It is important to note that the flexibility of modifying building orientation may not be possible in all cases and hence there are other means of protecting the building from direct solar gains. [2]

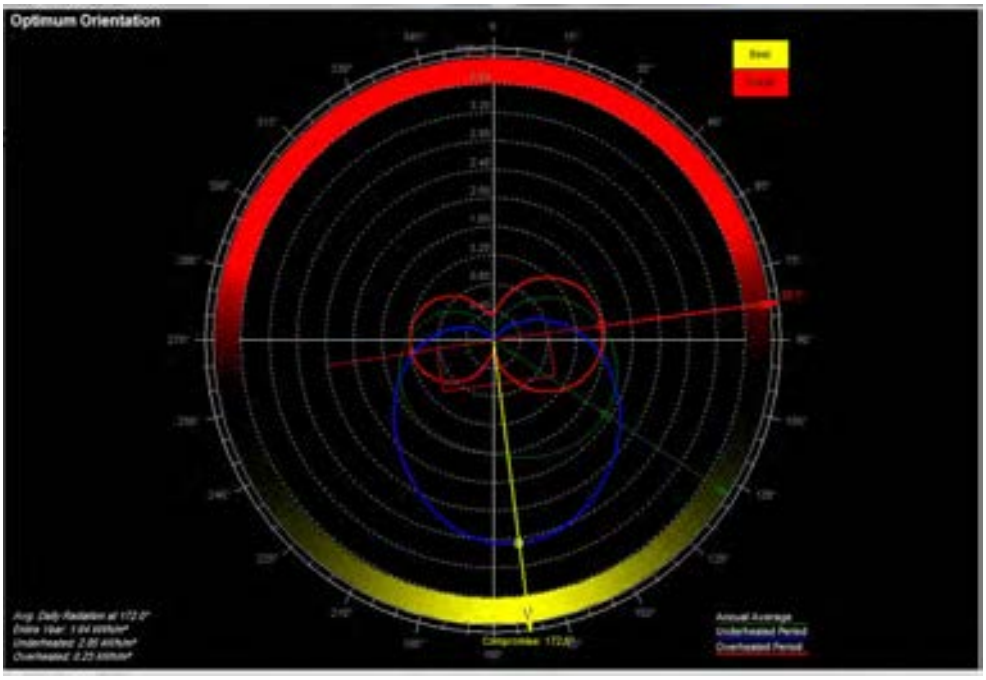

Figure 4. BIM model of the building (made in Revit architecture) shows the best orientation of the building

6.2. Glazing type Window-to-Wall Ratio Optimization

Fenestration is the important part of a building in terms of energy amusement.

In order to reject unwanted heat gain without reducing the quality for daylighting within occupied spaces. Conduction gains through the building skin are also significant in the overall heat balance equation. Where possible, try to reduce the window-to-wall ratio. Even the best-performing glass selections cannot compare to the thermal characteristics of an insulated wall. [3,p.162]

The advanced fenestration products may actually increase the cooling load in warm climates, as their extremely low thermal transmittance prohibits the dissipation of the heat from internal gains to the outdoor environment. [42] Inanici MN, Demirbilek FN found that the building aspect ratio has minor influence on energy performance compared to the south windows size in both cool and warm climates. [31] While Persson M-L, Roos demonstrated the size of the triple glazed ,low-e window sin passive houses is dmore relevant for the cooling load, while it does not have a major influence on the heating load. [43]

The optimal choice of an envelope should take into consideration the yearly (heating and cooling season) energy and daylighting performance. In a country like Iraq, where cooling of the building is the primary requirement in summers, minimizing direct solar radiation helps to saving energy. On the other hand Yıldız Y, ArsanZD. in his study investigated that the total window area, the glazing U-value ,the solar heat gain coefficient and the building aspect ratio have the most considerable influence on the energy performance of a building in a hot and humid climate. [44] Glass selections with low U-factors will reduce the heat gains and losses. is very important for designers to look at the entire window assembly properties, including the frame and the spacers and not only for the glazing. Good glazing U-factors can be severely compromised by having none thermally broken frames. [3,p.162] **Thus, it is important to determine the area and type of glass and create a balance with aesthetics in order to minimize solar heat gain, giving due consideration to both capital and operation costs.**

Different glazing types were assigned to the exterior windows of the building model and the corresponding annual energy consumption rates was calculated out and compared with the base case. From the results, it can be

concluded that high performance glazing can play an important role in terms of energy efficiency improvement. In the proposed model, using Triple glass aluminium frame and double cavity filled with argon 16mm crated high performance windows can contribute to nearly 98% energy saving compared with the single glazing window case, and can produce 37.5% energy saving based on the base case building, which is equivalent to LEED achievable points (See Figure 5.).

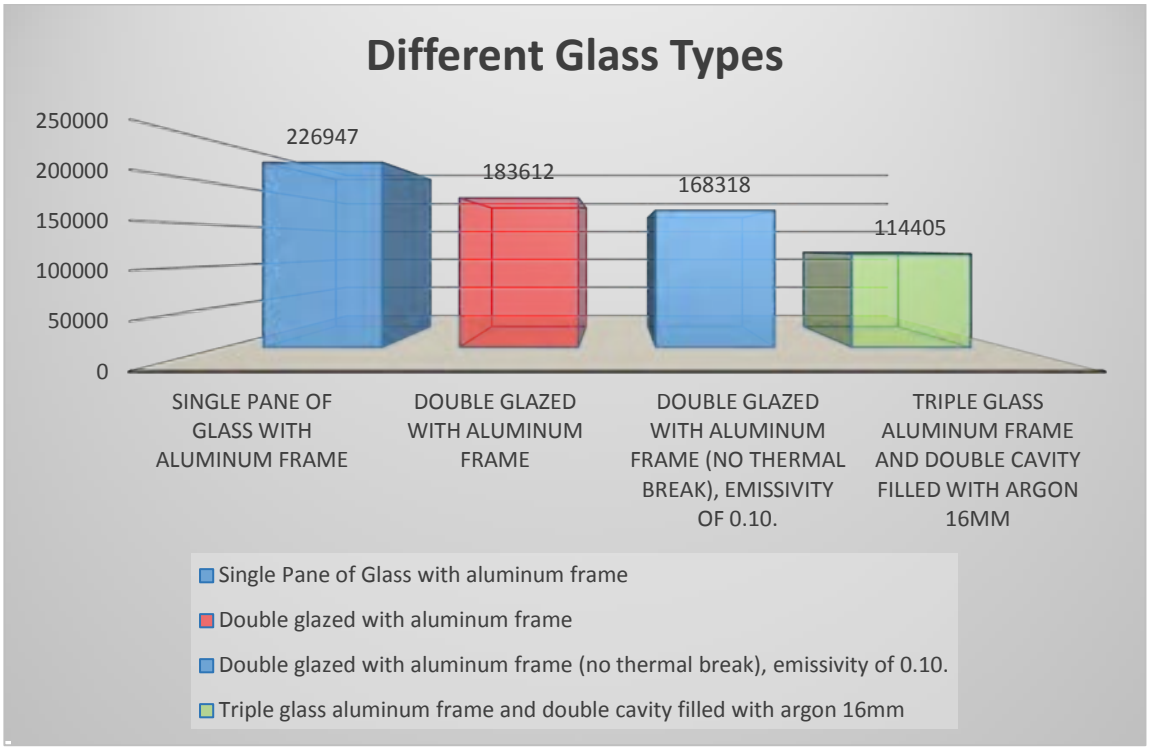

Figure 5. Graph highlighting impact of different glass types on energy consumption

Thus Glass should, therefore, be placed and orientated to optimize views and day-lighting whilst avoiding heat gains. In the case study, adjusting the window-to-wall ratio (WWR) of the building envelope affected the amount of heat entering the space, as opaque enclosures generally resist heat transfer better than glass (Figure 6). Hence, an optimized WWR of 20% contributed to 9% saving on the annual energy consumption of the building, reducing it from 152739 m^2Wh to 140006 m^2Wh per year (See Figure 6.).

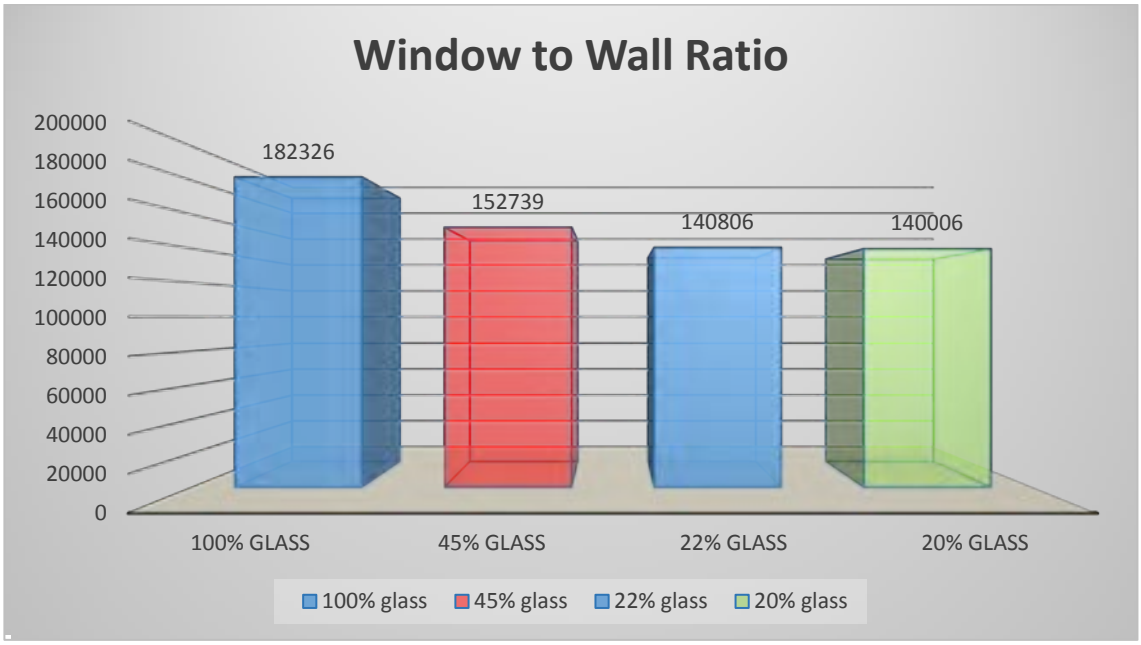

Figure 6. Graph highlighting impact of WWR on energy consumption

6.3. Energy simulation based on different types of roof and wall Assembly Optimization

Walls are generally have more power on a building envelope and are expected to provide thermal and acoustic comfort within the spaces, without affecting the aesthetics of the building. The thermal resistance (R-Value) and thermal conductivity (K) of the wall/roof is crucial as it affects the building energy consumption strongly, especially in high rise buildings, which the ratio of the wall is high beside the envelope area. Also, try to minimize the U-factors of the walls and roof by using insulation with high R-values. Where thermal bridging may occur due to structural elements of the building, provide a continuous interior layer of insulation to minimize this effect. [3,p.162] Study investigated that the window cells in optimal solutions are biased towards the top-west quadrant of the façade. [45] Wall and roof assembly consisting of building material with high thermal mass and thermal insulation plays a vital role in energy savings. Walls with thermal insulation have a higher chance of surface condensation when the relative humidity of ambient air is greater than 80%, provided the convective and radiative heat transfer coefficients of the exterior wall are small. This problem is more severe during winter months and in colder climatic regions with higher humidity levels. [46] The study also found that the roof insulation and efficient window glazing are most cost effective measures in hot climates. [47]

The calculation for evaluating the energy performance have applied for the roof and four different types of wall instead of the base case. It can be seen that the roof cannot contribute too much to energy performance improvement in all building, while façade system can serve as a major factor especially in high rise buildings, where the ratio between wall and total envelope area is high. Energy saving rate due to Roof is only about 0.5%, while insulating exterior wall can help to produce 4% energy saving. Using high performance roof system in all building cannot achieve significant energy improvement due to the relative smaller percentage of roof area compared with rest parts of the building envelope. So for making energy efficiency improvement in a tall building, façade system plays the key role, (See Figure 7.).

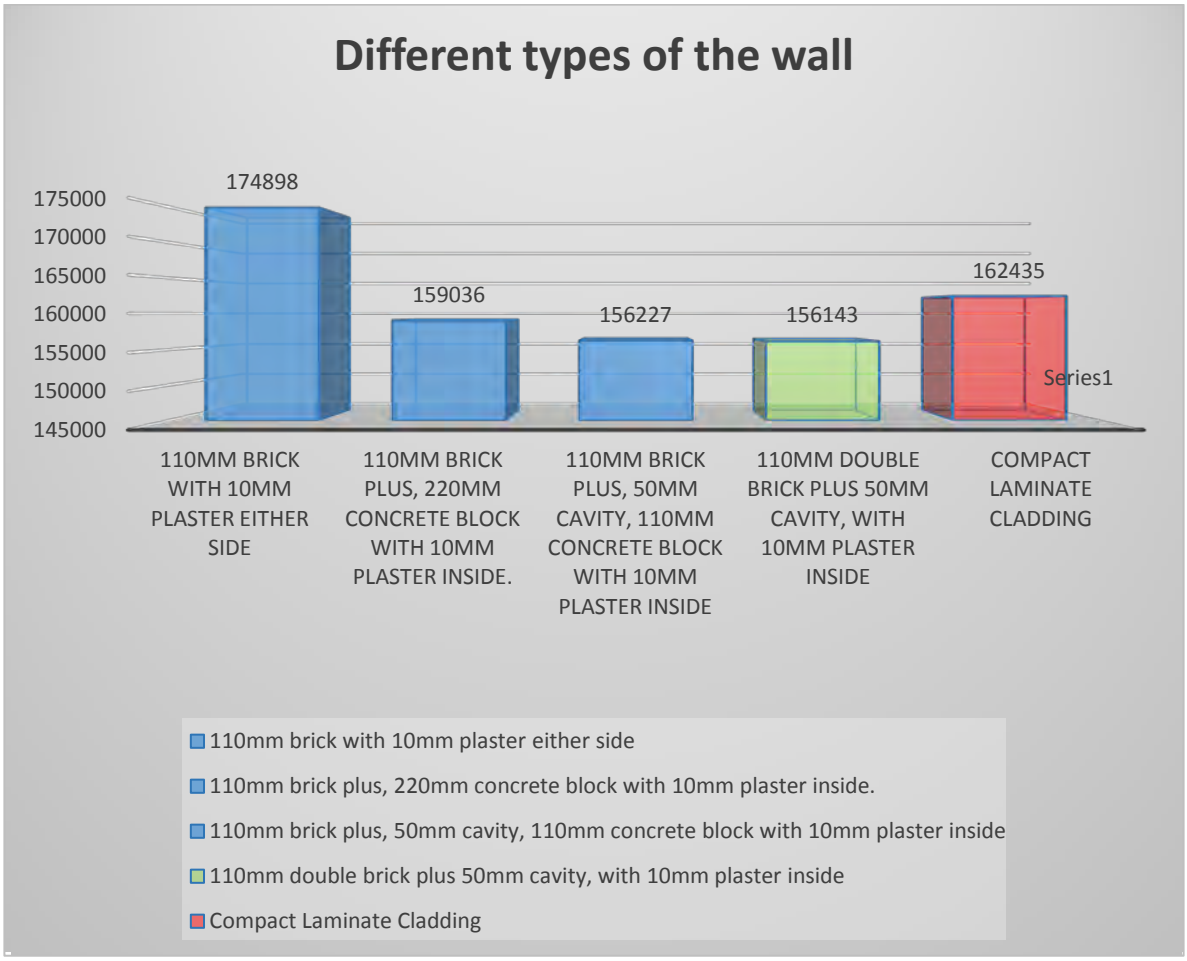

Figure 7. Graph highlighting impact of wall assembly on energy consumption

6.4. Shading devices optimization

An external sunshade can be used as a design, For the purpose of reducing solar heat gains. Besides, shades also serve the purpose of controlling views into and out of a building, reducing solar glare, providing rain protection for openable windows and serving as a part of the protective strategy. Thus, sunshade design should always be influenced by solar geometry and sun-path studies to ensure its effectiveness.

Study found that a proper combination of glazing, shading and control set points in a fully glazed building may lead to only 15% increase in the energy consumption compared to the reference building with 30% windows-to-wall ratio. [48] Yet the other study demonstrated that the half egg-crate louver is most suitable for the southern and northern facades, whereas a horizontal projection with 301 down ward tilt is most appropriate for the eastern and western facades. [49] While in ASHRAE Solar radiation through the windows can be one of the largest gains during the summer cooling season. Providing external shading can effectively minimize these gains. Horizontal shading, or overhangs, on the south face of the building will block the high sun during the day for much of the year, and vertical shading on the east and west can reduce gains early and late in the day as the sun rises and sets. [3,p. 161] Keeping in mind the above considerations, shading devices with different widths were simulated for analysing their effectiveness in cutting down direct solar radiation into the occupied zone. This helped in cutting down the direct solar radiation, reducing solar ingress and allowing the diffused component of light to enter the building. An optimized building designed with shades 2ft contributed 1% saving on the annual energy consumption of the building, reducing it from 152743m^2Wh to 152690m^2Wh per year (See Figure 8.).

Thus, the combination of these six basic steps, i.e. optimized orientation, window wall ratio, shading devices, glazing type and insulation in wall/roof resulted in 53.6% saving in annual energy demand. This analysis clearly indicated that there is no substitute for a correct fundamental design and these interventions in early stage of design can help cut down the annual energy bills of a building and also optimize the initial cost (See Figure 9).

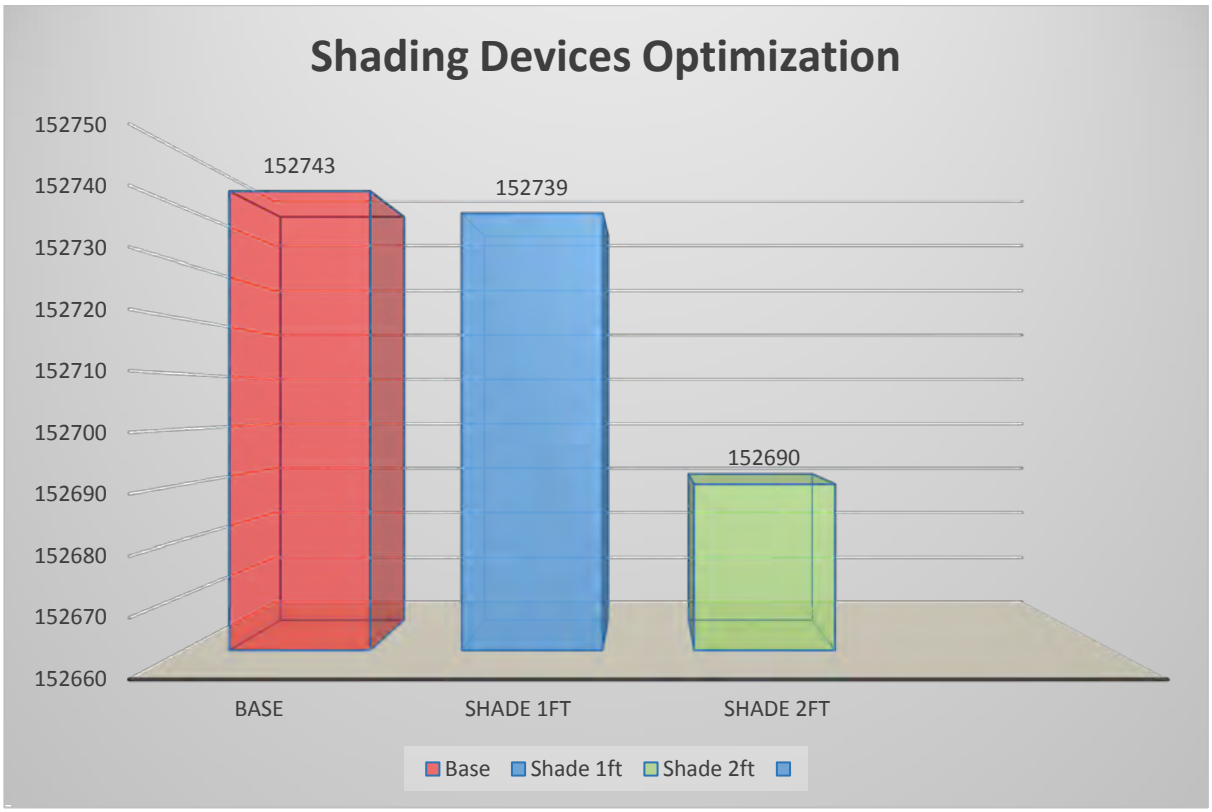

Figure 8. Graph highlighting impact of shading devices width on energy consumption

53. 6% saving

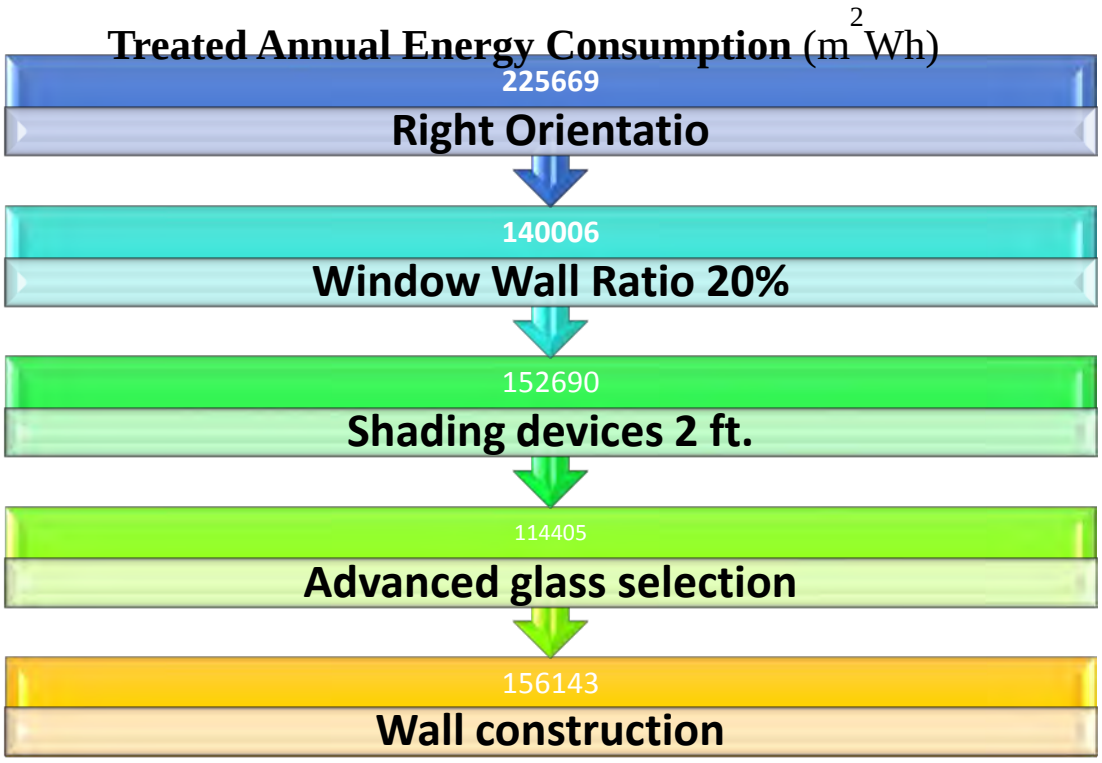

Figure 9. Cumulative reduction in energy consumption by applying basic passive strategies

7. LEED ACHIEVABLE POINTS CALCULATION

7.1. Sustainable site

The Sustainable Sites (SS) portion deals with issues outside of the building, including some of the building exterior, the land that is being developed, and the surrounding community. [50,p.29]

The project is a residential use development with mid population density. The building site is in the urban area, on the brown field, near Main Street, and is accessible via public transportation facilities such as bus and or other public transport. While there is a lake of outside building design such as Provide a high ratio of open space to develop land scape, adequate bicycle storage or changing grooms. However the high ratio of un designed roof have seen on the project. Thus reduce heat islands to minimize impact on microclimate, through use roofing materials having a Solar Reflectance Index (SRI) equal to or greater than:

- 78 for low-sloped roofs (slope ≤ 2V:12H);
- 29 for steep-sloped roofs (slope > 2V:12H) **OR**

Install a vegetated roof for at least 50% of the roof area. **OR**

Install high albedo and vegetated roof surfaces that in combination meet the following criteria:
(Area of SRI Roof/0.75) + (Area of Vegetated Roof/0.5) ≥ Total Roof Area. [50,p.84] (See Table5.).

Table 5.

Sustainable site analysis.

LEED 2009 for new construction and major renovation			
21	**Sustainable sites**		**Possible points: 26**
	Prereq 1	Construction activity pollution prevention	
1	Credit 1	Site selection	1
5	Credit 2	Development density and community connectivity	5
1	Credit 3	Brownfield redevelopment	1
6	Credit 4.1	Alternative transportation-public transportation access	6
1	Credit 4.2	Alternative transportation-bicycle storage and changing rooms	1
	Credit 4.3	Alternative transportation-low-emitting and fuel-efficient vehicles	3
2	Credit 4.4	Alternative transportation-parking capacity	2
1	Credit 5.1	Site development-protect or restore habitat	1
1	Credit 5.2	Site development-maximize open space	1
1	Credit 6.1	Stormwater design-quantity control	1
1	Credit 6.2	Stormwater design-quality control	1
	Credit 7.1	Heat island effect-non-roof	1
	Credit 7.2	Heat island effect-roof	1
1	Credit 8	Light pollution reduction	1

7.2. Water efficiency

Use high efficient water fixtures and water treatment and recycle system, as well as rain water collectors. Reduce potable water consumption for irrigation by 50% from a calculated mid-summer baseline case. [50,p.116] (See Table 6.).

Table 6.

Water efficiency analysis.

LEED 2009 for new construction and major renovation			
10	**Water efficiency**		**Possible points: 10**
	Prereq 1	Water use reduction-20% reduction	
4	Credit 1	Water efficient landscaping	2 to 4
		Reduce by 50%	2
		No potable water use or irrigation	4
2	Credit 2	Innovative wastewater technologies	2
4	Credit 3	Water use reduction	2 to 4
		Reduce by 30%	2
		Reduce by 35%	3
		Reduce by 40%	4

7.3. Energy and atmosphere

Create high performance façade system and energy efficient air conditioning equipment, as well as lighting control technology. Thus the intention of this credit is to establish and require a minimum energy efficiency in the building and many of its systems. [50,p.145]

Apply comprehensive energy saving strategies and perform energy simulation in the project development phase. Achieve increasing levels of energy performance to reduce environmental and economic impacts associated with excessive energy use (See Table 7.).

Table 7.

LEED 2009 for new construction and major renovation			
26	Energy and atmosphere		Possible points: 35
	Prereq 1	Fundamental commissioning of building energy systems	
	Prereq 2	Minimum energy performance	
	Prereq 3	Fundamental refrigerant management	
10	Credit 1	Optimize energy performance	1 to 19
		Improve by 12% for new buildings or 8% for existing building renovation	1
		Improve by 14% for new buildings or 10% for existing building renovation	2
		Improve by 16% for new buildings or 12% for existing building renovation	3
		Improve by 18% for new buildings or 14% for existing building renovation	4
		Improve by 20% for new buildings or 16% for existing building renovation	5
		Improve by 22% for new buildings or 18% for existing building renovation	6
		Improve by 24% for new buildings or 20% for existing building renovation	7
		Improve by 26% for new buildings or 22% for existing building renovation	8
		Improve by 28% for new buildings or 24% for existing building renovation	9
		Improve by 30% for new buildings or 26% for existing building renovation	10
		Improve by 32% for new buildings or 28% for existing building renovation	11
		Improve by 34% for new buildings or 30% for existing building renovation	12
		Improve by 36% for new buildings or 32% for existing building renovation	13
		Improve by 38% for new buildings or 34% for existing building renovation	14
		Improve by 40% for new buildings or 36% for existing building renovation	15
		Improve by 42% for new buildings or 38% for existing building renovation	16
		Improve by 44% for new buildings or 40% for existing building renovation	17
		Improve by 46% for new buildings or 42% for existing building renovation	18
		Improve by 48% for new buildings or 44% for existing building renovation	19
7	Credit 2	On-site renewable energy	1 to 7
		1% Renewable energy	1
		3% Renewable energy	2
		5% Renewable energy	3
		7% Renewable energy	4
		9% Renewable energy	5
		11% Renewable energy	6
		13% Renewable energy	7
2	Credit 3	Enhanced commissioning	2
2	Credit 4	Enhanced refrigerant management	2
3	Credit 5	Measurement and verification	3
2	Credit 6	Green power	2

7.4. Material and resources

Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources. [50,p.212]

As well as Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation. [50,p.220] Encourage environmentally responsible forest management certified wood and other certified green products (See Table 8.).

Table 8.

Materials and resources analysis.

LEED 2009 for new construction and major renovation 8	Materials and resources		Possible points: 14
	Prereq 1	Storage and collection of recyclables	
	Credit 1.1	Building reuse-maintain existing walls, floors, and roof	1 to 3
		Reduce by 55%	1
		Reduce by 75%	2
		Reduce by 95%	3
	Credit 1.2	Building reuse- maintain 50% of interior non-structural elements	1
2	Credit 2	Construction waste management	1 to 2
		50% Recycled or salvaged	1
		75% Recycled or salvaged	2
1	Credit 3	Materials reuse	1 to 2
		Reduce by 5%	1
		Reduce by 10%	2
1	Credit 4	Recycled content	1 to 2
		10% of content	1
		20% of content	2
2	Credit 5	Regional materials	1 to 2
		10% of Materials	1
		20% of Materials	2
1	Credit 6	Rapidly renewable materials	1
1	Credit 7	Certified wood	1

7.5. Indoor environmental quality

Prevent or minimize exposure of building occupants. Provide additional outdoor air ventilation to improve indoor air quality for improved occupant comfort, well-being and productivity. [50,p.254]

Thus Strict smoke control, enhanced ventilation, optimized daylight environment, high performance facade can help to improve interior thermal comfort (See Table 9.).

Table 9.

Indoor environment quality analysis.

LEED 2009 for new construction and major renovation 15	Indoor environmental quality		Possible points: 15
	Prereq 1	Minimum indoor air quality performance	
	Prereq 2	Environmental tobacco smoke (ets) control	
1	Credit 1	Outdoor air delivery monitoring	1
1	Credit 2	Increased ventilation	1
1	Credit 3.1	Construction IAQ management plan-during construction	1
1	Credit 3.2	Construction IAQ management plan-before occupancy	1
1	Credit 4.1	Low-emitting materials-adhesives and sealants	1
1	Credit 4.2	Low-emitting materials-paints and coatings	1
1	Credit 4.3	Low-emitting materials-flooring systems	1
1	Credit 4.4	Low-emitting materials-composite wood and agrifiber products	1
1	Credit 5	Indoor chemical and pollutant source control	1
1	Credit 6.1	Controllability of systems-lighting	1
1	Credit 6.2	Controllability of systems-thermal comfort	1
1	Credit 7.1	Thermal comfort-design	1
1	Credit 7.2	Thermal comfort-verification	1
1	Credit 8.1	Daylight and views-daylight	1
1	Credit 8.2	Daylight and views-views	1

7.6. LEED total points and certification level Check

LEED Achievable Points (See Tables 5.–9.):
(1).Sustain- able sites;
(2).Water efficiency;

(3).Energy and atmosphere;
(4) Materials and resources and
(5) Indoor environment quality, the following summary can be obtained. Summary: Sustainable sites (26),Water efficiency (10), Energy and atmosphere (35), Materials and resources (14), Indoor environmental quality (15), Innovative and design process (1), Regional priority credits (0),Total achieved point certified (80+). [51] LEED: a sufficient standard for sustainable 21st century high rise architecture. [52]

8. CONCLUSION

Energy efficiency is a primary challenge in today's every building construction spatially in high rise residential buildings. How important are energy efficiency gains from a building envelope is a topic that is gaining momentum amongst architects and designer. In the context of Erbil city, this paper has examined six strategies for lowering the energy consumption of high-rise apartment buildings. The results suggest that energy savings for high-rise apartments in hot & dry climate can be as great as other climates.

The simulation results for the six passive design strategies indicate that the strategies on selecting the advanced glass type for external windows are more effective than those for walls. However the results show that adjusting the window-to-wall ratio (WWR) of the building envelope affected the amount of heat entering the space, as opaque enclosures generally resist heat transfer better than glass. The simulation results also indicated that that the roof cannot contribute too much to energy performance improvement in all building, while façade system can serve as a major factor especially in high rise buildings, where the ratio between wall and total envelope area is high. Some strategies described in this paper can be applied to building design by architects and building designers with minimal cost implication, i.e. an external sunshade can be used as a design, For the purpose of reducing solar heat gains. Besides, shades also serve the purpose of controlling views into and out of a building, reducing solar glare. This study also suggested that the use of thermal modelling in building design can assist the architect to produce a more energy-efficient design by evaluating the effectiveness of various alternatives. The results of this paper can be integrated with life cycle cost/energy analysis to produce a more holistic picture of environmental impacts and cost benefits of low-energy apartment design. In other hand the USGBC and its LEED rating system are reducing the effects modem high-rise buildings have on the natural environment. The effect a building has on the natural environment through the use of natural construction materials is profound, that impact can be softened if the building is designed to incorporate less material. The aim of green buildings is to develop environmentally friendly construction practices that contribute in energy savings, reductions of emissions, and reuse and recycle of materials.

However, as we continue the journey down the realization of the dream for a perfect facade, there is an underlying statement that adhering to the basics of building design provides the maximum benefit and becomes the foundation for adopting better technologies, providing a cost effective solution.

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Operation of Load Frequency Control with PID Controller in Single Area Renewable Green Photovoltaic Energy Systems

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Abstract

In this study it was to investigate the frequency of load balancing power system is located in a zone of the solar system. PID is used as the controller. The classic PID controller gain values are set by Ziegler Nichols method. Loads with variable values are used to represent the network in unstable conditions depending on designed models. The power depends on weather conditions obtained from rapidly expanding solar energy systems. Radiation changes that may occur during a day are included in the power system modeling. Due to the frequency of these factors mentioned then aimed to keep within the legal limits of deviation from occurring. The modeling and simulations have shown to regulate the frequency of the control performed by the PID by the results. All modeling and simulation was obtained MATLAB / Simulink software.

Keywords: Load-Frequency Control, Photovoltaic Systems, PID Controller

1. INTRODUCTION

World energy demand is increasing at rapid industrialization results. As a result of the limited availability of conventional energy sources, energy is becoming an important factor. More importantly, the inability to store electrical energy [1]. So the energy produced and energy consumed must always be regular. The stability of the power system frequency is the most important parameters. The aim is to keep the power system during normal operation. Normal operating condition consists of three parts. First, the stabilization of the instantaneous load changes. Second, is to satisfy the active-reactive power balance. Third, the frequency is fixed at a constant value [2].

Interconnected power system consists of a lot of work with adaptation between production and consumption centers. Stable operation of the interconnected grid depends on the balance between energy production and consumption centers [3].

When the system is in equilibrium, energy consumed by the load is different from the energy produced by the generator, frequency will change. The energy generated is greater than the energy consumed frequency increases, but if the opposite occurs at a frequency of reduction. The resulting lowering aware that it is possible to again the zero level by monitoring the speed of the turbine that moves the generator. In recent years, small-scale hydro or thermal power plants than for sources of renewable energy has been included in the grid [4-5]. This article studies

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the frequency, including a result of the impact occurring in the single area interconnected grid of the most common potential of renewable energy sources as solar power plants will be studied. Operating conditions of solar power plants is greater need to load frequency control because it is not works like a conventional fuel power plants. The sudden fall of the value of the power produced as a result of climatic conditions, an imbalance occurs between rapid produced and consumed energy [6]. These events is observed more frequently in areas with the possibility of sudden changes in the weather. The frequency value is defined by the Union for the Coordination of Transmission of Electricity in the range of 49.2 to 50.8 Hz internationally. The frequency value for the continuity of the relationship with the union of 50 Hz frequency in Turkey must be within legal limits. It also demonstrate the importance of load-frequency control of interconnected networks.

2. SYSTEM MODELLING

2.1. Simple Photovoltaic Model

Circuit model is required ranging from 1960 to the present modeling was carried out. Public static equivalent circuit models of solar cells connected in parallel or in series on the PV cells to be connected to variable light intensity and temperature changes will be carried out to respond to a dynamic model should have such a model with a dynamic realize importance of protecting the long-term is a subject by researchers. FV at a simplified equivalent circuit of the solar cell is shown in Figure 1. PV solar cell in Figure 1, a current source (I_{FV}) is represented by [7]. With the current source of the incident photons of light obtained by the action of electrical current is shown as current sources. I_D, the PV solar cell formed in the reverse saturation current, R_s resistance is an important part of this article forming operation, heat losses at the point represents PN. Output voltage circuit of Figure 1 to be obtained by Equation (1) are also shown [8-9].

$$V_{pil}=\frac{A*k*T_{pil}}{e}\ln\left(\frac{I_{FV}+I_0-I_{pil}}{I_0}\right)-R_S*I_{pil} \quad (1)$$

Where the symbols are defined as follows;

I_{pil} : Cell output current (A)
I_0 : Reverse saturation current of diode (A)
I_{FV} : Photocurrent, function of irradiation level and junction temperature (A)
V_{pil} : Cell output voltage (V)
R_S : Series resistance of cell (Ω)
e : Electron charge (C)
K : Boltzmann constant (J/ºK)
T_{pil} : Reference cell operating temperature (ºK)

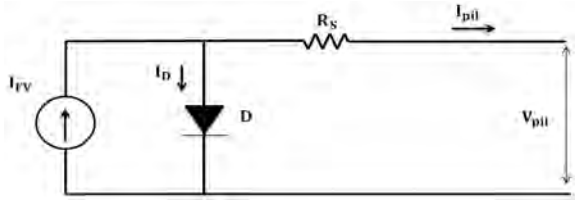

Figure 1. Solar cells have been reduced to the simplest equivalent circuit

2.2. Generator Model

Synchronous generators are located for the purpose of supplying power to the load is connected to the interconnected grid. Use diesel generators for standalone system from the grid. But the grid is working with turbine generators are used in a larger interconnected. The turbines and generators used in modeling the transfer function equations (2) and (3) are also shown [10].

$$G_G(s) = \frac{1}{T_G(s) + 1} \quad (2)$$

$$G_T(s) = \frac{1}{T_T(s) + 1} \quad (3)$$

3. LOAD FREQUENCY CONTROL

In this study, system used is shown in Figure 2. In this power system consists of various components. The load-frequency control system will ensure that the working grid photovoltaic nicely balanced. A control flow diagram is designed as shown in Figure 2. This design while MATLAB / Simulink is used. In this design photovoltaic system will be used to behave as load. In addition, it has the power produced by the photovoltaic power system to consider the variation in climatic conditions will also increase and decrease depending on the time occurs. This change is shown in Figure 3. Load-frequency control system in which all of this parameters takes place is done in two different ways. Firstly, in the primary frequency control, electrical energy is done by adjusting the balance of power in case of turbine speed governors in two different areas. The secondary frequency control by controlling the power flow between the regions of the interconnected network is performed on through a permanent frequency error reduced to zero [10-11].

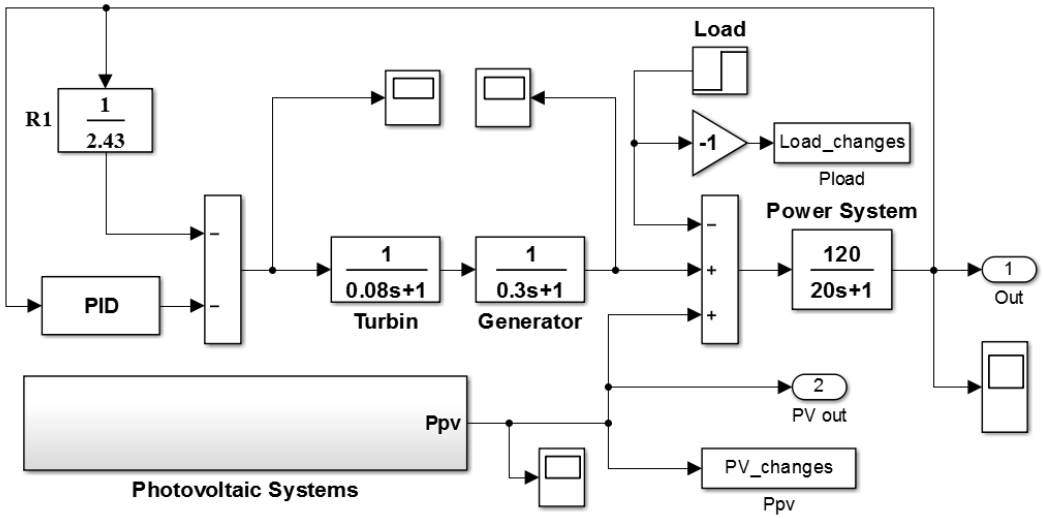

Figure 2. Single area interconnected grid connection

4. SIMULATION RESULTS

This study was performed by single area including solar energy system on the load frequency control. While control process, conventional Ziegler Nichols (ZN) PI and PID control methods were applied. When simulation performing, variable load and conditions are considered. Also assuming that the output power varies depending on the weather conditions of the solar power system frequency sustainability is obtained. The parameters used in the single area interconnected power system shown in Figure 2.

Ziegler Nichols method set by PI and PID controller coefficients used during the control processing are shown in Table 1.

Table 1. The controller gains balanced by Ziegler Nichols method

Kontrolör	K_P	K_I	K_D
PI	1.136	0.833	----
PID	1.47	2	0.125

Basically three parameters were taken into consideration during the simulation. First, a balanced system has been included in solar energy systems at 5th seconds. After this time it is experiencing disruption in the second step of the frequency that varies depending on the climatic conditions in the solar power system in the 15th seconds. Finally, a slight decrease in system load from the 30th second to occur considering the results obtained. This load change is shown in Figure 4.

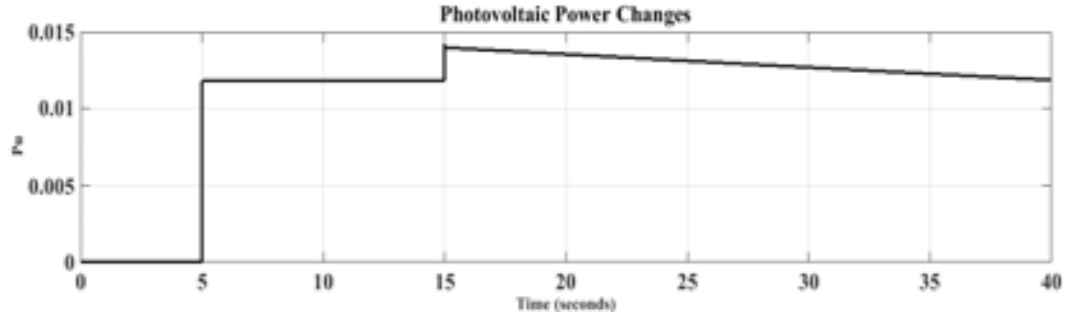

Figure 3. Photovoltaic Power Change

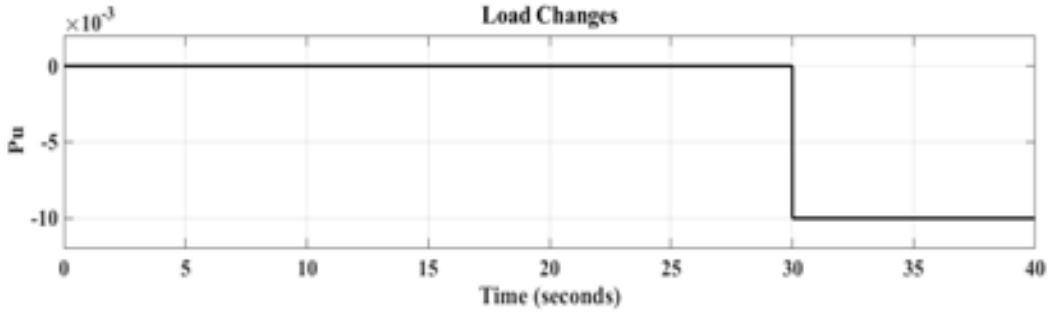

Figure 4. Load Change

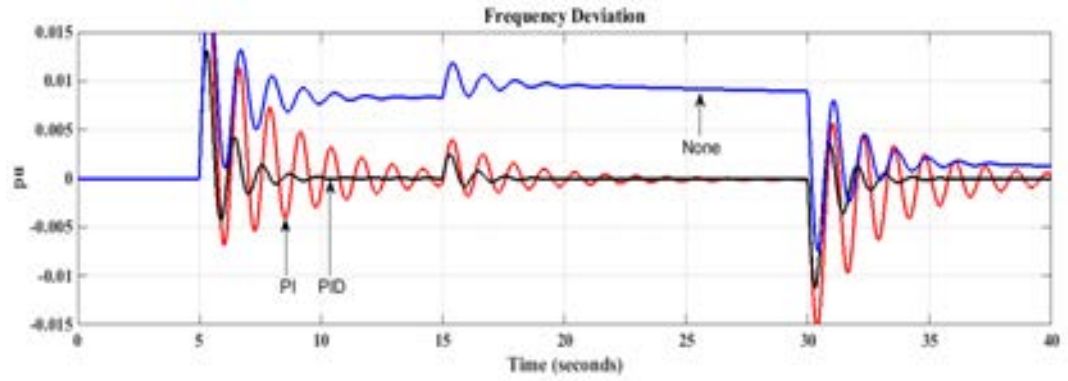

Figure 5. Frequency deviation during the whole simulation

5. CONCLUSION

This study was controlled by PI and PID controllers of single area power system with solar energy system integrated. This controller is adjusted by coefficients of Ziegler Nichols technique. These techniques were studied to determine the optimal coefficients. The load on the system because it occurs a decrease in frequency control is provided stay within certain limits. In addition, when there is a change on the climatic conditions, power system is achieved frequency regulation. The ZN-PID controller was performing better frequency balancing from the ZN-PI

controller. Solar energy systems using optimization techniques of a change of power value based on the short term and climate is to determine the PID coefficients are evaluated in the system can be further worked well. However, modern control techniques can be used together.

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ICOEST 1st INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND TECHNOLOGY
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FROM PAPER TO E-DOCUMENTS: A DREAM OF ECOLOGICAL BALANCE

Bahattin YALÇINKAYA [1]

Abstract

Extending information technologies pave the way for the paper-free office dream where printed materials exist. Until the middle of the 2000, contrary to popular belief, increase in the information technologies has not decreased the paper consumption in the business world and public sector and on the contrary it increased significantly. Thanks to the some legislative arrangements as of 2010, they help work more stable in e-state and e-document management for the countries. The restructuring of e-state concept in public services both decreases the bureaucratic procedures and clearly increase the service quality in the world. The most critical factor is that document production is started to decrease. We can give the social media and the use of web technologies by the press as another factor.

In this study, striking statistics will be revealed for the paper consumption in the world. Their damages to the environment will be analyzed. Furthermore, it will be discussed how to decrease the paper consumption through use of electronical environment and widespread internet technology. The objective of this study is to reveal the contribution of the states to the nature by facilitating the use of technology and importance of emphasizing the nature in their legislation concerning the information and document management.

Keywords: Paper Consumption, Paperless Office, Environmental Pollution

1. INTRODUCTION

Today, in the European Union as well as other regions in energy production and usage preference focuses on biofuels. The European Union ministry of environment have declared that they aim to reduce the gas causing climate change by up to %60-80 from 1990 until 2050. The emissions of paper industry have increased globally and steadily since the 1990s.[1] The increased consumption has been balanced with the emission obtained per ton. A plethora of research has been carried out on this subject and initial findings can be said to be as follows, reducing the paper consumption, change of carbon emission and increasing the energy efficiency paper at every stage of the life cycle.[2] The damage caused by paper production and consumption must not by any means. be underestimated.

Having such an impact on environment, with developing technology, paper production continued to increase until 2010. Despite the developing technology, paper consumption has not decreased. On the contrary, it increases, almost creating a paradox and the reason for that is none other than the thought of the increase number of copy machines also make it easier to copy materials.[3] Even though the term “paperless office” has been a discussing

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matter for a long time, a significant increase in the success rate has not been achieved. The term “paperless office” refers to removing or decreasing the number of papers in offices.[4]

The term “paperless office” was first introduced in a Business Week article published in 1975 for the purpose of defining the future office.[5] This idea was representing a dream with the idea that every document kept in paper form could be kept in electronic form. With the increasing number of personal computers, the idea of achieving this dream started to get stronger but this was a vision suggested without thinking the possibility that the number of documents could also increase.[34] Because the documents reflected their activity, in 2000s depending on the technology they began to face an increase on the number. Contrary to the popular belief that young people, in particular, use the screen to read something, the surprising fact that they actually print the documents lasted until 2010s.

2. THE ENVIRONMENTAL IMPACT OF PAPER

The environmental impact of paper is important both as industrial sense and personal and work level. With the use of technology, single use papers have become cheap commodities. This caused a increased paper consumption and became a growing like an avalanche contaminant for industrial society. Paper made from raw materials has been effective on industry and governments as a regulatory with the intention of spreading the idea of sustainable environment awareness. However, it is important for a habitable world to take certain measures that will reduce the paper consumption since recycling paper is not at a desired level. In paper production it is obvious that only in recent years a reduction can be seen. Insensible use of paper causes some environment problems.

Table 1. World Paper Production in Million Metric Ton from 1950-2010 [6]

Particulars	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**
Europe (East)	2,84	5,77	10,56	14,1	3,54	11,26	22,32
Europe (West)	10,35	20,06	34,82	45,39	62,33	88,81	87,14
USA	22,11	31,26	45,19	57,79	71,52	85,83	75,85
Canada	6,18	8,14	11,14	13,39	16,47	20,77	12,79
Japan	0,873	4,51	12,97	18,09	28,09	31,83	27,29
China	0,511	1,91	3,75	5,1	13,72	30,9	92,6
Others	0,876	3,28	11,26	18,26	43,14	54,58	75,92
World	**43,74**	**74,93**	**129,69**	**172,1**	**238,8**	**324**	**393,9**

2.1. Deforestation

Paper consumption around the world has caused %35 of trees to be destroyed for the production of paper. This rate has increased by %400 for the last 45 years.[7] Cutting trees is not important only for the reducing oxygen level, but it is also alarming for the ecological habitats of the tree structure. [8] The deforestation to obtain pulp is especially high in developing countries thank the others.[9] Deforestation for paper production refers to the destruction of %1,3 of all trees in the world.[10] This rate means that a horror movie is being filmed for the next generations. Deforestation may be the most important impact on environment of paper production. Each ton of paper consumption leads to destruction of 17 trees. These cut trees cover an area of 85 m2.[12] Considering the paper production in 2010, around 7 billion trees were cut for production. This number corresponds to approximately 40,000 km^2.

2.2. Environment and Air Pollution

It is a known fact that the toxic gas emitted by the paper producing factories is at too high a level. These gases are nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and, carbon dioxide (CO_2) which emit into the atmosphere during paper production. CO_2 is one of the most effective one on the climate change.[11]

The pollution caused by paper consumption can be explained partially with the benefits of recycling paper. The amount of CO_2 emitted during the production and the consumption of a ton paper is 36 tons.[12] Considering the paper production in 2010, every year around 15.000 million metric ton CO_2 is emitted into the atmosphere. However, considering the same statistics, 116 million metric ton toxic gas is emitted into the atmosphere every year.

Chlorinated organic substances, phenols, dioxins and furans released during paper production damage the environment. In recent years, even using eco friendly chemicals has proved not to be sufficient. Advanced delignification cooking, oxygen delignification, elemental chlorine replacing with chlorine dioxide and ozone, bleaching oxygen and peroxide should be applied in every factory. Also, regulations about pollution parameters and limits in pulp and paper industry should be updated.[18]

Chlorine, one of the used elemental in paper production contains significant amount of dioxin.[13] Dioxins are generally considered as environmental pollutants which also cause permanent damage to human health.[19]

In terms of environmental pollutant, for pulp production sulfur based components are used both during crafting process and sulphite process. Sulfur dioxide is a particular concerning material in terms of environment and it causes acidic rains. In 2006, Canadian paper industry alone emitted 60.000 tons of sulfur dioxide (SO_X) into the atmosphere.[13][20]

In terms of environmental pollutants, the other components emitted by factories are; hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and other volatile sulfur compounds. Again, during paper bleaching process some of the components spreading through water are; carbon monoxide, ammonia, nitrogen oxide, mercury, nitrates, methanol, benzene, volatile organic compounds, chloroform. In 80s, nongovernmental organization succeeded to affect the paper industry and governments concerning this issue with the increasing public awareness. [21] This pressure is mainly concentrated in the Scandinavian countries. As a result of this pressure, components used as elements, chlorine dioxides and organic components for paper bleaching have been accepted as international environmental pollutants with the Stockholm Convention.[22]

2.3. Water Pollution

Wood pulp found in the waste water of paper factories causes dissolved organic materials to mix into the nature in a solid form through waste water canal. Also, these waste waters contain alcohol, chelating agent and chlorine, inorganic materials such as transition metal components. These released wastes into the water systems cause the death of some ecologically important water organisms. Chlorine used for paper bleaching is also a substance which effects substantially the pollution of the water.[13] The pulp and paper industry is the third largest industrial buyer of elemental chlorine.[15]

In paper production as well as the pollution caused by factories, the consumption of papers during production also refers to a significant amount. For every ton of paper consumption 26.500 liters of water loss is experienced.[14] The amount of wasted water during the process of a tree growing and transforming that tree into paper reaches quite a significant number.

2.4.Waste

Waste is one of the biggest problem in the world. In USA alone % 40 of papers are wasted and every year almost 72 million metric ton paper is thrown.[16] Every US household throws out the equivalent of 4 trees in paper waste.[17]

Table 2. Paper consumption per capita/kg (Selected Countries) [6]

	Country	Per Capita Consumption (Kg./year/person)		Country	Per Capita Consumption (Kg./year/person)
1	**Germany**	242	**14**	**Saudi Arabia**	101
2	**U.S.**	229	**15**	**China**	75
3	**Japan**	219	**16**	**Turkey**	68
4	**Sweden**	215	**17**	**Mexico**	60
5	**South Korea**	184	**18**	**South Africa**	50
6	**Italy**	169	**19**	**Brazil**	49
7	**Australia**	156	**20**	**Russian Federation**	46
8	**Canada**	155	**21**	**Ukraine**	30
9	**UK**	147	**22**	**Indonesia**	29
10	**France**	142	**23**	**Bosnia & Herzegovina**	26
11	**Spain**	133	**24**	**Iran**	22
12	**Malaysia**	109	**25**	**India**	10
13	**Portugal**	105			

When analyzing table 2, it can be seen that in developed countries the use of paper is high per person. The amount of paper consumed is given as an annual kilogram basis. When this table is predicated on, world average of paper consumption per person is 110 kg. The main consumption areas of paper are, Corrugated/Packaging, Newsprint, Writing & printing and Other. In particular, Newsprint and Writing & Printing related consumption is rather high.

3. MITIGATION OF PAPER EFFECTS

3.1. Reducing Paper Consumption

Paper has become an indispensable material in life. The use of valuable papers can be listed as following; books used for information stocking, magazines, newspapers, notebooks, documents, files, paper used for personal use, paper use for communication, paper used for packaging, paper used for cleaning, construction and building industry.

Table 3 shows the annual paper consumption of countries. When compared with the population, while Republic of China ranks 16th in consumption, it is in first place in production. When these countries are taken into consideration, the amount of paper per country is 13,7 million tons. It is necessary for countries to reduce the consumption at least to half by raising awareness of their population.

Table 3. Paper consumption Selected Countries (MT - Million Metric Tones) [6]

Country		Net Consumption Million Tons	Country		Net Consumption Million Tons
1	**China**	105,456	**14**	**Spain**	6,200
2	**U.S.**	72,604	**15**	**Canada**	5,397
3	**Japan**	27,877	**16**	**Turkey**	5,023
4	**Germany**	20,038	**17**	**Australia**	3,596
5	**India**	12,123	**18**	**Malaysia**	3,178
6	**Italy**	10,265	**19**	**Saudi Arabia**	2,869
7	**Brazil**	9,734	**20**	**South Africa**	2,608
8	**UK**	9,268	**21**	**Sweden**	2,327
9	**France**	9,055	**22**	**Portugal**	1,792
10	**South Korea**	9,028	**23**	**Iran**	1,711
11	**Mexico**	7,225	**24**	**Ukraine**	1,375
12	**Indonesia**	7,064	**25**	**Bosnia & Herzegovina**	0,105
13	**Russian Federation**	6,643			

3.2. Paper Production Methods

Various methods have been tried for paper production throughout history. Especially the times od handmade paper, paper related world pollution was not a major player. However, with developing technology, paper production methods also changed. This change causes new technologies for paper production and also still causes pollution. Paper production uses mainly chemical pulping, mechanical pulping and deinking methods. Moreover, while using these methods, the amount of additives used is not so low to disregard. For manufacturers to take this matter in hand choosing more eco friendly additives, more respectful production techniques towards nature, and more technological investments in recycling paper will reduce the environmental factors.

Table 4. Important large-scale techniques for manufacturing chlorine dioxide [23][24]

Reducing Agent	**By-Products in the CIO2 Product**	**By-Products**	**Process Technologies**		**Potential Specific environmental concern**
			Vacuum	Atmospheric	
Methanol	Formic Acid	Sodium Sulphate (1)	SVP-LITE, SVP-SCW, R8, R10	(Solvay)	NA
Hydrogen Peroxide	(Oxygen)	Sodium Sulphate (1)	SVP-HP, SVP-Pure, R11	HP-A	NA
Sulphur	NA	Sodium	NA	Mathieson	Handling of

Dioxide		Sulphate (1)			SO2
Chloride Ions	Elemental Chlorine	(Sodium Sulphate(1)) Sodium Chloride	(SVP-Classic) (R3), R6, (R7), SVP-Total HCI, Lurgi, Chemetics	(Day-Kesting), (R2), (R3)	The CIO2 water becomes saturated with CI2

NB: Processes mentioned wihtin brackets are no longer relevant for new plants; some units are still in operation

NA=not available

(1) The genrated salt can be used as a make-up chemical in the recovery boiler or for pH adjustments

(2) Chlorine dioxide is not traded as such. Important trade does however exist for various large-scale processes.

* SVP-SCW, SVP-LITE, HP-A, SVP-HP, SVP-PURE, SVP-Classic and SVP Total HCI are trademarks of Akzo Nobel
*ERCO R3, R3H, R5, R6, R7, R8, R10, R11, R12 and R13 are trademarks of ERCO Worlwide
*Some other common names are Mathieson and Solvay porcesses

3.3. Paper Recycling

The basic raw materials of recyclable paper production can be analyzed in three categories which are mill broke, pre-consumer waste and post-consumer waste.[25] Mill broke process is to grind paper turning it into junk. Later, in the factories it is turned into pulp again. Pre-consumer waste refers to taking preventive measures related to consumer waste. Post consumer waste is the process of recycling printed material the consumer possesses such as old magazines, newspapers and so on. Papers suitable for recycling are called scrap paper.[25]

Today, more than %40 of pulp are obtained completely from trees. Every one of three cut trees is used for paper production and this means that %1,3 of trees in the world are cut for paper production.[8] Each ton of recycled newspaper equals to a ton of pulp and two tons of newspaper pulp.[8] To produce kraft paper, twice of the normal amount raw material is needed. In fact, the number of trees a ton of recycled paper saves depends on the size of the tree. However, the crucial question is how many times it can be recycled.[26] It is estimated that recycling paper saves 81.000 km forest areas and cover half of the paper need in the world.[27]

Table 5. Recovered Paper:Consumption/Usage Selected Countries (MT - Million Metric Tones) [6]

	Country	Recovered Paper:Consumption/Usage (MT)		Country	Recovered Paper:Consumption/Usage (MT)
1	**China**	48,840	**14**	**Canada**	2,705
2	**U.S.**	46,350	**15**	**India**	2,640
3	**Japan**	21,750	**16**	**Russian Federation**	2,100
4	**Germany**	15,293	**17**	**Turkey**	1,534
5	**South Korea**	8,827	**18**	**Sweden**	1,327
6	**UK**	8,154	**19**	**Malaysia**	1,200
7	**France**	5,259	**20**	**South Africa**	1,151
8	**Italy**	4,649	**21**	**Saudi Arabia**	1,000
9	**Spain**	4,552	**22**	**Portugal**	0,735
10	**Brazil**	4,363	**23**	**Ukraine**	0,339
11	**Indonesia**	3,934	**24**	**Iran**	0,080
12	**Australia**	3,179	**25**	**Bosnia & Herzegovina**	
13	**Mexico**	3,039			

The contribution of recycling paper on energy saving is also very important. There are two different claims on this issue. One of them is EIA's (The Energy Information Administration) claim saying it provides almost %40 of energy saving. The other one is that this rate is %65 claimed by BIR (Bureau of International Recycling).[28][29] It is claimed that recycling a ton of newspaper provides 4.000 Kwh (14GJ) energy.[30]

4.PAPERLESS SOCIETY AND INSTITUTION

The idea of creating a paperless society was a theory proposed in the beginning of 80s.[31] This became a reality when in 90s computer technologies started to be developed making possible for society to follow the communication in the electronic media rather than the printed media. In a paperless society, relations between citizens and government was going to on electronic media so that bureaucratic processes was going to be reduced

and a serious paper saving around the world was going to be maintained. Society would be able follow the press and reading a book, magazine and so on would be possible through electronic media.

This idea started to host the arguments that might become reality since the beginning of 2000s. The rapid spread of computer technologies helped paperless society strategy to be accepted by society with various developments such as social media and e-government investments. Although these technological developments have increased paper production until 2010, since 2010 it tends to move towards reduction. However, it seems hard to expect a paperless society anytime soon. Because business world was keeping %95 of their information created in 1995 in paper form.[32] This rate, although it has been 20 years since then, remained at %75. Today, still 3.5 trillion printout papers are obtained. Until 2018, it is estimated that this rate will increase by %1.7. In the business world, %80 of works and processes are still done paper based.[33]

Table 6. Various Type Paper Production in 2010 (MT - Million Metric Tones) [6]

Paper & Board Category	**Production Million Tons (MT)**	**%**
Newsprint	33.0	8.4
Other Writing & Printing Papers	110.0	27.9
Packaging Paper & Paperboard	204.0	51.8
Hygiene & Sanitary Paper	29.0	7.4
Others Papers & Paperboards	18.0	4.6
Total	394.0	100

Table 6 shows the basic types of paper production. %36,3 of papers are produces as Newsprint, Writing & Printing Papers. This equals to 1/3 of whole paper production. In other words, with the goal of creating a paperless society, it is possible to reduce the paper production by 1/3 rate. Particularly transferring the papers used in press and business world will reduce this rate and the goal of creating a paperless society will be reached.

4.1. Reduction of paper use and what to do for transition towards a paperless office

Every organization must act to support paperless office activities. The importance of paperless office is obvious in terms of environmental protection. Nevertheless, paperless institutionalization is not only a term in terms of being eco friendly, but it is also a term appropriate for the current age that helps corporations, organizations, even governments create their vision of more efficient service, commercial activities, democratic and transparent management approach. From the perspective of the basic functions of the business world and the government, to prevent paper consumption, the existence of some preventive measures can be mentioned that should be done to reduce consumption. These are;

- Putting some reminders near duplicating machines that reminds the employees the environmental damage of printing.
- Keeping the duplicating machines under control and putting a paper use limit for employees to reduce the paper consumption.
- Sharing monthly paper consumption with the employees to attract attention and controlling copy machines to reduce the printing amount.
- Encouraging employees to reduce their paper consumption by sharing that paperless office is all about using technology.
- Contributing to following newspaper news by using technology and social media, especially developing a habit of reading e-books in schools.

In addition to preventing waste of paper, we can list the elements that need attention as the following;.

- Giving importance to spreading online systems, use of e-mail, use of database and electronic files (Records) management or building an electronic document (Documents) system,
- Persuading all employees to achieve the goal of creating a paperless office,
- Strengthening the corporate IT and establishing a backup mechanism for electronically generated documents and files,
- Creating a more reliable mechanism than the paper form about information and document protection and making investments taking into account the growth of business in the future;
- Making individuals who can manage the process of transition to a paperless office become a part of this system,

- Helping systems such as document management systems, electronic fax, scanner, data backup systems, security system, file converting techniques and process management system to integrate into a paperless office ,
- Proceeding the goal of creating a paperless office with small and secure steps.[35]

4.2. Processes of Paperless office

There are two methods of transforming a company into paperless office. The first is by automating the processes that generally use paper as an essential tool. Technologies that exist in facilitating that process are:

- Enterprise Data Automation Software. Software used to integrate forms and data with systems that processes them.
- Form Technology. Software used to design various types of forms. Using forms is no longer necessary if people performing business transactions have personal computers with form technology in it.
- Databases. Device to replace the function of a filing cabinet. Data is made into digital form and then stored in a database with sufficient security technology in it.
- Digital Signature. Software allows evidence of signature in digital form. Papers are generally used as business evidences. This is required in business transactions to generate legal binding between two or more parties.
- Workflow Platforms. Process flow of an office. Paper documents are generally used totransfer a data to other departments so that it can continue doing what is needed next. This flow of work can now be documented and transferred in digital form, using the workflow platforms.

The second method of pursuing the paperless office is data storage transformation. In a general office, the data is conventionally stored and protected in a filing cabinet or in warehouses. This generally ends up creating piles of useless scrap paper rather than useful files. Using the “Paperless Office” technology, all this data can be transformed to a digital form very easily. Some of the tools available to support this process are scanners, book copiers, photo scanners, microfiche scanners, negative scanners, fax to PDF converter, and document management systems. [36]

4.3. Benefits of Paperless Office

Although removing papers out of sight seems only an approach towards being eco friendly, it has more effects on corporate and organizations. Cost and efficiency can be as important as the environmental approach. The most important issue of transitioning from paper form to electronic form would be the advantages on institutionalization. Advantages of paperless office are;

Organizing document and files becomes extremely ergonomic for corporations. Paperless office contributes to institutionalization by providing a more secure storage. It gives the ability to process more effectively than the works and processes done in paper form. All transactions made in paper form can be carried out through the use of electronic signatures in electronic form. Having a document management done in electronic form helps corporations to be transparent and accountable.

Paperless office is the main factors that speed up the document management and communication in electronic form. It provides a rapid internal and external communication between institutions. Particularly, it helps government institutions to stay away from bureaucratic tendencies and makes them more citizen-oriented state institutions. It contributes positively to forming an e-government term in an appropriate manner.

Documents are easier to access in electronic form. Moreover, it is obviously a more secure environment in terms of backup and data loss. Providing a registration on financial, administrative and legal rights of the institutions means to be able to overcome the various problems they might encounter in their future.

Paperless office is the key to create a better world to live in. It will contribute in short and medium terms to create an environmental awareness and to make people adopt a more eco friendly approach. Paperless offices will reduce the environmental damage so that the world that has been entrusted in the hands of humans will be handed to next generations.

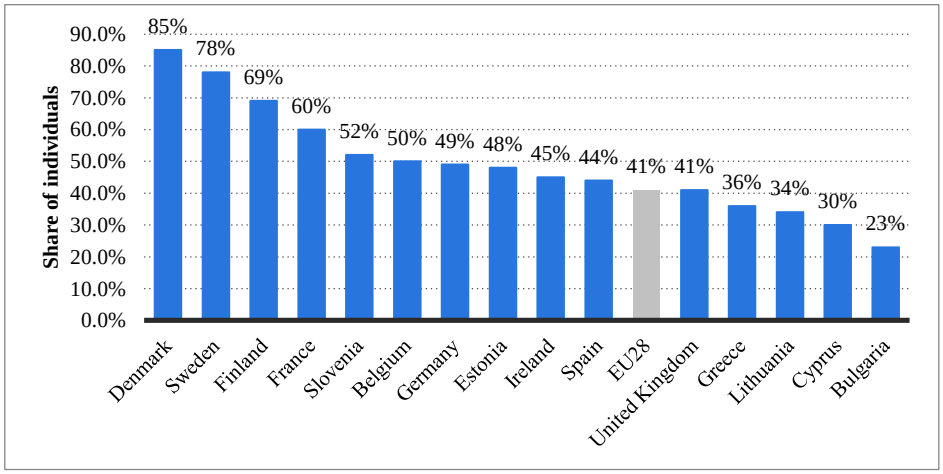

Figure 1. Individual usage of e-government services in selected European countries in 2013 *[37]*

5.CONCLUSIONS

In this research paper in which the effects of paper on the environment were studied, the environmental damage of paper is evaluated over the paper production numbers in the world. The damage caused to the environment by paper was examined under the titles of; deforestation, air and environment pollution, water pollution and waste. The reduction of the environmental damage of paper, reduction of paper consumption, various changes which can be done on production techniques and the contribution of paper recycling were listed.

Having such an importance, the situation of paper production has been analyzed in the world of press and office. The results show that 1/3 of paper production is used in press and office fields. In order to reduce this rate, paperless society and paperless institutionalization is discussed. The advantages of document management in electronic form for from small companies to countries all over the world are highlighted. What must be done for reducing paper consumption and for paperless offices are listed. The process of paperless office is analyzed. The terms paperless society, paperless office and paperless government are evaluated through various scientific numbers which lays the groundwork of the necessity of these terms.

In conclusion, the possibility of reducing the use of paper was discussed, critical questions about spreading the use of systems such as e-institution, e-document management and e-government were tried to be clarified. The main purpose of this research intended to put conscious management in the forefront is to help spread the technological based solutions while considering the environmental damage caused by paper. This purpose is also about the imagination of a world where the paper consumption is reduced and the world becomes a better place to live in.

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